Action Line 4 “Test-beds design and implementations”
AC4.1/2 “In/formal Learning TBs design and implementations”
WP4 “SEES analysis and requirements specifications”

D8 – SEES Specifications and Feasibility Analysis

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Part I: Introduction

1 About this Document

This document includes the outcomes of the SEESs analysis and requirements specifications and results from the organisational, pedagogical and technological feasibility analysis of the SEESs. The document is organized as follows:

Part I (current part) describes the purpose of the document, includes some general considerations that have to be taken into account when a new technology is intended to be used for learning and draws some conclusions from that for the SEES specification and feasibility analysis. It furthermore describes the methodologies and approaches applied for the requirements specification and for the feasibility analysis.

Parts II to VII are dedicated to the SEESs specifications (Subpart A) and feasibility analysis (Subpart B). The organisational and pedagogical analyses were provided by FIM (FAU), with peer comments from CEMSAC. The technological feasibility analyses were provided by CSSI with peer comments from KTU and FIM (FAU).

Part II is dedicated to SEES #1 "Virtual Institute for Alphabetisation for Development". The final version of the analysis and requirements specifications for SEES #1 was produced by UM2 and CNRS, the two organisations in charge of SEES #1.

Part III is dedicated to SEES #2 "ENCORE". The final version of the analysis and requirements specifications for SEES #2 was produced by CNRS and FUNDP, the organisations in charge of SEES #2.

Parts IV and V are dedicated to SEES #3. Due to the high complexity of SEES #3, SEES #3 has been separated in two parts. SEES #3a "e-Qualification" is specified by UPPA and SEES #3b "e-Assessment" is specified by the OU.

Part VI is dedicated to SEES #4 "Master on ICT at a distance". The final version of the analysis and requirements specifications for SEES #4 was produced by AIT, the organisation in charge of SEES #4.

Part VII is dedicated to SEES #5 "Physics Course". The final version of the analysis and requirements specifications for SEES #5 was produced by the HOU, the organisation in charge of SEES #5

Part VIII includes an overview of the results and conclusions takes from the SEES Analysis and requirements specifications as well as from the organisational, pedagogical and technological feasibility analysis. A special focus is put on the complementary aspects of the SEES and the requirements for further proceedings in the ELeGI work.

Part IX (Appendix) includes the guidelines for the SEES analysis, based on the *volere Requirements Specification Template* (The Atlantic Systems Guild). Most of the specifications applied this template and their numbering corresponds to the numbering of the guidelines, which allows a lookup of further explanations for each section. The Appendix includes also topics and questions for the organisational and pedagogical feasibility analysis and finally a snapshot of the Wiki based WP4 glossary maintained by KTU.

2 Purpose and Scope

The deliverable D8 – SEES specifications and feasibility analysis – is a central document for the further deployment of the ELeGI project. It is related to the following objectives which are binding for the activities in WP 4: SEES Analysis and Requirements Specifications:

- To instigate a cross-project understanding of requirements engineering
- To identify and agree on common representations and modelling techniques for requirements engineering in the ELeGI SEES context
- To provide a detailed requirements analysis for each SEES using common formats, modelling techniques and presentation formats
- To carry out a thorough feasibility study of each of the five proposed SEESs

This document will present the results of an in depth, individualised requirement analysis process which was carried out with each of the SEESs in order to approach issues such as available infrastructures, pedagogical goals, technological options, deployment costs, institutional and administrative clearances and many more, which are relevant for a coherent and realistic vision of the final goals of the SEESs and the most appropriate ways to reach them.

When a new technology like Grid comes up, the very potentials for learning cannot all be imagined at a first glance. A natural gap exists in this technological innovation phase between the practitioners in the learning field which cannot imagine yet the full scope of emerging new options and the technicians which have to translate the principal mechanisms for different fields of applications. An intense discussion process is needed to clarify, on the one hand, for the user groups the specific options in a given learning setting, on the other hand, the technologists have to communicate their view about emerging features and services useful for learning. This two-sided shaping process is materialized in this document and its results are essential for the further technical development in order to enable the technology providers to envisage the right Grid services and interfaces tailored to the specific requirements of each SEES.

This analysis process is demanding and time consuming in ELeGI, since the selected testbeds have a broad spectrum of ambitions and contexts. It ranges from a 'classical' formal eLearning setting to a very experimental, open, informal, conversational approach in a rural area. In addition, activities collateral to learning like distributed creation of learning content and computer assisted assessment are part of the experimentation.

In this document, we first take a look on current discussion about the relationship between technology/media and learning, a topic which is crucial for the success of ELeGI. Than we explain the chosen methodology and give references of the interactive specification process before presenting, SEES by SEES, the requirement specification and the feasibility results. The summarised conclusions and recommendations in terms of organisation, pedagogy and technology are given subsequently. In the annexes one can find the relevant guidelines and the current status of the harmonised language in a Wiki-based glossary.

3 Technology and learning

An crucial question for the successful deployment of the SEESs in the framework of ELeGI is the following: What can the SEESs expect from a new technology like Grid for their ambitions towards new ways of learning in informal and formal learning contexts. It is more economic to work towards realistic goals from the beginning than to loose time in struggling with expectations which may be too difficult to reach.

The following considerations highlight briefly the ongoing technology & learning debate and, at the same time, the spirit, in which the requirement and feasibility analyses for this deliverable has been conducted. So, before taking a look into the specific conditions and reflections of the different SEESs with regard to the use of Grid technology for learning in the following chapters, we would like to summarise the ongoing world wide discussion on potential impacts of media and technology on learning.

Looking back

Each human sense, especially visual, oral and tactile, and their combination, has been exploited since ever for teaching and learning, in a variety of didactics driven activities like writing, drawing, watching, role playing, manipulating, telling, and every emerging technology has given specific support to these senses and activities.

Since the invention of mass book printing by Gutenberg in the 15th century, media have been playing a continuous role in all forms of learning, also in distant teaching (which began around 1840, and where printed text was **the** medium). When we ask about the impact of every new technology since, we can state that the effects were rather on mass distribution of learning than on reinventing the learning. With the still picture photography and moving picture cinematography, with radio and TV broadcast visual and oral learning content was accessible for everyone everywhere.

Progress for the learning itself came with the development of instructional theories and methods in the 19th and 20th century and with the research on human information processing, memory and motivation. The instructional 'toolkit' for the learning designers became more and more rich and flexible.

Looking backwards we see the phenomenon that, with every new emerging technology, a learning revolution was expected and learning was rethought in technology dimensions until, after some often costly and disillusioning experiences, the human factor was reconsidered. As Rick Shearer (2004) states, '*the possibilities ... are not constrained by technologies or distance, but from tunnel vision when new technologies are introduced. All too often we abandon proven technologies in response to the latest technology that is held as the holy grail for education'.*

Richard E. Clark (1983) carried out a meta-analysis of 80 years research on effects of technology on learning and he reports, that there is no empirical evidence on learning benefits from media (the 'no significant difference' statement) which led him to the conviction, that *'media will never influence learning'*, only, in the best case, the cost-effectiveness of learning will be improved. His analogy is the 'delivery truck' where, even replaced by a vessel, the content remains unchanged.

One of his strongest arguments is the 'replaceability' test which shall prove, that ever medium can be replaced by another one with the same learning results.

Since these, at the first glance, deceiving results and Clarks' provocative statements, a spirited, vivid debate arose about the real value of media and technology for learning. R. B. Kosma (1991 and following) is one of Clarks' most prominent counterparts. He is convinced that it is rather a question of research design to unscramble the interaction between medium and method and to isolate – statistically spoken - the specific contribution of media for learning with regard to different target groups and contexts.

We cannot present the entire discussion in this context, but we would still like to emphasize some problems and some results which seem relevant to us for our work in ELeGI and for the ongoing work of the consortium.

Research Design

It has been proven to be very difficult to develop an experimental design and setting which can meaningfully show causal effects of technology on learning and which guarantees that just the technology makes the learning difference whereas all other variables are controlled. The attempt to search for causality leads very often to marginal experimentation on basic issues without practical relevance. This is still specifically true in the rapidly changing field of learning technology, where the results are often outdated in the moment of their publication. The very complexity of learning settings is difficult to mirror in a classical experimental design with quantitative statistical analysis. There are many arguments in favor of system oriented action research with emphasis on qualitative evaluation in combination with some quantitative indicators collection.

This issue is very crucial for the ELeGI case where we find, especially in the informal settings, very complex arrangements which demand a carefully elaborated evaluation strategy. Some crucial methodological questions are: when should be measured, which are appropriate indicators, should the focus be on quantitative or qualitative aspects of learning, which actors can judge about success or failure of interventions, is there a basis for comparison (before/after; with similar settings)...

Method and medium

Another discussion point is if, following Marshall McLuhan, the medium is the message, means that media and method are identical and inseparable, or if, as Clark argues, medium and instructional method are distinct entities which can be varied independently from each other. This would mean that each didactical approach can be supported by any medium or technology. A realistic view seems to an interactive one: Some technologies contribute more to specific methods than others. Conversational learning approaches at a distance, e.g., could be imagined by phone and fax, but internet services and exchange technologies seem to be more pertinent. To this problem, ELeGI is not supposed to provide experimental evidence, since the technology decision is taken in favor of Grid and the didactical options are chosen as well. It can be shown in this project, if and how the chosen technology and related services are able to support the instructional philosophy of ELeGI in the SEESs' contexts, bearing in mind the above described methodological problems.

Being proactive

To achieve successful work in the ELeGI testbeds we cannot content ourselves with discussions and descriptions of problems. The above quoted very interesting background discussion about the contribution of technology to learning gives some useful inspiration to a more comprehensive view of the overall complex. On the other hand, some of these questions may to some extend even hinder significant progress in the research on technology use in learning.

It seems to be necessary to rephrase the argumentation and not to ask about the contribution of technology to learning in general, since it is evident that a new technology per se has no impact at all on learning, as long as it is not embedded in a specific context of use. Instead, we should analyse carefully every new technology for its contribution to learning for specific methods, learners, contexts, contents.

What is the very **potential** of a new technology/medium. The potential of every medium is specific and normally different from previous media. Normally, a new medium does not include all features and functions of previous media. A new medium should be used where it adds value to the existing, the notion of replacement is not appropriate. If we examine the added value of the Internet, an undoubtful advantage for learning is the facilitation of point to point and multipoint synchronous and, still more important, asynchronous communication. It allows for the emergence of virtual communities and this communication aspect seems to us the most powerful contribution to learning since the invention of the paper. But still, if we look at old technology, the majority of people would prefer to read a long text on paper. Rather than looking for replacement, we should argue in terms of synergy with the existing. Grid, e.g., can facilitate the access to existing resources.

Another question when speaking about the contribution of technology is about **economy**. Can technology, with the same costs, improve the learning results or can the same result be achieved with lower costs? Cost – effectiveness of learning and teaching is a mayor issue: Learning settings will survive which achieve with the lowest resources the best learning results (however they are measured). We have to investigate how technology can contribute to better, faster learning for more people. Here we see a potential of Grid in the sharing of remote resources.

Another question is about **learners**. There are many advantages of new, networked technologies for the learners. The most obvious concern the dimensions of time and space. New groups of learners can be reached which have been excluded due to distance or incompatible agendas. Other advantages are potentially in individualisation, in better support, in more autonomy, in better communication and community building, in the chance for immediate role change for every learner (from learner, to teacher, moderator, animator..) in his virtual learning community, in better feedback... It remains the task to shape the (Grid-) technology (and the whole learning settings) to fulfill these benefits.

Another question is about **boundaries** of technology. The use of technology for learning is always embedded in a larger context where human actors have specific roles and other systems are related. For every service we intend to provide for the learner, we have to decide, which part of the service is delivered from human actors and which part from technical systems. This is at a first glance a decision concerning economy and efficiency, but social compatibility and learners' expectations are of equal importance. These boundaries are supposed to vary depending on the learning context and the target group.

Conclusions

We can expect significant impact from technology for learning if we do a careful analysis of its potential, but we have to face the fact that subsequent actions fail, if initial concepts are wrong. If, e.g., we do not take into account the learners' metacognitions about learning, their believes on their individual 'costs' and gains associated with different learning options, we will not attract them even with the most sophisticated technology.

If we achieved, through this interactive process of requirement analysis, SEESs specification and feasibility analysis, to reconcile the real learning needs of our clients in the testbeds with the powerful offers of the Grid technology, we have reached our aim.

4 Methodology and Approach

4.1 Requirements analysis and specification

The basic idea for the requirement analysis was to provide the SEES with a well experienced tool and with a coaching context which allowed them to progress to a consolidated, well reflected elaboration of their scenario which, on one side, should form a sound and meaningful learning environment and, on the other side, should demand for sophisticated, powerful, Grid based technology.

As general framework and starting point for the requirements specification, the '*volere*'-tool (The Atlantic Systems Guild) was chosen, proposed by the OU. Originally developed to formalise product development, it was carefully customised for the needs of ELeGI. Since the SEESs do not have to come up with industrial products, but with very specific services for self-controlled learning, some substantial changes had to be introduced into the original guidelines/template.

The very 'spirit' of ELeGI has been transferred to the *volere* guidelines (see Appendix A), condensed in concise, well explained tables backed up with definitions, comments and references. An orientation was given about the choice of Grid enabled tools to use, about relevant pedagogical/didactical approaches, about pedagogic demands and requirements on the Grid technology and about main applications of the Grid technology. These resources provided an inspiring framework for the SEESs in order to position their specific experimentation in relation to ELeGI framework. The different sections of the guidelines have been enriched with learning related examples facilitating the transfer of the guidelines' topics to the individual SEES' context.

The methodological approach was presented and discussed in several meetings with the SEESs, shaped with the adoption of their feedback and finally approved.

In order to facilitate the specification work for the SEESs and to allow for individualised support, the specification process was cut into three steps, each to be elaborated in a two weeks period, focussing on selected parts of the adapted Volere template with its 27 sections and around 80 items, leading to an increased level of detail:

- Step 1 to shape the initial SEES idea, clearly defined enough to be proofed for general technological and pedagogical feasibility at a very high level.
- Step 2 to complete the organisational SEES definition with all relevant conditions that are needed to carry out the scenarios' planning properly and as preparation for the formulation of the software requirements
- Step 3 for the transition of the project constraints to the software requirements. It identifies the actors, business events and interactions within the service.

After each step, an individual feedback was given to each of the SEESs (documented on the non-public part of the project collaboration space).

The combination of a comprehensive requirements guideline/template and a step-wise specification process with feedback cycles allowed the SEES partners to produce continuously growing and refining analyses, addressing upcoming questions, doubts, considerations, and suggestions as early as possible. This complex and non-trivial process had to be carried out in a very limited time frame, it could be finished in time.

The requirements specification template is meant to be an open document allowing continuous update of the planning process until the technical and organisational deployment process will start.

4.2 Feasibility Analysis

The feasibility analysis was carried out by partners independent from those producing the SEES specifications, which ensured a critical and neutral review. It was not performed as a single blocked activity after the final SEES specification but in an iterative question and answer process that accompanied the step-wise specification.

The specifications were reviewed according to common criteria and key questions (see below). Questions resulting from this review were sent to the SEESs' responsibles, who answered directly and included the required clarification in the next version of their specifications.

For the organisational and pedagogical feasibility this process started with the first specification step. For the technical feasibility it started with the second step, when the primary goals and drivers were clear and the constraints and non-functional requirements had to be defined. After finishing of the third specification step, the results from the iterative Q&A process were collected and the feasibility analysis produced.

4.2.1 Organisational and pedagogical feasibility

The organisational and pedagogical feasibility analysis was carried out by FIM (FAU) with peer comments provided by CEMSAC. For this purpose a list of topics and questions was developed (see Appendix B). The produced list of topics and questions aimed the evaluation of all organizational and pedagogical issues according to the SEES descriptions in the "Analysis and requirements specification" documents provided by the SEES responsible. According to the results of the organisational and pedagogical analysis an overall summary was written resuming the strengths and weaknesses of the related SEES. The summary provides a first organisational and pedagogical feasibility statement.

The *Organisational and pedagogical feasibility* analysis will stay an open process allowing continuous update according to the continuous specification process until the technical and organisational deployment process will start.

The specification and definition process of the SEES will continue. A viable solution will be sought for the detected weaknesses that may have impact on the SEES' feasibility.

4.2.2 Technical feasibility

The technical feasibility analysis was carried out by CSSI, with peer comments provided by KTU and FIM (FAU). The analysis in this document is a collected view of their contributions. The leading questions to be considered for the technical feasibility are related to Grid technology in general and to the embedding in the development process of ELeGI:

Grid technology

- Which *Grid functionalities* are needed for the SEES? What are the *priorities*?
- Which of the *Grid benefits* are stressed by the SEES? What is the *focus*?
- Can the envisaged services be implemented with Grid technology?
- Why can't the services be implemented by another technology?

ELeGI embedding

- Which *ELeGI related software* is appropriate for the specific SEES?
- Which of the Grid services and applications can be taken from a general ELeGI solution, which have to be *implemented individually* for the SEES?
- What are the *special requirements* for the technical development? How will they fit into a general Learning Grid architecture?

- What are the *interdependencies* between the different components, and what are the *implications* for the software development?
- What are the concepts and problems (pedagogical, technological) that need a *further research?* What research issues of other ELeGI action lines are addressed? How can practical solutions for these issues be developed within ELeGI?

The approach was to start in an unformalised, iterative and conversational way, go through a transformation effort, leading to requirements specifications which allows efficient software development. This process hat not come to an end - it will go on in the next months for the detailed functional requirements and the updated version of this document.

Due to the complexity of the SEESs and to the fact that the basic technical concepts are developed in parallel, it was decided to keep the SEESs specifications in this document on a level above the fine grained functional and data requirements. Therefore the technical feasibility can at the moment only be analysed in a very general way.

4.3 Harmonisation of terminology

In parallel to the requirement and feasibility process, a harmonisation attempt towards a common, consolidated terminology was started in order to reduce misunderstanding and to make collaboration more effective.

To this purpose, a Wiki-environment (PmWiki, http://pilis.if.ktu.lt/tt/wiki/) was provided to the consortium where all new emerging terms can be filled in by every project partner. One partner (KTU) carries out the quality control, a second partner (OU) provides native language support.

This terminology environment remains also an open space, new terms can be put in and validated at every time. A snapshot of the glossary is found in Appendix B.

Part II: SEES #1 (VIAD)

A) SEES #1
Analysis and Requirements Specification

Author(s)/Responsible:	Arnaud Martin (CEFE, CNRS) Serge-André Mahé (Université de Montpellier II)	University of Montpellier II are and CNRS are the partners 4 and 20.

Version History

Version	Comments, Changes, Status	People
1	First proposal	Arnaud Martin & Serge André Mahé
2	General description of the SEES – step 1	Arnaud Martin & Serge André Mahé
3	Step 1 and beginning of step 2	Arnaud Martin & Serge André Mahé
4	Step 3	Arnaud Martin & Serge André Mahé
5	Final version	Arnaud Martin & Serge André Mahé, with adds and comments from Philippe Lemoisson

1 SEES Glossary

TERM	DEFINITION
ANPE	***Agence Nationale pour l'Emploi*** (employment office*)*
CAPEB	***Confédération de l'Artisanat et des Petites Entreprises du Bâtiment :*** *Professional union of artisans and small enterprises in building area.*
CC	***Communauté de Communes***[1] is a grouping together of communes lead by councils (all the mayors and a part of each commune councils)
CEFE	***Centre d'Ecologie Fonctionnelle et Evolutive.*** An associated research centre (University of Montpellier II (partner 4) and the CNRS (partner 20) are involved together in this centre). Arnaud Martin and Francisco Di Castri works in this lab.
CG	**Conseil Général : *département*'s council (here : *le département de l'Hérault*)**
CNRS	***Centre National de la Recherche Scientifique*** Partner 20 of the consortium.
Commune	Smallest administrative subdivision in France. Each *commune* has a town council and a mayor.
CPIE	***Centre Permanent d'Initiation à l'Environnement***
CRN	**Centres of resources' Network:** the project of Pays Larzac – Coeur d'Hérault in partnership with ELeGI.
Département	Administrative subdivision in France intermediate in size between communes and ***regions***.
End-user	An individual who has a project or is active in a project in *pays Larzac-Coeur d'Hérault*. This person needs services to help him succeeding.
GQM	Goal Questions Metrics
ICT	**Information and Communication Technology.**
Languedoc-Roussillon	The name of the *région* which include the *Pays larzac- Coeur d'Hérault.*
Larzac-Coeur d'Hérault	Area in south of France near Montpellier (77 communes, 60 000 inhabitants) which is administratively a ***pays.***
LIRMM	***Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier.*** An associated research centre (University of Montpellier II (partner 4) and the CNRS (partner 20) are involved together in this centre). Nailah Abdullah, Maria Nunes, Stefano Cerri, Philippe Lemoisson, Clement Jonquet and Pascal

[1] In France, there are 38,000 *communes* in all. 90% of them have less than 2,000 inhabitants but several small villages may make up a single *commune* and they can make up together communities of *communes*. A *commune* is a subdivision of a *département* itself a subdivision of a *région.* Finally, in France you could find *5* levels (subdivisions): *communes, communauté de communes, pays, département, région*

	Dugeny work in this lab.
Network learning agent	ELeGI learning prototype or a physical tutor in the subsequent collective learning system able to help end user's research and able to learn what end user needs.
Pays	Gathering of several communities of ***communes.***
Région	Largest administrative subdivision in France. Each *région* has a council le *conseil régional*.
Super-User	An individual with internet skills able to learn on the web and able to be a tutor to help someone's learning.
Université de Montpellier II	Partner 4 of the consortium. Serge-André Mahé works in this university
User	A client, in fact a civil person (administrative subdivision, centre of resources…) locally involved in the SEES and who has also specific projects. UE, *Région*, CG34, CCLL, Pays who paid the survey (7000 €) are the actual clients.
VIAD	**Virtual Institute for Alphabetisation for Development**, this was the original name of SEES #1. We should better say now: virtual institute for sustainable development (with alphabetisation as a way to improve it).
VLO	**Virtual Learning Organization**

2 Introduction

SEES n°1 was born at the crossing of two projects:

- a local development project in *Larzac – Coeur d'Hérault*[2] ;
- the European project ELeGI.

The local project in *Larzac – Coeur d'Hérault* has the following objectives:

- Creation of a ***CRN***: Centre of Resources' Network (with many topics: development and subsequently environment, urbanism and heritage);
- Empowerment through better communication and information sharing between local actors.

This local project has started a few years ago, with actions taken by local government officers in order to enhance information and experience sharing with the help of new tools on Internet.

These new tools are mainly dynamic web sites to emphasize actor's empowerment. A significant one is **www.resoform.org** web site. It contains information about events and actors. Each actor or individual can contribute to give information via this website.

resoform.org set up a computer assisted human network with thematic pages distributed within a virtual territory centred upon the *Larzac – Coeur d'Hérault* population. This site links all the actors involved and motivated by The *Pays* development and mutual collaboration.

When they asked Montpellier II University to help them for collaborative aspects in 2003, it appeared that the SEES approach with collaborative knowledge construction fitted with this need.

For instance, resoform.org web site does not use collaborative knowledge construction but it shows the need of such a technology. It's necessary to make the site completely usable.

In regard to the European project ELeGI, *Larzac – Coeur d'Herault* is a good opportunity to experiment with an already existing community, where many actors are already involved.

In fact *ubiquitous and collaborative learning* is already effective in *Larzac – Coeur d'Heraul* : the corresponding scenarios already exists in actual context. We can find them as human driven scenarios in stakeholders' activity using databases and web technology. To manage ELeGI goals and CRN *Larzac – Coeur d'Hérault*'s project we have to fit these scenarios to Grid technology. Hence, experimentation with ELeGI prototypes and their evaluation will be done. ELeGI prototypes will be used to create the CRN and to enhance collaboration and information sharing between local actors.

The following generic protocol will give us guidelines for the beginning of the SEES #1 process:

- In actual task (i.e; 4.1)
    - Identification and description of the community which will be considered as a VLO
    - Survey of the existent services and technologies and communication infrastructure;
    - Carry out a software requirements analysis with collaborative learning.
- In further tasks: conception / specification / implementation / customisation of a bunch

[2] More information are available on a power point presentation : see folder "SEES #1" on Portal project

of services based on the E-LeGI Software Architecture;

- Evaluation from pedagogical and technological point of view;
- Evaluation of exploitation phase based on the qualitative analysis of the sessions and statistics record of the sessions (statistics and qualitative analysis).

For task 4.1, which requires sociologic skills and approach, an UNESCO student's team[3] is supporting us to realize different surveys in the *Larzac – Coeur d'Hérault.*

The purpose of this SEES is to enhance collaboration and to give a significant contribution to empowerment for *Larzac – Coeur d'Hérault*. During the whole process, we shall lead the experiment driven by the following objectives:

1. to define models for ubiquitous and collaborative learning
   - Formalisation of methodologies for evaluating the effectiveness of these new learning approaches from the pedagogical and usability points of view
   - Formalisation of protocols and conversational processes for learning organisations and actors in the learning process
   - Integration of Enhanced Presence tools in the learning protocols and conversational processes

2. to enable ubiquitous and collaborative learning through the Grid based software architecture
   - Scenarios for ubiquitous and collaborative learning, allowing the validation and evaluation of the software architecture and the didactical approaches
   - Feedback of these new learning approaches and update of the scenarios

3. to disseminate our results
   - The strong connection with the team driven by F. Di Castri will be a great help for this dissemination
   - The Chair UNITWIN UNESCO will provide an international network of people involved in sustainable development.
   - Scientific papers and workshops in different congresses.
   - Dissemination in *Larzac-Coeur d'Hérault* to help SEES.

[3] Master Degree, UNESCO CHAIR UNITWIN (Development and Integrated Land planning)

3 General context

3.1 Empowerment, web, and e-learning

As it has already been mentioned in the Technical Annex of ELeGI project, conditions of sustainability can be found when the following three conditions are met, at least to a reasonable extent.

1. Empowerment of the local people and the emergence of their entrepreneurial capacity. They are the only actors capable of meeting their aspirations for development with their concern for conservation of their culture, their environment and their biodiversity. Conservation of cultural and natural heritage should be considered as a dynamic and continuously adaptive and evolving process, and not a simple preservation of the status quo, or of a hypothetical status quo ante.

2. Connectivity among all stakeholders concerned, from local populations to potential service users and providers. Aspects of in situ social cohesion and connection, as well those of international marketing and benchmarking are equally important, going from the local to the global scale. This implies a network based, decentralized approach, which is largely facilitated by new tools of the information technology.

3. Diversification of activities. A service “monoculture” would be too risky in the current unpredictable society, and would not ensure per se conditions of sustainability. All aspects of cultural diversity (both the tangible and the intangible facets, language, traditions, system values) and of biological diversity (from genes to species, to ecosystems and landscapes) should be considered under this item

Today, most people live in big cities. People living in rural and isolated areas are facing different and even more acute problems of development. EU gives some structural funds to help them, but building development projects remains difficult because the stakeholders are few and scattered: they can’t meet easily, they are socially distant.

In *Larzac-Coeur d’Hérault*, the need of sustainable development is obvious. It is a politic attitude to develop the economy to fight unemployment and to preserve the quality of life important either for tourists and autochthons. To satisfy it, the local integration of many parameters concerning different Ministries is necessary and the centralized French administration does not support it easily. In such a rural context empowerment is necessarily to make sustainable development possible: this gives transversal links in the society and not only top down links of hierarchical organizations. This authorizes a multidisciplinary approach which is essential to ensure projects dynamism. This is put forward by politics with the concept of *participative democracy* use by political parties actually in power in *Languedoc-Roussillon* and in *Larzac-Coeur d’Hérault*. In the population, stakeholders agree with this type of organisation and are opinion leaders to develop corresponding social attitudes.

One of the most important way for sustainable development in many region in the world (like *Larzac–Coeur d’Hérault*) is to assure benefits from tourism development and preserve environment through the conservation of biodiversity.

Francesco Di Castri[4] pointed out relation between information, conservation of biodiversity

[4] Prof. Francesco Di Castri, Director of Research emeritus, at the Center of Functional and Evolutionary Ecology, National Center of Scientific Research (CNRS), Montpellier, France; he currently works for several international organisations (ONU, UNESCO, International Convention for the Biodiversity, etc.)

Di Castri F. (1998): Environment in a global information society. *Nature and Resources* 34: 4-7.

Di Castri F., Balaji V. (2002): *Tourism, Biodiversity and Information*. Backhuys Publishers, Leiden, 502p.

Di Castri F. (2003): Sustainable development in small islands. Local empowerment as the key factor. *INSULA*, and development of tourism. He explains how exchange of information on the web was the starting point for the development of the tourism and the conservation of biodiversity in Easter Islands.

For sustainable development and especially in *Larzac-Coeur d'Hérault*, empowerment is a key aspect: the delegation of authority and commitment to actors or stakeholders is necessary to fulfill sustainable development. It gives a social synergy between inheritance integration, urbanization control and environment protection. Hence, equilibrium can be reached between:

– preservation of its wonderful landscapes,
– quality of urbanization,
– economic development.

In the context of sustainable development and empowerment, information is very diverse: know how and skills, multimedia databases, oral tradition. Information exchanges are also diverse: shared experiences between individuals, databases with remote access and last but not the least, collaborative learning to make empowerment possible.

At the moment, stakeholders have already, as we said, learning attitudes and internet skills to realize their projects. Our aim to empower stakeholders is to give them more efficient tools. Then, they will realize their projects more often, more quickly and in a better way! And, forward, there will be more stakeholders and more projects to be realized.

On a whole, we find in the context of *Larzac-Coeur d'Hérault* a rich ground to experiment with scenari and observe their transformation while using communication and software tools to improve interactive processes. This is an appropriate context to test the software tools of ELeGI : learning and Grid prototypes.

3.2 Web versus Grid

In the SEES n°1 context, it is necessary:

- to establish natural interaction between projects
- to give tools to assist empowerment of the population to make a better sharing of experiences an enhance collaboration.

The web gives already an efficient link between people and an opportunity to change the situation, but is not sufficient for at least two reasons:

1. If we really want to bridge the gap between product delivery and service provision, the initial goal of the "client" has to be managed like a project by the "provider", and therefore the provider has to be able to rely on statefull resources which will keep track of the whole processes while allowing interruptions.
2. If we really want to bridge the gap between product delivery and service provision, we have to imply, as often as necessary, human agents in the transactions, and we have to allow each of them to bring his "context" with him in order to be well understood. For example, Clark[5] talks about the following features during human conversation :
   - copresence
   - visibility

International Journal of Island Affairs 12: 11-17.

[5] [Clark, 1996] H.H. Clark. *Using Language*. Cambridge University Press,1996.

- audiblity
- instantaniety
- evanescence
- recordlessness
- simultaneity
- extemporaneity
- self-determination
- self-expression

Moreover according to Marc Eisenstadt, http://www.jabber.org/jeps/jep-0119.html describes the following attributes for Extended Presence Protocol Suite:

- user's geographical location.
- user's physical address.
- user's activity.
- user's mood.
- availability: can you be interrupted right now, do you WISH to be interruptable?
- attention: what proportion of your cognitive capacity can you devote to a conversation right now?
- device-capability: what kind of device are you using and what are its capabilities (e.g. PDA with WiFi, GPS-enabled phone, laptop, full/half-duplex etc.
- connectivity: related to device-capability, but distinct, in terms of the quality of your connection (e.g. the above device might be in my living room, but my home connection might be 1Mbps or only 56Kbps)

All of these features, which will play a central role in ELeGI scenarios, will hopefully soon rely on the distributed power of Grid technologies.

3.3 Larzac-Coeur d’Hérault features

Larzac-Coeur d’Hérault is subdivided in four communities of *communes*. Its surface is around 1,000 km² and the population is approximately 60,000 inhabitants.

The main characteristics are:

– high quality landscapes

The site of *Saint Guilhem le Desert* (on the way of *Saint Jacques de Compostelles* pilgrimage) has a wild and out-of-the-way side.

– « hot spots » for tourism

Saint Guilhem le Desert welcomes almost 1 million of tourist each year. *Cirque de Navacelles* or La *Couvertoirade* are not far from this result.

– low quality in proposals and infrastructures (especially for accommodation an d lodging).

Such a place like *La Couvertoirade* has two small wooden huts as tourism office. It has to be larger and more convenient with web stations for instance. But, on the other side, a larger tourism office has to be harmful for the place to respect the historical buildings and the landscapes.

– important local knowledge

This knowledge is particularly rich and has a wide range of disciplines and subjects, among them: agriculture, architecture, pottery, legends memory…

– population exchanges

In 1900-1970, Larzac-*Coeur d'Hérault* has suffered of rural depopulation. Then quick urbanization appears with the growth of *bedroom villages*. Today, the north is still depopulated, but in the south urbanization grows quickly: many foreigners from north (of France and EU) transmigrate to Languedoc.

– crisis in viticulture

Intensive grape growth in *Département* of Hérault, raise of production quality vine in such countries as California, Chile or Australia, decreasing of the wine consummation in France are the principal reason of the crisis. Today, Hérault wine yards become again among the best in the world as it was in the antiquity and produce very high quality wine.

– unemployment

Département of Hérault has one of the highest levels of unemployment in France.

All political decisions are taken by the different mayors or local elected councils but the *pays* enhance global policy coherence through different commissions to facilitate interactions between different actors and the councils.

In this context, empowerment is a must: the social realities are so diversified and at the same time tied together that links must be established between actors interactively with a mutual understanding even if their world are opposite.

4 SEES #1's Scenario

4.1 The approach

4.1.1 Our goals, and how to reach them

Our major goal in this VIAD SEES is **to enable ubiquitous and collaborative learning through the Grid based software architecture**; with the following measurable sub-goals:

- Building projects for ubiquitous and collaborative learning, allowing the validation and evaluation of the software architecture and the didactical approaches;
- Getting a feedback from these new learning approaches and updating the global scenario.

In a further phase of the project, we shall analyse the whole experiment in order to **define models for ubiquitous and collaborative learning**, that is to say:

- We shall formalize protocols and conversational processes for learning organisations and actors in the learning process;
- We shall integrate Enhanced Presence tools in the learning protocols and conversational processes.

Our approach is iterative. Because of the local development project in *Larzac – Coeur d'Hérault*[6], a pre-defined Virtual Community offers us the opportunity to contribute to local empowerment. In order to understand the characteristics and needs of this people, we have organized a survey aimed at producing a first set of requirements specifications. This will be described in chapter 7.

According to the results of this survey, we intend to proceed in two steps at the beginning of the experiment:

1. In a first step, a simple and clear objective is to enhance collaborative project with tools for telepresence like Buddyspace and Flashmeeting. Different actors will tend to be connected with potential different virtual communities. An actor will be able to belong to several communities, as agents in a multi-agents system, according to the Agent-Group-Role model (cf AALAADIN http://www.lirmm.fr/rech/arc/agen.html).
2. In a second step, actors will have to appropriate tools and to organize themselves in virtual organisations (called VLO in our text for Virtual Learning Organisation) by project or by class of problems. At first, those communities will probably be thematic communities but we think that they will evolve rapidly to communities of interest. Agents will tend to advise users to make them join different communities. Then, we hope that those communities will express spontaneously questions about their needs (new services and then tools) to develop their collaborative learning. We, ELeGI partners, shall support the administration of the tools.

4.1.2 Improving Information systems through collaboration and Grid technology

Among the predictable projects, "information system management" will take an important place; we recognize three levels of state of the art in information systems technology:

[6] More information are available on a power point presentation : see folder "SEES #1" on Portal project

- data centralization,
- projects interaction,
- learning services.

First level is well understood by users. Most of the time they see information systems as centralized data bases with data flows to store and then distribute the information.

Second level is in fact a network organisation where the information system is rather a dynamic communication system. At this level information systems are seen as collections of processes to be synchronized.

At third level we do not precise architecture of the information system. It is seen as a collection of collaborative agents, software agents or individuals able to construct specifics object to satisfy needs.

Grid technology integrates second and third level especially in SEES #1 with collaborative learning. Else where in the text we opposite web services (most of the time at first level with client server architecture) and Grid services (most of the time at second and third level).

4.1.3 Iterative development process

The SEES #1 has naturally an iterative an incremental development process:

The users and end user's are heterogeneous. Their needs can be satisfied many ways. Without any software and ICT, with web services and, further, with Grid services.

The following figure gives the six different steps of the process as it appears actually to us.

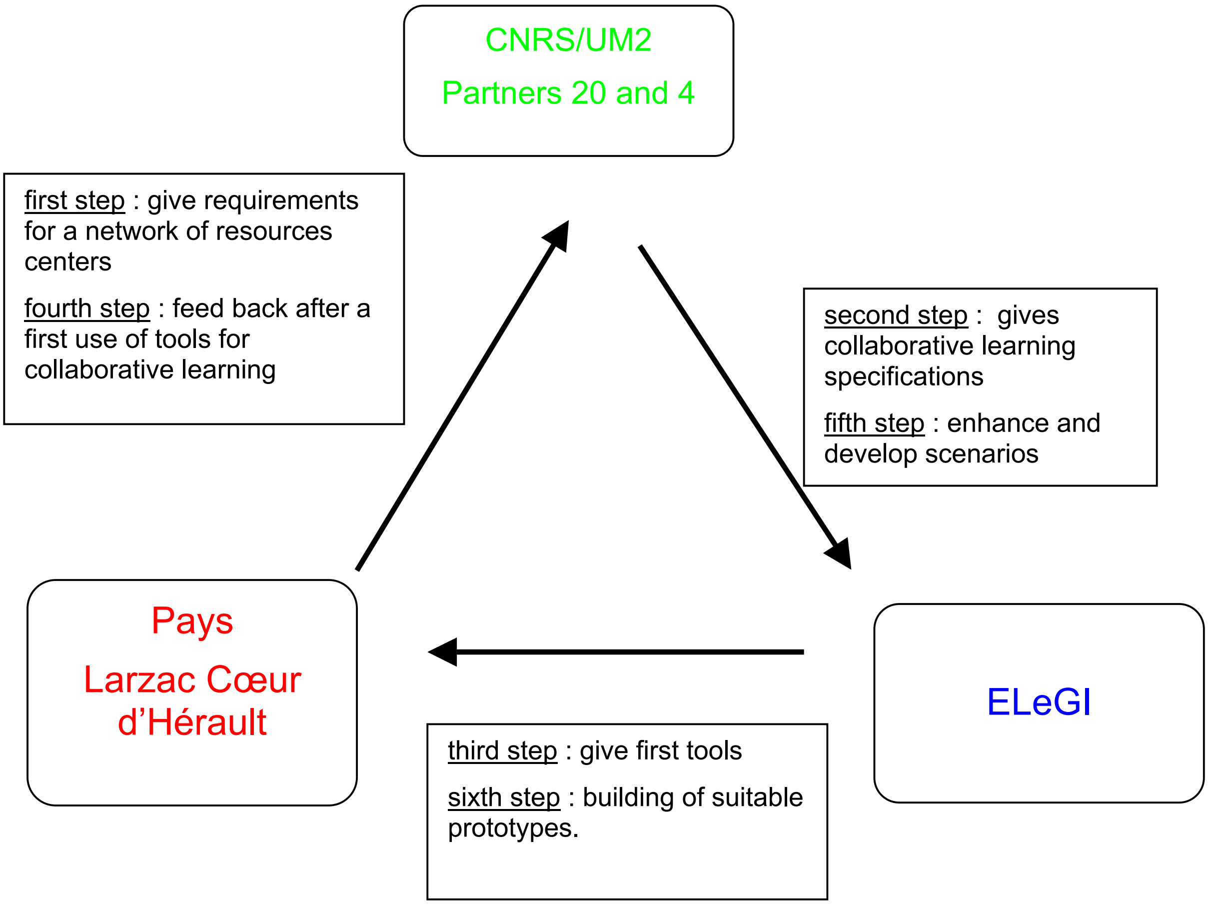


Figure: iterative development process

4.1.4 Elicitation measurement - feed back analysis

We will analyse the tools utilisation (exchanges frequency, integration of new members, constituting new communities, etc.). Our objective is to measure as precisely as possible the elicitation of requests for different communities. In a first time, those questions will probably trend to the use and improvement of the telepresence tools. But, in a second time, those questions will probably be more application-driven (elicitation of service, tools to build services). Analyses of communities needs ought to permit us to comprise precisely the process of service elaboration in a VLO.

4.2 Pays Larzac-Coeur d'Hérault Agreement.

The University of Montpellier II and the CNRS have been realizing studies in *Pays Larzac-Coeur d'Hérault* for several years. This is why we have proposed this region for the SEES n°1. We have implicated local actors step by step. The first step has been the realization of the survey by students of the UNESCO (see part 7). During this step, we have had several reunions in order to validate the realized work. The result of the survey has come in publicly three times at last of the month of June. Lastly, the 15 July 2004, we have had a meeting with Mathieu Guillot (local officer for Larzac.) to validate the local implication in the phase of Experiment of ELeGI. This meeting took place in the city of *Lodève* in presence of Stefano Cerri, Francesco Di Castri, Serge André- Mahé and Arnaud Martin. The result of reunion has been very positive and we have obtained the implication of 10 to 15 home actors for the start of the Experiment of the SEES n°1. Finally, the proposed experiment is considered like the beginning of the CRN expected by the Larzac-Coeur d'Hérault.

The Country will supply in September an official letter of agreement to the consortium of ELeGI.

4.3 Schedule and costs

The following table gives proposals schedule and costs for the beginning of the Experiment.

Some materials have already been bought in view to create a Grid Node (LIRMM, WP6 and SEES #1) and to test some tools. To start the experiment for the SEES #1, it is necessary to buy other portable PC (with GPRS for the connection). Some material is available in the *Larzac* (almost the actors involved are connected). Finally, the *Pays* should buy the hardware lacking. Nevertheless, this table must not be considered as definitive.

period	To do	Material/ person	cost	Consortium ELeGI contribution	*Pays Larzac-Coeur d'Hérault* contribution
First time/phase September 2004 to June 2005	Implementation of the tools on a server (Grid node) and testing the tools	1 Server, 5 PC	12 500 euros	100%	
	Material lacking to connect the actors	Portable PC, PCMCIA card and annual GPRS Subscription	10*3170 euros	25%	75%
	Teach the actors, analysis the exchanges	equivalent of one full time person		100%	
Second Time/Phase June 2005 to June 2006	Tools administration. Implementation of new users and new end-users. Evaluation of exploitation phase based on the qualitative analysis of the sessions and statistics record of the sessions (statistics and qualitative analysis).	equivalent of one full time person	48 000 euros	50%	50%

5 Learning aspects

5.1 Learning need

The reasons why *Larzac-Coeur d'Hérault* asked for learning is inherent of sustainable development problems because they are naturally interdisciplinary. Heritage, urbanism and environment give complementary views. It needs naturally a constructivist learning approach with high interactivity between projects via the CRN.

The need for different knowledge integration yields to learning because no one is usually able to be omniscient! Scenario will give or describe how users will obtain the knowledge and the know-how they need for their projects.

5.2 Learning modelling

The approach in SEES #1 is naturally learner-centred and also here, user-centred! In fact, in this SEES, we have to integrate in the same user-interface these two aspects. The better way to do it is to accept different user interface, a very general one to provide Grid services and specific ones for each centre of resources. In fact most these centres have already a portal. For each user interface the learning may be different, the first reason why is because ontologies are not the same from a centre of resources to another.

Users may be helped by super-users who have already the appropriate skills on the web as tutors. Then they will be assisted with learning ELeGI prototypes or other tools already on the market.

The super-users have in fact, on the web, the role of the future Grid-service users, agents or tutors. As ELeGI prototypes will be introduced, ordinary users will be able to be themselves super-users. But super-users will keep an interest to be the first tutors for learning of ontologies and acquisition of skills.

The CRN needed by pays Larzac-Coeur d'Hérault will evolve, within ELeGI, to introduce collaborative learning between different type of users and then agents to help them. Accessing, collecting, aggregating information with multi-process protocol to design a product by learning will define what we call Grid services.

5.3 Pedagogical / didactical approach

Approach	**Usage** (whether, how, why, by whom)
Collaborative learning, cooperative learning, social learning, project related learning	It is the major goal of this SEES; therefore, collaborative learning is supposed to concern everybody and to happen at anytime, since the beginning of the experiment. We will measure the elaboration (and elicitation) of services through telepresence tools for collaborative learning. SEES #1 should be based on several VLO (more or less inclusive). Each VLO is autonomous and can add members at any moment. In a VLO, each actor is considered as well as a teacher or a learner.
Constructivist learning	This pedagogy could not be used in the first time, but it should be usable in a second time.
Experiential learning, active learning, Problem based learning (PBL)	Only if actors require it.
Personalised, individualised learning	Only if end users require it.
Ubiquity and accessibility (anytime/anywhere)	Yes, the system must be the most accessible. Since next phase of the project, tools of telepresence will have to power be used everywhere (With WiFi and Bluetooth technologies for software and hardware)
Contextualised, adaptive, situated learning	No
...	

5.4 ELeGI related software

Tool	**Usage** (whether, how, why, by whom)
GRASP	GRASP compliance is to be studied for each tool.
IWT	Probably, for example a VLO for cultural heritage should propose it to teach their knowledge to the tourist (and also, everybody who works for the tourism in the *Pays*).
Finesse	No
Virtual Control Laboratory	No
BuddySpace	Yes, It will play the most important role during the first time of the experiment. All the local actors should be users for this tool.
KMi Stadium	Probably not
Magpie	Yes, this tool should be proposed to the local actors during the first time of the experiment simultaneously and proportionately to the expressed demands. All or a part of them should be users for it.
madkit	No
Strobe	No
Webra	Not yet, at this time.
DYXWEB	Yes, As soon as a VLO will have asked us how to write a document together.
Flashmeeting	Yes, It will play the most important role during the first time of the experiment. All the local actors should be users for this tool.

6 Technological aspects

6.1 Grid opportunity

To respond to a particular user need and more precisely to give a service, we have in fact 3 ways interesting for ELeGI and particularly for SEES #1:

- presential service

You have to meet someone physically to obtain the service. Most of the time, you have to present yourself to a desk and start the appropriate process.

- web service

The meeting here may be virtual and you can start the process at distance. But the service is most of the time the delivery of an object which already exists; it has only to be packed and not really customized. The way the service is realized is only to provide via a server the appropriate object to a client.

- Grid service

Meeting and deliveries are not enough and customization (as it is sometimes done on the web) has to be reinforced to reach a plain constructivist attitude. Some Grid features are by the way necessary: data traffic's and storage capacity rise for instance. But for SEES #1 we need (to meet the two last levels in 4-1:

- synchronization of processes

  Multi processing is necessary to send messages in different domains. Answers will be analyzed and processed as knowledge by network learning agent to produce the needed objects or a refinement of their specification.

- associative addressing

  It is necessary to use searching algorithms because useful sites may not be known by the end-user.

6.2 Grid architecture

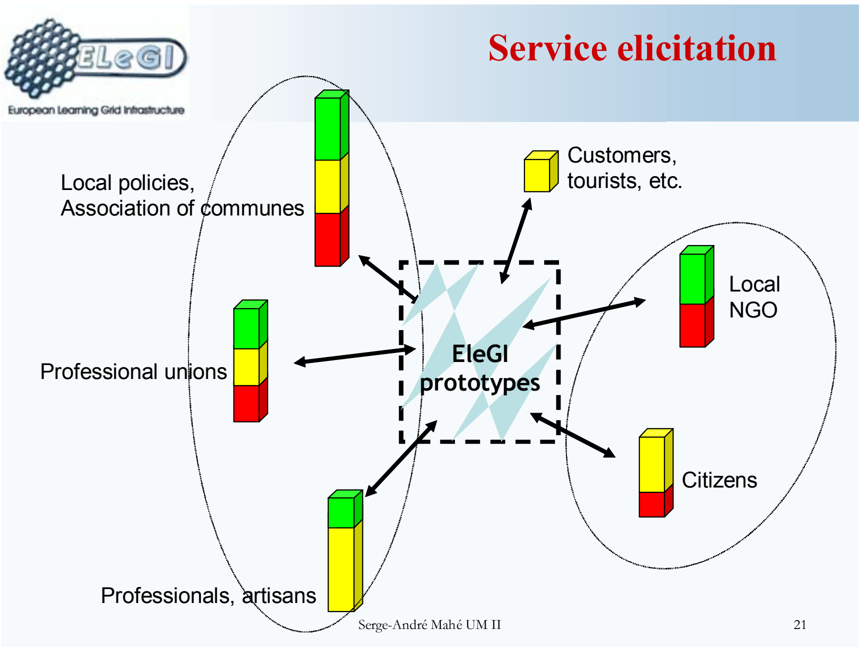
On this SEES, we have already and will have different tools and prototypes to test in different social and technical contexts. It will be possible to experiment with all the use-cases. The following slide explains that Grid oriented scenario will be obtained by generalization:

The services have to be widely improved: it will become true to design and deliver a product interactively with several servers and collaborative actors (human or virtual). This need is a need of a new architecture as Grid will be.

6.3 *Grid* design

The following slides explain Grid design strategy for this SEES.

First step: service elicitation



We use ELeGI prototypes to experiment with user's scenarios to improve the service ability with collaborative learning.

Second step: generic user interface

In sustainable development, end users are citizens, the different tools and scenarios will operate with them. Their profile cannot be more diversified and that is a guarantee SEES #1 is the only to give to obtain by generalization Grid oriented scenarios.

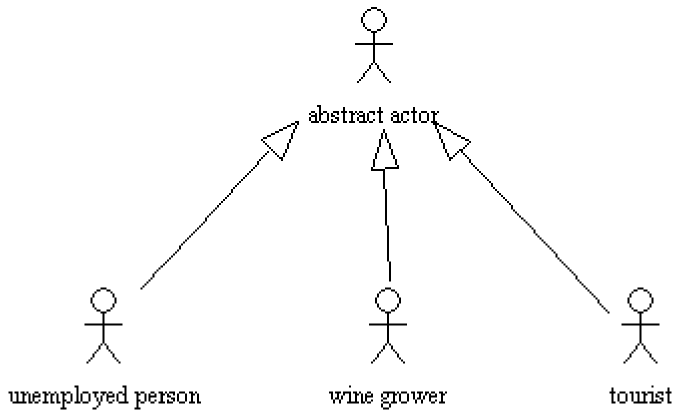


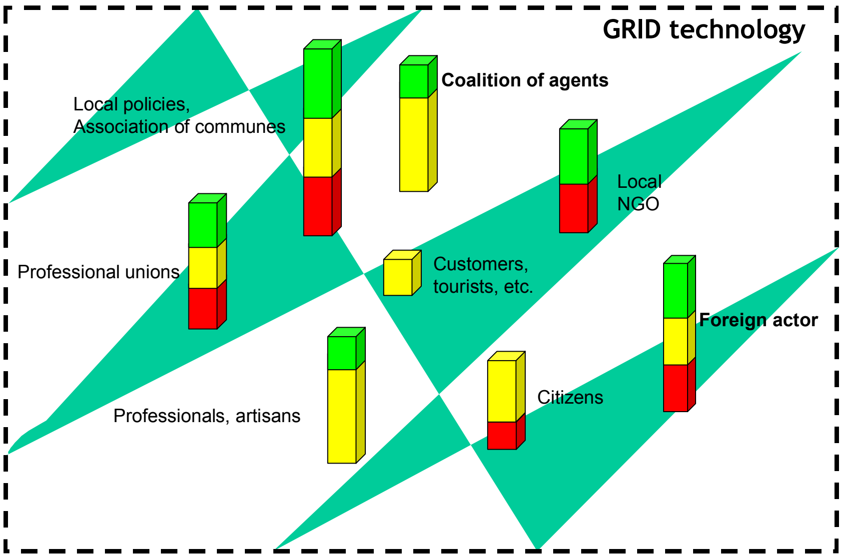
Figure: From service oriented scenarios to abstract oriented scenarios

The study of a user-centered interface, convenient for anyone anywhere, is consistent with the learner-based modeling (cf § 5.2). But this leads in SEES #1 to adopt different user interfaces: super user's prototype interfaces, adaptable end user's interfaces and last but not the least centre's of resource interface (in fact Grid oriented sites able to integrate improve prototypes). These latter interfaces are in fact thematic portals wide open to the other topics of the CRN.

Third step: service oriented architecture

All SEES's software (prototypes, interfaces and collaborative tools in general) will lead to a service oriented architecture based on (or convenient for) Grid technology.

Service oriented architecture



Functional requirements to Grid technology	
Functionality	**Usage** (whether, how, why, by whom)
Mass calculation	Probably yes.
Distributed resources	Yes, because for each VLO the resource (local, people knowledge) is not centered. Each actor (with its hardware) should be considered as well as a people who give resource or a people who ask for.
Peer-to-peer	Yes, see above.
Discovery and brokering	Yes, the different VLO will elicitate service, demands to solve several different problems. This is very important for the users (end-users) because the different VLO should give many different resources. They have to point as quick as possible where they could fine their service (request, elaborated ask, etc.).
Metering and accounting	Probably, but: to be refine during the first time of the Experiment.
Service Level Agreement Negotiation	Not at this time.
Monitoring	Probably not
Data, information and knowledge management	Yes, in second time of the Experiment. The actors should very quickly ask us how to manage their information together. This will depend on the demands from the different VLO during the first time of the Experiment.
Virtual organizations and groups	SEES #1 is based on Virtual learning Organization. This wills the starting point for the Experiment.
Load Balancing	Probably yes, because of the weakness of the communication network currently available in the *Larzac*.
Fault tolerance	Probably yes.
Advance Resource Reservation	Probably yes.
Notification/Messaging	Yes, this will have to be available for each VLO.
Workflow management	
Certification	
Authentication, Authorization and Accounting (AAA)	Yes, probably to identify the super users from the other users.
Trust Management	
Digital and intellectual rights	As soon as confidential data or document are produced by a VLO.
...	

Communication and collaboration	
Functionality	**Usage** (whether, how, why, by whom)
eMail	No, because, all the actors involved have already an email.
Discussion forum	This function is already included in the pays Website.
Instant Messaging	This function will be used with the telepresence tools Buddyspace and Flashmeeting.
Chat	This function will be used with the telepresence tools Buddyspace and Flashmeeting
Audio conferences	This function will be used with the telepresence tools Buddyspace and Flashmeeting
Video conferences	This function will be used with the telepresence tools Buddyspace and Flashmeeting
Application sharing	For the CRN
Shared editing of documents	It will depend on the VLO demand
Shared collection of structured information (databases)	Yes, but this should be organized for each VLO after its demand
Shared structuring of knowledge (ontologies)	Yes, but this should be organized for each VLO after its demand
Shared maintenance of knowledge (resource centers, repositories)	Yes, but this should be organized for each VLO after its demand
Shared projects (planning of tasks, timelines resources)	Probably Yes, it will depend on the demand
Collaborative simulations, games	Not yet
...	

7 Feedback from the iterative development process: steps 1 & 2

7.1 The major actors implied in the feasibility analysis

In 2003, the *Larzac-Coeur d'Hérault* asks us to build a **CRN**. This network will imply different actors: stakeholders, NGO representatives, economic actors and government officers, etc…

An explicit aim of this network is to enhance *collaborative learning* (through shared experience and knowledge). For example, this network would become a decision helping tool for the local councils but it can help also *end users* in their projects. This network is a very good support to validate *Grid pototypes*. This is the starting point for the SEES VIAD.

For STEP 1 (cf § 2 above), which requires sociologic skills and approach, an UNESCO student's team[7] is supporting us to realize different surveys in the *Larzac-Coeur d'Hérault*.

Each year, a student's team join the University of Montpellier to prepare their master degree at UNESCO. In 2003 the team provides a study about scenarios for tourism development in the north part of *Larzac-Coeur d'Hérault* (the document is in the folder SEES #1 in the portal). In 2004, the team realize some interview for a survey-in-deep to obtain requirements for SEES #1.

The survey was supported by a grant given by the *Larzac-Coeur d'Hérault.*

Two meetings with different local officers and Arnaud Martin occurred during February and March.

7.1.1 The UNESCO Team

14 students are involved in the UNESCO Team since September 2003 until July 2004. They went from the north and the south. They different scientific knowledge, different skills, but all of them are interested in local development and land planning.

Their names and the topic of their knowledge, skills, or previous job:

Deutschland:	*Bach Anne - Communication*
Burkina-Faso:	*Adouabou Basile – Forestry Officer*
	Sanou Lassina – Forestry Officer
Bolivia:	*Gutierrez Rita – Environment*
Colombia:	*Gil Cardona Alejandro - Biologist*
France:	*Beyls Anne-Sophie – Agro-Economist*
	Cavalier Mathilde – Agro-Economist
	Gallardo Julien – Land Planning
	Geney Clément- Biologist
	Philippet Sophie – Jurist & Geographer
Luxembourg:	*Brenner Amelie - Sociologist*
Poland:	*Swierz Dorota - Tourism*
Czech Republic:	*Lorencova Katérina – Civil Engineer*
Senegal:	*Goudiaby Abdou Karim - Geographer*

[7] Master Degree, UNESCO CHAIR UNITWIN (Development and Integrated Land planning)

7.1.2 The survey, actors and organizations

The Survey was realized by the UNESCO team during May and June 2004. 17 person (and organization) was interviewed.

The survey was directed by Arnaud Martin and Serge-André Mahé since April until the end of June 2004.

Many meetings occurred with the local officers and the different stakeholders during this period. The results and analysis was presented in the Pays, June 1st and June 29th. Another presentation occurred in June 30th in the University of Montpellier. Some members of ELeGI were present (Arnaud Martin, Serge-André Mahé, Stefano Cerri, Philippe Lemoisson and Clement Joncquet). All the document given by the student (4 volumes) are written in French. The main document is now available on the portal.

The following table give information about the organizations (centres of resources) and their topics of interest and knowledge.

Centres of resources	**Type of organization**			**Topics of interest and knowledge**			
	Local government	Ministry	NGO	Agriculture	Environment	Heritage	Urbanism
CAPEB			X			X	X
CAUE			X		X	X	X
Charte Intercommunale du Lodévois-Larzac			X	X	X	X	X
CC du Clermontais	X			X	X	X	X
CC du Lodévois	X			X	X	X	X
CC du Lodévois-Larzac	X			X	X	X	X
CC Vallée de l'Hérault	X			X	X	X	X
Conseil Général (CG) Service Environnement	X			X	X		X
Conseil Général (CG) Valorisation du Patrimoine	X					X	X
CPIE			X	X	X	X	
DRAC		X				X	X
Fondation du Patrimoine (+ APN)			X			X	
Grand Site de Navacelles			X		X	X	X

OGS Navacelles							
Manufacture des Paysages			X			X	X
ONF		X		X	X		
SEE			X		X		X

The following table gives information about individual actors most of the time invested in the CRN and their main needs. These data have been obtained by the UNESCO student's team.

Name and organization	**Role and location**	**First identified needs (interviews in process, May and June 2004)**
M. Pascal Christol CAPEB	Responsible of the CAPEB.	Share information and knowledge between building professional.
Ms Valerie Bousquet CPIE	NGO manager in environment (provides education and knowledge)	Share information, web mapping.
M. Alain Riols CG	Local government officer for the heritage site valorisation	Save the know how, give information
M. Bernard Kohn Manufacture des Paysages	NGO Manager "La manufacture des paysages", architecte	Information and education, improve the quality of urbanism
Ms Kanmberou	Architect, research department (Architecture, urbanism and environment)	Enhance collaborative knowledge, communication.
M. Mathieu Guillot Charte Lodévois-Larzac	Local government officer (North part of the pays), he is identified as one of the leader of the network	Give answers for the user (citizens, stakholders, etc) about urbanism, project for development questions
M. Sebastien Pujol CC de la Vallée de l'Hérault	Local government officer (Community of communes *vallée de l'Hérault*)	Enhance collaborative work (knowledge, tasks, learning) between the actors.
M. Gil Cloix ONF	National Forest Officer	Learning, communication, valorisation of local knows how. Access to information.
Ms Sophie Roudil OGS Navacelles	Local NGO for the Navacelles cirque Touristic site	Share experience, decision helping tools.
Ms Pages	Olive oil cooperative	Communication
M. Christian Olive DRAC	Local officer, Ministry of the arts	Give information, he distinguishes different users (end user(citizens), super-user(stakeholders, local officers)

M. Jean-Louis Lacroix Amis du Patrimoine de Nébian	Local government officer (culture heritage)	Share information for the tourism
M. Barsse ONF	National Forest Officer	Communication, education for environment.
MS Clarisse Schaevers SEE	NGO officer Sens Espace Europe	Urbanism and architecture
Ms Sophie Roudil *OGS Navacelles*	NGO manager for *Cirque de Navacelles* tourist organisation	Share experience, decision helping tools.
M. Thierry Rebuffat Pays	Main Officer for *pays Larzac–Coeur d'Hérault*, he is identified as one of the leader of the network.	Enhance collaborative knowledge

7.1.3 Different types of actors

In regard to ELeGI and the Experiment SEES n°1, we can define 4 types of **actors**:

User	A client, in fact a civil person (administrative subdivision, centre of resources…) locally involved in the SEES and who has also specific projects. UE, Région, CG34, CCLL, Pays who paid the survey (7000 €) are the actual clients.
Network learning agent	ELeGI learning prototype or a physical tutor in the subsequent collective learning system able to help end user's research and able to learn what end user needs.
Super-User	An individual with internet skills able to learn on the web and able to be a tutor to help someone's learning.
End-user	An individual who has a project or is active in a project in *pays Larzac-Coeur d'Hérault*. This person needs services to help him succeeding.

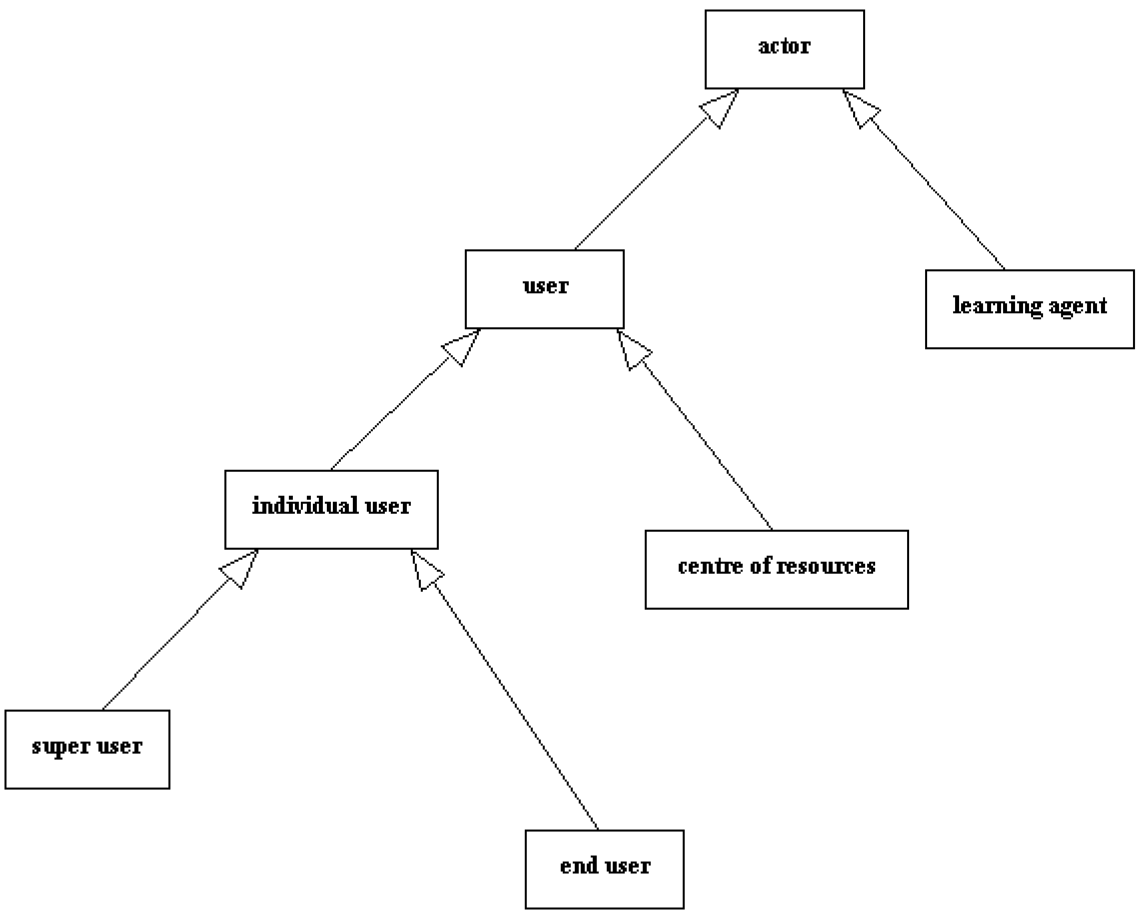


Figure: actor's class diagram

7.2 Interactions among actors

7.2.1 Results from the survey: abstract

The survey was conducted by a UNESCO student team during May and June 2004. The survey has concerned 17 actors who live or work in the *Larzac-Coeur d'Hérault*. These actors are different person (local officer, forestry officer, local stakeholders), but all of them are imply in a local committee for environment and development. Since 2003, they have regular meetings to share ideas about development (with economic and environmental issues).

Thierry Rebuffat and Mathieu Guillot (who are local officers for the Pays) represent the driving force for the local committee. They ask Arnaud Martin (partner 20) to drive a survey to analyse the needs in collaborative learning.

All the actors were interviewed by the UNESCO students. Each interview was approximately 2 or 3 hours long. The aim of the survey was to have more qualitative than quantitative information. The analysis mainly described the different relations between the actors, the current tools they use, and their needs.

All the actors use phone, fax, mail and email daily. Others tools like net messenger, chat, e-conference seems to be never use presently. All of them are frequently Internet users to find different documents or databases. Certain Institutions or companies have developed their own Intranet which essentially provides databases and maps (including web mapping).

The local committee organizes 3 or 4 meeting each year, but some of the actors have several other opportunities to meet them. Nevertheless, there are some constraints: (1) this is always difficult to schedule meetings, (2) the distance, because the region is a little bit hilly.

The analysis of the survey reveals that the local committee operate like an informal network with different topics (environment, urbanism, development, forestry and agriculture). The meetings are often an opportunity to have interdisciplinary brainstorming. This network is more than a simple way to share information. Some actors use the network as a way to enhance collaborative learning. Nevertheless, the actors point out several weaknesses:

- Identify (and access to) the skills (and afterwards, information, available databases, etc.)
- Lack of telepresence (especially for those who lived in mountains)
- Lack of interoperability of databases
- Lack of means to build collaborative knowledge (especially for information about cultural heritage and environmental maps)

All the actors express an organizational weakness for their network. Nevertheless, they are not really able to imagine what kind of tools they could use to solve this problem, because:

- They are not really "up to date" about new Internet tools.
- Almost all of them are under extra work.

This survey has helped us to refine our approach, not to the point where services can already be elicitated, but the point where:

- a first phase aimed at learning collaboration protocols and mastering enhanced presence tools has been decided and planned
- a second phase will imply several project driven VLOs (cf example of scenarios)

Both the results from the survey and our approach for the experiment have been welcomed and validated by the actors, the local policy officers and the local authorities.

7.2.2 The aims of the centres of resources

The CRN was justified by goodwill to do sustainable development. During the two last decades, some environmental problems occur in the *Larzac-Coeur d'Hérault*. Some actors would strongly act to change the direction of development to save the life quality of this region.

The survey gives us some detailed data about the main problems and needs feel by the actors:

- Preserve quality of life
- Preservation the traditional work knowledge
- Preserve and improve the quality of architecture
- Control the massive population growth
- Social integration of the arriving people
- Improve the service quality for the tourists
- Etc.

These needs are very large, very integrated and very common. We should have the same information from a lot of region of Europe. Find a good direction for the development need a large integration of skills to find solution (sustainable development) for such problems.

Access to information and collaborative learning are probably the only one solution to enhance a sustainable development.

7.2.3 Relationship between actors

The survey gave us excellent results about the current relationships between centres of resources. Different types of relationship have been expressed. The interactions mean the capacity of the actors to share not only information but also ideas and concepts. These relationships are often Interdisciplinary and as we said, associate different topics (environment, urbanism, forestry, etc.).

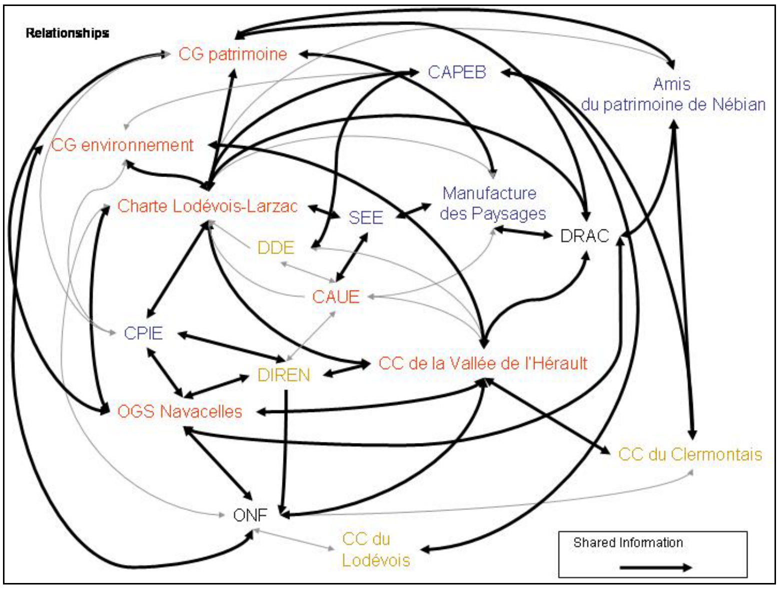


Figure: interactions between center of ressources

The grey arrows are data flows (first level) and the black arrows are interactions between projects (second level).

At the moment, only two centres of resources declare current relationships based on collaborative learning. This specific relation exits because these actors are concerned by the same geographical region and because they have supported relation since a long time. For all the others actors, collaborative learning is low or null. The main reason is the lack of convenient tools. Collaborative learning could be enhanced using tools like *buddyspace*, *wiki*, *dyxweb* or *compendium* (see the coakting project: http://www.aktors.org/coakting/resources.html).

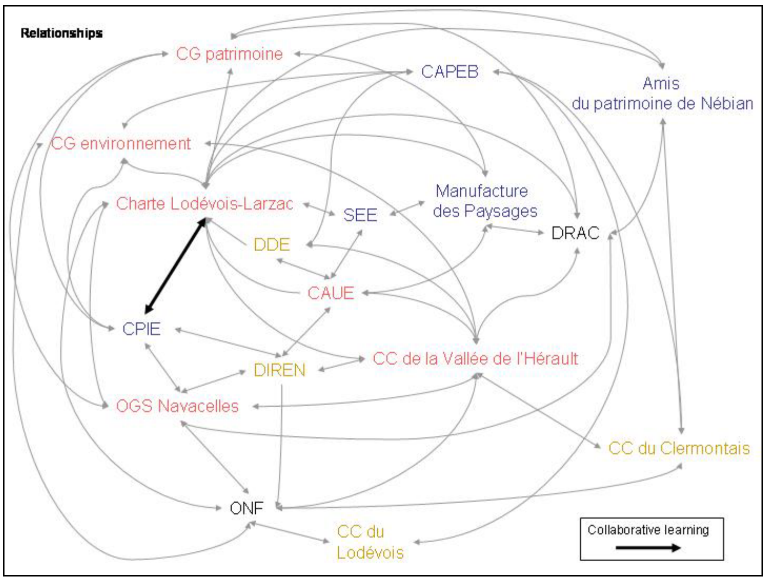


Figure: observed interaction with learning

The grey arrows are data flows (first level) and the black arrows are interactions between projects (second level).

7.3 Use cases' selection and examples

7.3.1 A first view of possible use-cases

- Find (or create) a job in *Larzac-Coeur d'Hérault.*
- A farmer wants to increase his own economic development.
- Tourist who wants to optimise his schedule during his staying (example of interaction: heritage organisations/tourism offices).
- Prevent forest fires with an example of a dynamic and continuous fire prevention system.
- To create a cultural event.
- To realized a building project
- To produce dynamic maps

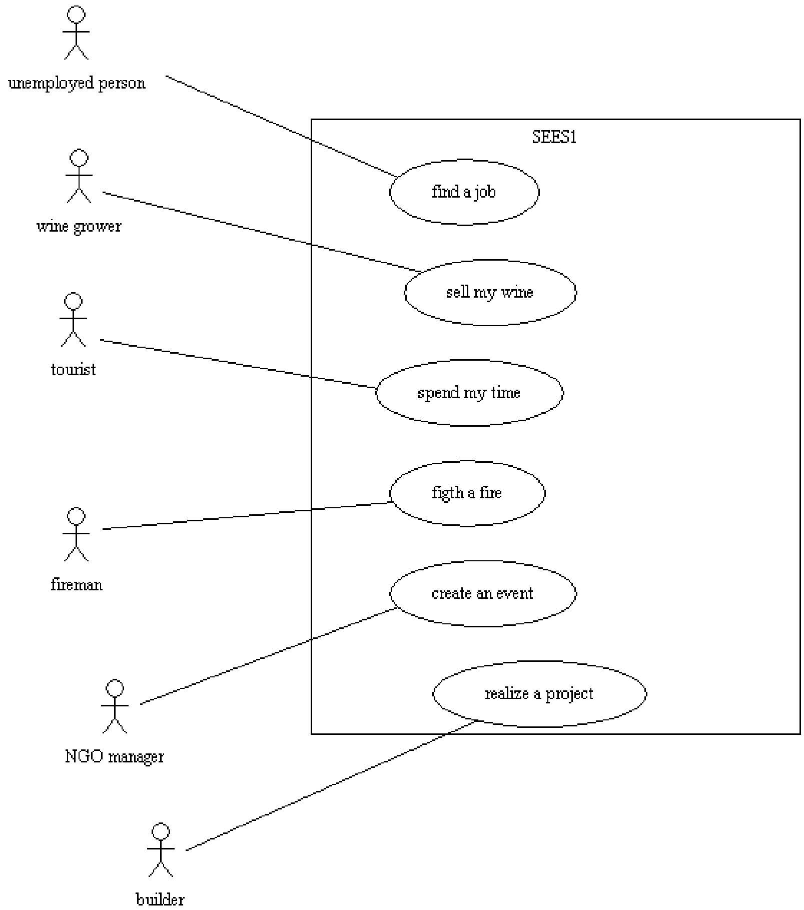


Figure: end-user's use cases examples

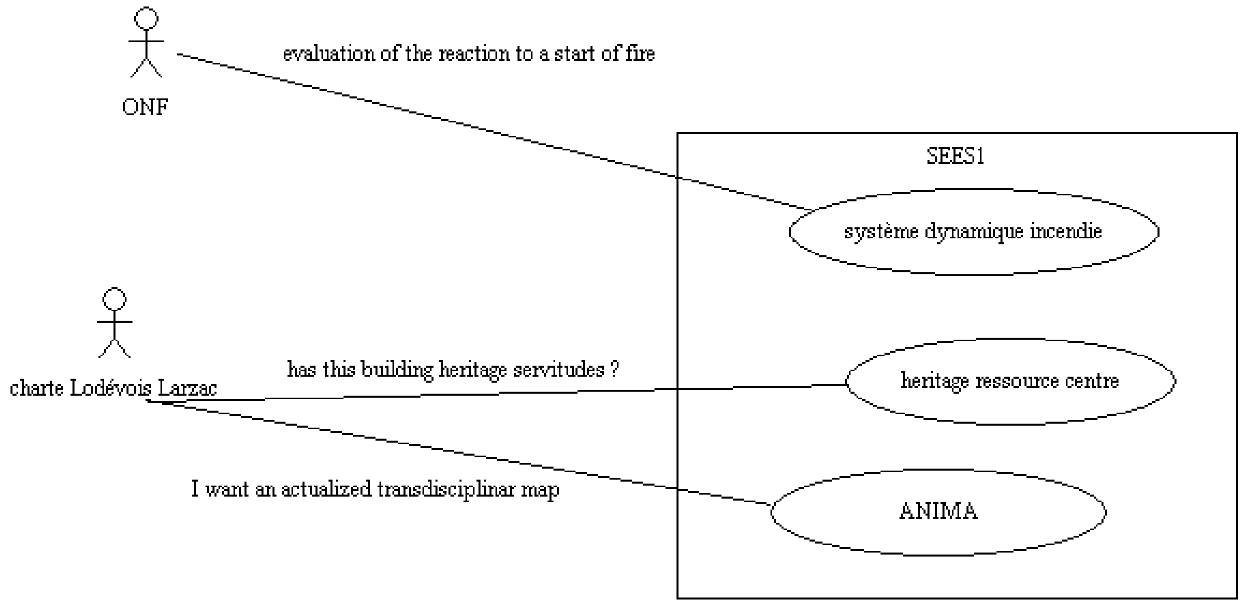
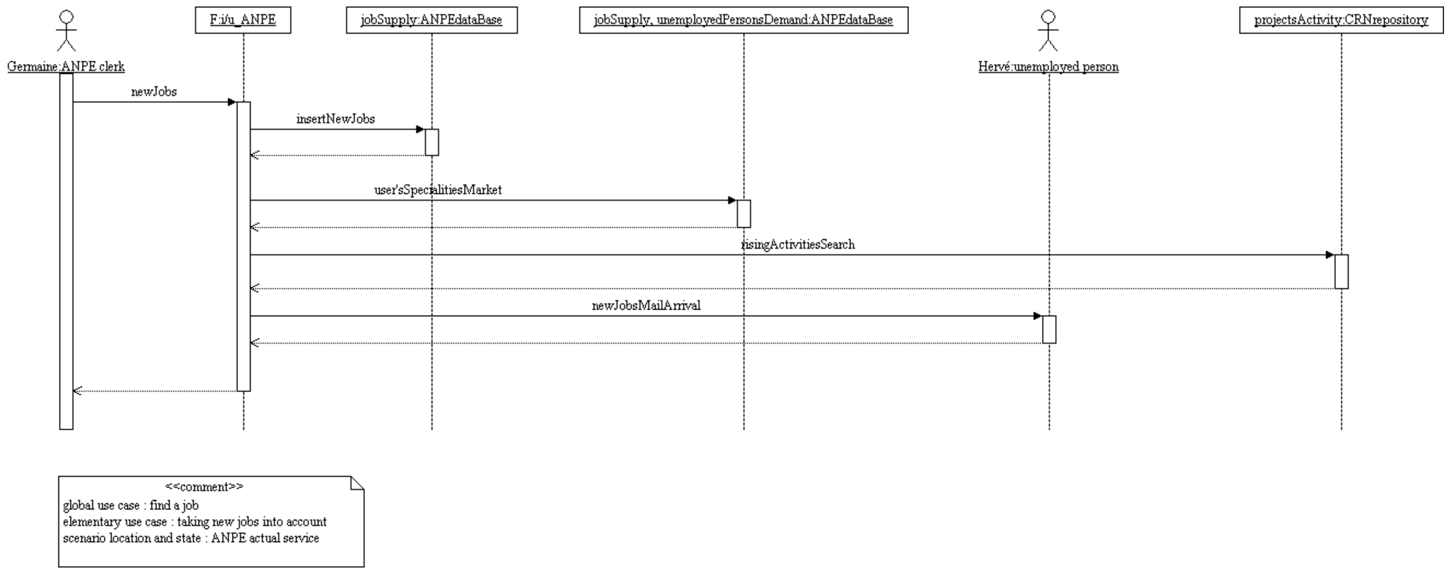


Figure: centre of resources' use cases examples

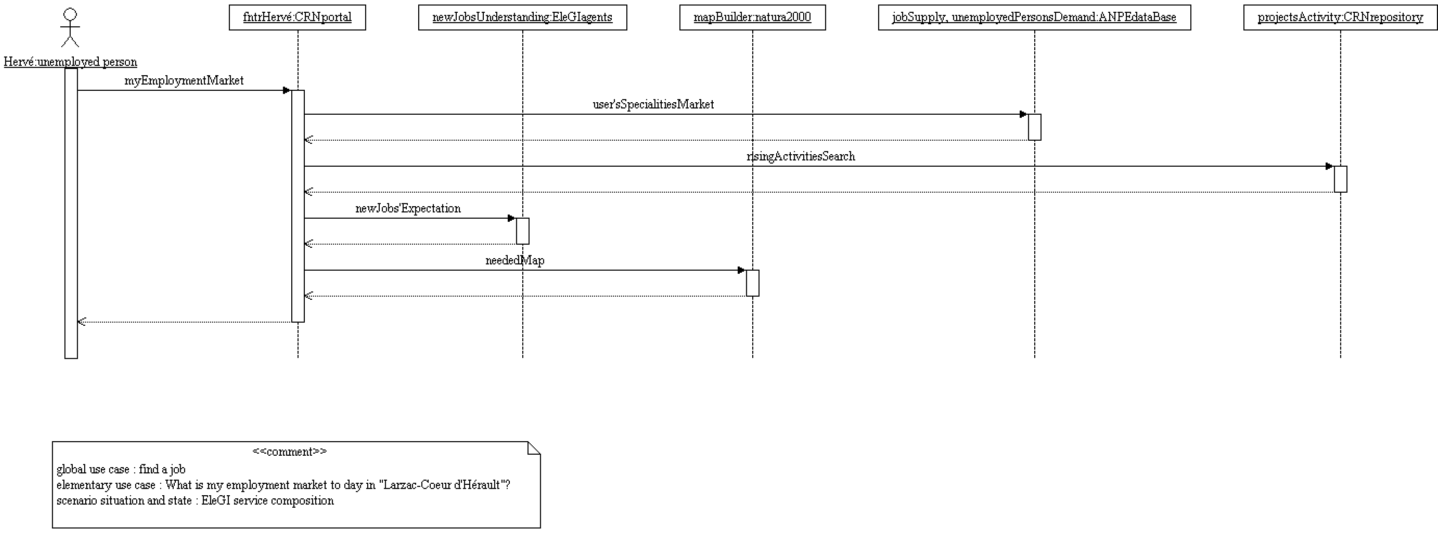
7.3.2 *Find a job* use case



This use-case shows a *find a job* sequence of messages. This is an actual ANPE service. The technical level is not bad: first level (cf 4.1.2) with some interactions (second level). The end-user for the survey was Philippe Trousseville who is an unemployed person living in Les Plants near the city of *Lodève*. He has also strong internet skills and is a potential motivated super-user.

In brief this use-case inserts new jobs in the database and sends a mail to the unemployed person with activities of the same type to consult the ANPE site.

A web sheet gives employers the profile of potential interesting people for this job.



This use-case shows a *find a job* sequence of messages. This is a proposal for ELeGI service.

The value added by this use-case (see one of them just above) is that it is event-driven to meet completely second level of technology evolution (cf 4.1.2).

First the end-user uses the CRN portal.

Then a *relational join query* gives the state of the market with conventional database technology. Notice that the query asks for the whole market's situation in the specialities of the unemployed person. The portal works in fact with contextualized views.

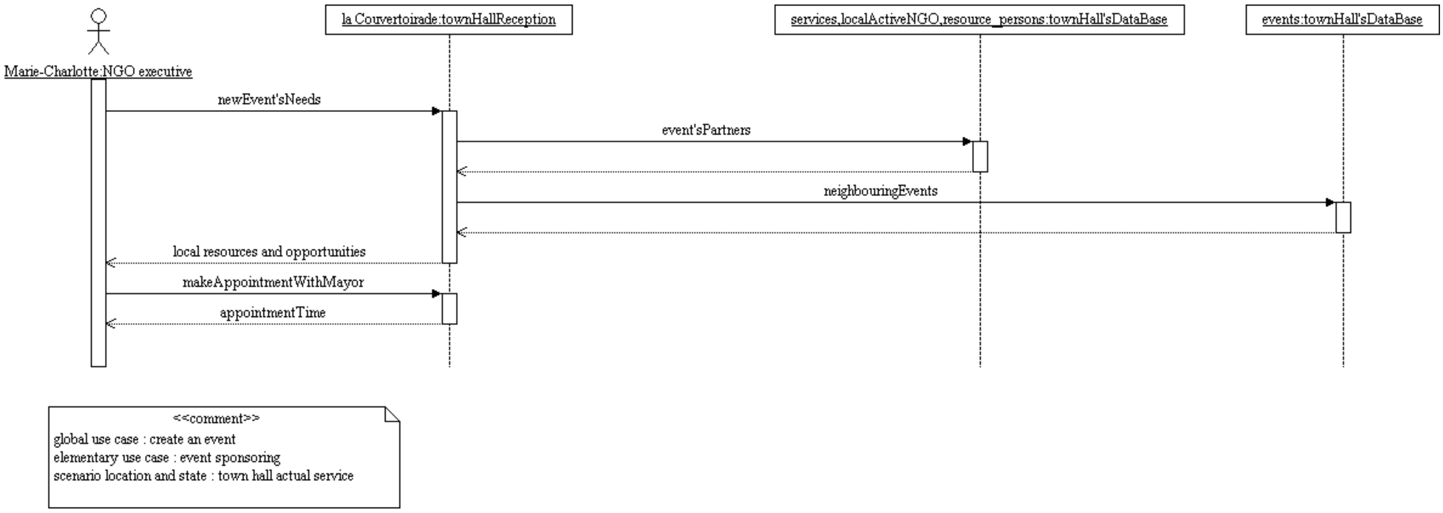
Next view gives the market tendency; in fact we use the links between projects to evaluate the activity traceable on the CRN repository (the corresponding processes could be done further on the Grid nodes with the right research engines). This market tendency can be analyzed with learning agents able to learn how former situations yields to new jobs creation.

Further in the project (second step in fig above) we shall be able to detail these collaborative learning services and give them also a conversational version to imply users.

A synthesis has also to be produced by *myEmploymentMarket* portal's operation between the actual and the future situation.

At last, this service is done by end-users; a *Chartre Intercommunale du Lodévois Larzac* project will interact to produce a map-interface, giving a contextualized and specific photo of the state-of-the-day Hervé's job market.

7.3.3 Create an cultural event use case



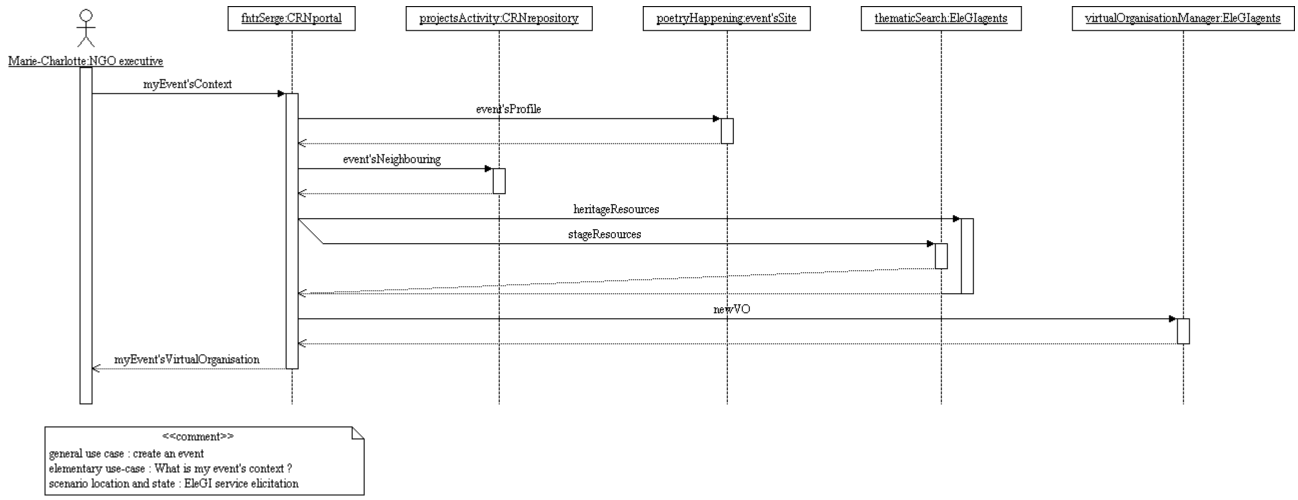
This use-case shows a sequence of messages for the use case *create an event*. It is a survey at *La Couvertoirade* town hall with the intention of creating a cultural happening: a live poetry week end. It shows a low technical level municipal service in presential. Marie-Charlotte Boutier was the end-user in charge of the week-end.

The events partners were:

- *les amis de la Couvertoirade* (Couvertoirade's friends) for heritage to give historical details and to organize a visit of the medieval site during the week-end,
- *les chaises qui bougent* for stage support : Templar Knight costumes, accessories, etc…
- le gîte de la Couvertoirade for sleeping,
- Mr Causse a specialist in Occitan for old local texts.

A happening has been found (as neighbouring event): the municipal bonfire of St Jean was the same Saturday evening but the church was free for a poetic show after the bonfire.

The inquiry totally succeeds: a meeting has been organized immediately with the mayor who gave her sponsoring and noticed that the event concerned la *Chartre Intercommunale du Lodévois Larzac* and gave maps to organize a poetic ramble around the *commanderie*.



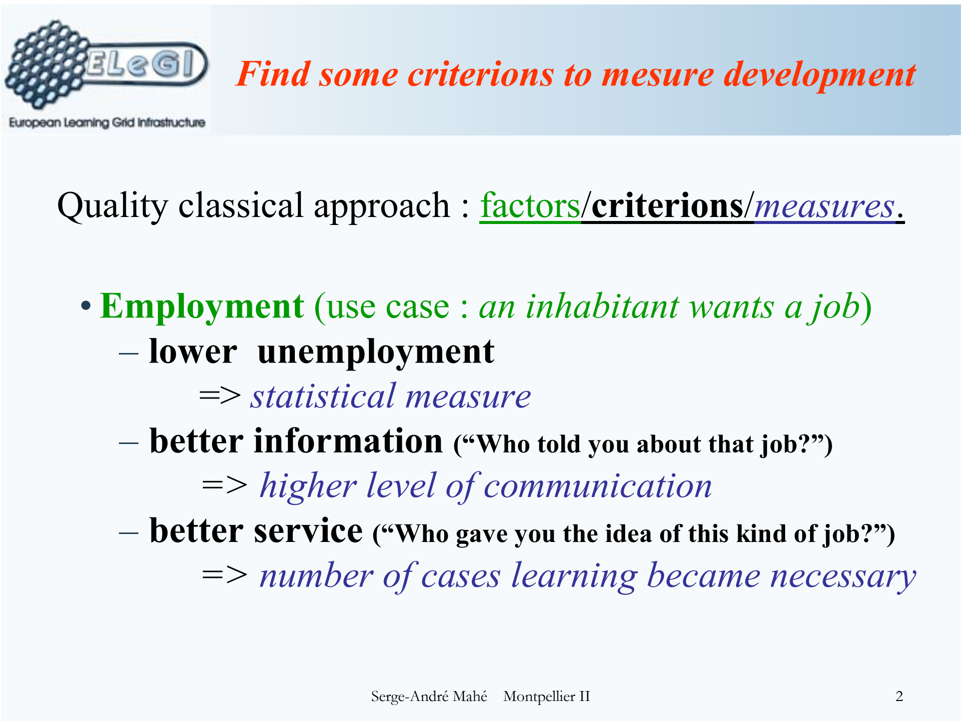
In this ELeGI VIAD scenario, all the information could be obtained via Internet. The services have several features :

- the partners and neighbouring events search is made not only in la Couvertoirade but also in the surroundings (or even else where in the world!). For instance, CRN includes le Caylar as a *commune* (close to la Couvertoirade) and *Chartre Intercommunale du Lodévois Larzac* as a centre of resources,
- the heritage resources and stage resources are found via centres of resources. The agents can identify the resources with learning tools. This opens the way to human interactions between tutors (human learning agents) and end-users. The corresponding processes will be studied in second step, see Figure above *iterative development proce*ss.
- the collaboration between the NGO executives, the mayor and other different subsidiary actors of the use case justify the building of a new VO to resolve potential problems concerning several persons to make the event succeed. The VO constitution has to be soft; people have to enter the VO progressively. The agents can build different maps to constitute different groups: geographical maps (with the lodging, the show places, the halts of the ramble, etc…and of course the people concerned), but also thematic maps (heritage map, theatre map with virtual scales for instance).
- The connection between actors can be made via CRN. In this example, a former partner of the NGO established himself in la Couvertoirade to create a centre of cultural activities. This place has been noticed at the town hall but the opportunity to join locally a potential partner as also to be noticed. It’s an interaction between this cultural centre’s project and the poetry week-end happening’s project.

8 Evaluation through the GQM method

SEES #1 gives an opportunity to reach "measurement goal : Building projects for ubiquitous and collaborative learning" and to define quality measures in each centre of resources. Each one is an observatory of the CRN with its own measure ability of data traffic (it is not enough) and succeeding interactions (it's better). Use cases will be chosen to provide a cross validation because each use case will have a specific goal and consequently measures.

This slide gives an example of measures for a specific use case *seeking for a job*:



In the approach factors/criterions/measures we can give three examples or measures for the use case *find a job*.

Each measure corresponds to a level of technology evolution but is any way operational.

First step: the ANPE can give statistics with its databases. If we meet our objectives, it can be red in this statistics within an interpretation if results of our action can be observed.

Second step: interactivity between projects: the CRN repository can observe the messages concerning job seeking and make some statistics about information exchanges for this subject.

Third step: because we give an ELeGI service we can report our activity and certify when our service succeed, in fact it is an experiment! In SEES we are still scientific people then we are able to give the experimental proof that our hypothesis of work is right, we are supposed to succeed!

9 Risks

Four main problems are identified at the moment:

- Low collaboration and under use of tools,
- Low or null exchange of information,
- Conflict of interests

9.1 Low collaboration and under use of tools

The first part of the experiment consists in using tools of telepresence like Buddyspace and Flashmeeting, the utilisation of which is really simple. Analysis of the survey shows that those tools can answer to actor needs. If a first kernel of actors (super-users) quickly "self-appropriates" those tools, then the risk of under utilisation will be limited.

The utilisation of those tools on a geographic narrow territory may appear a little bit surprising. Meanwhile, the *Larzac* is a mountainous territory and the time of displacement can be long. Meeting with all the actors are rare. The tools ought to considerably increase exchanges between actors.

We have foreseen the necessary time to learn to actors the utilization of those tools. We will help them equally to coopt new users (super users, users and end-users). Those two actions ought to minimize the risk of under utilisation.

9.2 Low exchange of information

Use of telepresence tools is a first step of the experiment. Those tools must incite different people to exchange knowledge more than nowadays. The survey showed that although actors never use nor even know these tools, they are open-minded. Meanwhile, the objective of the SEES is to develop means (and tools) for the collaborative learning between types of actor very different (cf 7.1.3). A hypothesis of the progressive actors' implication would be:

1. Use of tools of telepresence;
2. Request and utilisation of collaborative working tools (Wikki -> Dyxweb);
3. Request and utilisation of collaborative learning tools;
4. Services elicitation for the durable development.

The risk is that actors restrict themselves the use telepresence tools for the chat and the video conference, and that they could not or would not ask or elicitate new functions (to pass of the 1 in 2, then 3).

It seems us that the better mean to prevent this risk is the accompaniment of actors by "resource persons" (with competence on tools and on sustainable development). In addition to the persons from the partners part 4 and 20 of the consortium, we will be able to associate new persons with the financial help from the *Larzac-Coeur d'Hérault* .

To establish a good relationship with end-users and inhabitants, Francesco Di Castri[4] is a outstanding resource person.

Other people are very interesting because of their experience in the same situation as we are like Jérôme Valina who is the webmaster of www.ejenvie.org, one of the most important French website for collaborative learning in environment.

9.3 Conflict of interests

During the first phase of this experiment, risks of clash of interest appear very low. Many actors agree to start this experiment and thanks to the survey, we have already been able to strongly implicate some of them.

Conflicts of interest could happen later depending of two aspects (the proprietorship of the information and of the knowledge, a new redistribution of the power). Conflicts on proprietary of the information and of the knowledge ought to be eluded by the utilisation of contracts or of official agreements: this has to be defined.

Conflicts of power will be perhaps more difficult to resolve in the specific case of France. Indeed, France is a state with heavy administration and very complex imbrications of local public authorities. The construction of collaborative learning system for service elicitation (this is a way very important for empowerment) will develop new systems of “local democracy”. Then there is a risk of conflict with the “representative democracy” (from the different local public authorities). A mean to forestall this risk is to associate the representative democracy to the project. This is what we have done on occasion of meetings with different persons of *Région Languedoc-Roussillon* and the *Département de l’Hérault*. They will remain partners of the project until its end.

B) SEES #1
Feasibility Analysis

1 Specification Status

1.1 Summary of the goals

1.1.1 Goals

The identified and main goal of the SEES #1 is to develop a new collaborative learning framework allowing the information and knowledge sharing for the sustainable development. This aim will be reached by building Centre of Resources Networks (CRN). These CRN act like VO proposing to help users in elaborating their projects. The collaborative learning concepts are relevant for such infrastructure because of the multi disciplinary aspects and a Service elicitation approach is specified.

The main goals are the following :

Goal 0 **define models for ubiquitous and collaborative learning**

Goal 0.1 : Formalisation of methodologies for evaluating the effectiveness of these new learning approaches from the pedagogical and usability points of view

Goal 0.2 : Formalisation of protocols and conversational processes for learning organisations and actors in the learning process

Goal 0.3 : Integration of Enhanced Presence tools in the learning protocols and conversational processes

Goal 1 **to enable ubiquitous and collaborative learning through the Grid based software architecture**

Goal 1.0 : Scenarios for ubiquitous and collaborative learning, allowing the validation and evaluation of the software architecture and the didactical approaches

Goal 1.1 : Feedback of these new learning approaches and update of the scenarios

Goal 2 **to disseminate our results**

Goal 2.0 : The strong connection with the team driven by F. Di Castri will be a great help for this dissemination

Goal 2.1 : The Chair UNITWIN UNESCO will provide an international network of people involved in sustainable development.

1.1.2 Comments

The specifications of SEES #1 seems to be rather general because of the ambitious and wide objectives it tries to reach. Nevertheless, by applying the Service Elicitation and Evaluation/Exploitation scenarios it could become clearer afterwards.

The need of computer assisted tools in order to improve information sharing is showed but the specifications seem at the moment still vague, and perhaps some more concrete scenarios could fix ideas.

1.2 Relevance of the initial specifications

This SEES follows a cyclic development approach. The initial specifications describe an organisational framework in which first existing tools will be delivered to the actors and then, in a second cycle their feedback and usage experiences will help to provide detailed requirements for enhanced, Grid based versions of these tools. The approach is appropriate for the purpose and context of this SEES but as a consequence it will take longer to finish the detailed functional requirements.

2 Organisational and pedagogical feasibility

2.1 Overall summary

In this SEES, an informal learning approach is intended. Learning will be integrated into a working process; tools, contents and support will be delivered as a contextualised service. Learning takes place anywhere, at any time, and according to individual and situational requirements.

SEES #1 has the ambitious and sole aim of empowering the interaction and information processes among the different actors involved in a regional development process. Technology will support this process, but it should not be and cannot be the leading instrument for organisational change.

In order to analyse this very ambitious and innovative SEES further, detailed specifications of pedagogical issues are needed. These are:

- Profiling of the different target groups with focus on their needs and skills (e.g. key competencies)
- Detailed descriptions of the different users' roles
- Provision of motivation for the users and other beneficiaries to use the services and tools
- Specify the interaction process among the users and the specific tools and services to implement
- Specification of the support and training strategies for the different parties
- An overall strategy to develop a pedagogically effective system
- An evaluation concept to identify strengths and weaknesses of the scenario as well as the factors for user satisfaction.

The identification and specification of the topics listed above will allow for a better and more detailed analysis of the SEES.

The approach chosen in SEES #1 is certainly the most ambitious one in the ELeGI project and will support the research and testing of new learning systems to support the development of the European knowledge society, and contribute to the development of new concepts for lifelong learning in an informal learning context.

2.2 Motivation

The main interests from the organisational point of view:

Learning is understood as a continuous and obvious process. Learning achievements will be inherent to the work process (stakeholders involved in the regional development process) as well as to the use of a service (e.g. tourists).

Improved communication and collaborative processes among the different stakeholders are supposed to lead to sustainable regional development.

2.3 Organisational and pedagogical analysis

2.3.1 Learner/user-centred aspects of interest

Summary of the analysis of the main motivational aspects:

The provision of new tools and services to support the development process of a certain region can only be successful if the involved stakeholders (superusers and users) and other citizens (end users) as well as beneficiaries of the services (other citizens and tourists) are motivated to use them.

Stakeholders must be aware of their needs in order to actively and efficiently participate in the sustainable development process. The survey realised by the UNESCO team has helped to identify and define the particular need of the different stakeholders. Stakeholders are aware of possible synergy effects due to the improvement in collaborative and knowledge sharing processes. Further instruments to motivate stakeholders to work collaboratively and to share information are needed, since new and effective collaborative tools and knowledge-sharing services or tools adapt to support the network building process but are not a panacea.

Motivation will increase if the developed services are well accepted by the end users and other beneficiaries. Furthermore in order to assure a successful introduction of the collaborative system a "critical mass" of users must be reached, otherwise the system will not be attractive enough for the users.

The developed services will offer obvious advantages if they are easy to use and to access.

It is important to specify in more detail the communication, self-management, teamwork and ICT skills needed on the user side. This identification will make it possible to introduce appropriate tools, develop adequate support concepts and the contents needed in order to improve work process-related skills and to overcome existing knowledge and skills gaps.

2.4 **Peer comments**

The main objective of SEES #1 is the creation of a Centers of Resources' Network (CRN) empowered through better communication and information sharing between local actors. In this point of view, we believe that the Grid infrastructure is suitable to enhance collaboration and information sharing among local actors.

So, we believe that the purpose of SEES #1 is organisational and pedagogical feasible. Learning models for the ubiquitous and collaborative learning will have to be defined and subsequently will have to be evaluated from the pedagogical point of view. In order to favourite the organizational aspects of this collaborative activity, some methodologies and protocols for the conversational and interactive process will have to be identified.

Furthermore, attention will be paid in order to define and analyse the roles and the relations among the different users, which collaborate each others in the proposed learning environment.

3 Technical feasibility

The main issue in this SEES is to manage heterogeneous data in heterogeneous environments with a potential large amount of connections between system actors. The progressive approach proposed by the SEES #1 authors could be a solution to measure technical problems. On the basis of the document, taken a decision concerning the technical feasibility seems to us premature. We would prefer to have complementary information concerning the real services needed by this SEES.

3.1 Summary of Grid functionalities required and Tools

- Peep to Peer
- Dynamic creation of services
- AAA (Strong need)
- Service Location
- VO and groups
- Notification/messaging
- Workflow management
- Probably a Service Level Agreement, in case of reliability of the system.

The exchange of information with different levels of integrity imposes an reliable accounting system. These exchanges could be based on a Peer to Peer mode. A Service Location system will be an efficient tool to localize services for a user. In case of composite services a workflow management system will be necessary.

3.2 Peer comments

The current version of SEES #1 specifications have a user based approach, with a yet very rough vision about the technological feasibility. In all the schemes Grid is given as solution for combining all the services, but we find the need to describe it more technologically, what it gives for interactions between the centers of resources, how it should be used for user interface generalisation, etc.

The general demand for an integration of existing services and tools and access to distributed resources is especially expressed in the example use cases. However, each of the cases leads to a complex application scenario that needs its own dedicated analysis and development and can be supported, but not completely realised with generic ELeGI tools and services. Other contributors will have to invest in sustainable developments based on a Grid infrastructure. Taking into account the number and diversity of potentially participating organisations (even in surrounding areas), the realisation of cross-organisational services will put high demands on the maturity and reliability of the underlying Grid technology.

On the short it is a realistic approach to start with tools like BuddySpace and FlashMeeting to support selected local actors and to make them familiar with new communication techniques. A migration of these tools to Grid based prototypes in the mid term will help to identify the added value coming from Grid technology.

One specific goal is the formalisation of conversational processes. However, this should not force the actors to adapt their communication behaviours to a given technical formalism. Therefore the formalisms should work in background and the tools and user interfaces must be as intuitive as possible.

Part III: SEES #2 (EnCOrE)

A) SEES #2
Analysis and Requirements Specification

Author(s)/Responsible:	Edouard Untersteller (Partner 20) Alain Krief (Partner 19)

Version History

Version	Comments, Changes, Status	People
0.1	First draft	Edouard Untersteller
0.2	Completed draft	Edouard Untersteller
0.3	Submitted to Alain Krief, ELeGI partners	Edouard Untersteller
0.4	Submitted to Claude Laurenço	Edouard Untersteller
1.0	Revised in response to comments from Claude Laurenço, Fred Neuman Submitted to Alain Krief, Catherine Colaux	Edouard Untersteller
1.0.1	Additions from Alain Krief included	Edouard Untersteller

Project Definitions

0 SEES Glossary

Term	Definition
Antonymy	Relationship between the top-word and a term (antonym) having an opposite meaning. Ex. `subtraction` is-antonym-of `addition`
CML	Chemical Mark-up Language; http://www.xml-cml.org http://wwmm.ch.cam.ac.uk/moin/ChemicalMarkupLanguage
EnCOrE	Encyclopédie de Chimie Organique Electronique
Holonymy	Relationship with terms pertaining to a super category constituted as a whole by parts including the top-word category. Ex. `skeleton` is-holonym-of `bone`
Hyperonymy	Relationship with terms (hyperonyms) pertaining to more generic classes that contain the top-word class. Ex. `limb` is-hyperonym-of `leg`
Hyponymy	Relationship with terms (hyponyms) pertaining to more specific classes included in the top-word class. Ex. `arm` is-hyponym-of `limb`
iDOC	interactive Dictionary of Organic Chemistry
IUPAC	International Union of Pure and Applied Chemistry
Meta-language	A language or vocabulary used to describe or analyse language.
Meronymy	Relationship with terms (meronyms) pertaining to subcategories that are constitutive parts of the top-word category. Ex. `finger` is-a-meronym-of `hand`
Speech Acts	To be understood while using instant messaging is the main preoccupation of first time users. Misinterpretation of message content is frequent since the non-verbal information is missing. Use of 'emoticons' is an adaptive response to this problem, but emoticons are missing in context of scientific dialogue (accept, controvert, ask, explain, estimate...). Our proposition is the explicit labelling of speaker's intention, giving its speech act a category related to the intended position of its message into the rhetorical structure of the discussion. The sending act is the act that we propose to give the speaker an opportunity to label, in order to improve chance for the recipient to rapidly focus on the intended signification of the message, the ‘speech’.
Synonymy	Relationship between terms (synonyms) that can be substituted to the top-word producing the same meaning in one or several contexts.
Technolect	**Technol**ogy dia**lect** or specialized language in use within a community of practice, for example in a scientific domain or around a specific technology.
Virtual Laboratory	Computer supported collaborative environment for scientific work, including shared document edition, interactions within a virtual community, search through virtual libraries, organisation of writing

	activities on a virtual desktop, and publication. If virtual laboratory is usually understood as computer simulation of 'natural' processes, here, real individual and social working processes construct the scientific contents in computer mediated 'virtual' space.

Project Drivers

1 The Purpose of your SEES

1a The user problem or background to the project effort

As a part of Chemistry, Organic Chemistry produces its own objects of study through chemical reactions. Chemists are able to synthesize most of the compounds, even those which possess complex chemical structures including unknown ones, using rules, similarities with known facts and their own perception. Senior chemists are also able to share their knowledge and to educate adequately the youngest both at the experimental and conceptual level.

Organic chemists perceive their subject as intellectually highly structured, with many interconnected ideas. There are many quite different ways of teaching/learning it, because there are many starting points, but the end result is often the same - a broad understanding and a shared but to outsiders opaque language. The sense of logic to the interconnected ideas disguises the fact that there is a serious problem in making the subject truly systematic.

This is probably why senior chemists recognize difficulties in sharing their comprehension, especially in case of knowledge dissemination using electronic media. In fact building connections between the scientific experimental level and chemical equations, textual explanations and models in order to get an integrated expertise have not yet found an explicit expression.

These difficulties find probably their origin in several factors which lead to a set of ambiguous statements hard to exemplify and ineffective for knowledge sharing:

- Huge number of known substances which can be involved in each single generic chemical reaction;
- Necessity to talk about substructures restraining the vocabulary size to a reasonable magnitude while schemes are the only representation of adequate intricacy;
- Gap between the internal complexity of reactions (type and roles of reagents, solvents, catalysts, their ratio and concentrations, physical conditions, etc.) and the apparent simplicity of the chemical equation;
- Important influence of the context on the meaning and the understanding.

As a consequence of these facts, a project was launched: EnCOrE (<u>En</u>cyclopédie de <u>C</u>himie <u>O</u>rganique <u>E</u>lectronique) as a result of an inter-disciplinary, international agreement involving several scientists and departments.

1b Goals of the project

<u>*Summary*</u>

From the general vision of the EnCOrE project depicted in goal 0, an preliminary objective for the SEES n°2 is proposed as goal 1, i.e. conception of an interactive Dictionary of Organic Chemistry, an informal learning resource produced by collaborative construction within a virtual laboratory on the Grid and interactive evolution on the Web.

<u>Introduction</u>

As a science of complexity, Synthetic Organic Chemistry relies mainly on its semantically rich language, a dual language that includes first a traditional scientific language based on morphemes borrowed from various ancient or present languages, and on the schemes based on chemical structures. Schemes are at an intermediate level of representation between reality and language. This intermediate level is an adaptation to the primary goal of chemical language: to apprehend a non-visible reality, before any attempt to accurately predict outcomes of complex chemical phenomena. Learning this language is traditionally based on a mostly implicit human-to-human transmission, guaranteeing adequate reception and interpretation of context related meaning to associate with verbal or non-verbal signs. Development and use of information services requires (1) to allow some of this human-to-human transmission to occur via computer mediation (2) to gain a deeper formal knowledge of this language. These are the general objectives to be attained along the project development, hopefully guided by the following goal analysis.

Goals

Goal 0 General objective of the EnCOrE project is « learning and training of students and researchers in Organic Chemistry » by use of an intelligent information service based on an e-encyclopaedia.

Scientists will develop EnCOrE by working together on the Grid, in a 'private' virtual laboratory [Goal 2] dedicated to production and maintenance of encyclopaedic informal learning resources, and their related lexicographic, semantic [Goal 1], and ontological resources. Measurement of this goal is the production of scenario and methodologies associated with existing and developed technology that will contribute to the design of an original architecture for an e-encyclopaedia. EnCOrE will be a service allowing synthetic organic chemists to produce contents at the scientific level, allowing transmission of knowledge inside and outside the community, enhancing learning of students along their information searching activities.

Goal 0.1 To develop a representative shared vocabulary for knowledge organisation in Organic Chemistry

As a prerequisite towards previous goal [Goal 0], we need a shared vocabulary to build a conceptual structure of the encyclopaedia. Shared vocabulary construction requires inventory and negotiation of adequate names for concepts, and eventually creation of new names for concepts that are not currently explicitly identified. This work involves learning for chemists about their own language [Goal 5] in response to current worldwide sharing and computer mediation constraints. The shared vocabulary will constitute the required and presently missing reference to build ontologies [Goal 0.4]. It will also support advancement towards integration of textual and structural facets of chemist's language [Goal 0.2]. Development of a dictionary [Goal 1] will be the mean to achieve this goal.

Goal 0.2 To design the EnCOrE querying interface using chemist's natural language, integrating chemical structures into a text based query

Through its search interface, the service will allow user to construct interactively her/his query, helping to access knowledge resources like dictionary articles, encyclopaedia articles, experimental data, published dialogues, and forums. Support from a shared vocabulary [Goal 0.1] will allow informing user about ambiguity from query terms (text / chemical structure). Support from ontology [Goal 0.4] will drive the query interactive construction. Interactive search towards association of words and/or generic questions to chemical structures will greatly enhance query building.

Goal 0.3 To construct an interface that would enhance input, retrieval, and visualisation of chemical reaction information from databases

Each chemical scheme is a hierarchic representation of a collection of chemical actors with connectors ('+' and the reaction arrow). These chemical actors are substances when scheme pertains to a real reaction example. Attribution of roles to each substance is not fully explicit in databases, and roles attribution may change with the user viewpoint (for example, one may search reactions where THF reacts and reactions where it doesn't. one. In the query process, user will select or design an outline structure (user viewpoint) that will drive individual and global organization and presentation of results. Chemical schemes would be generated from reaction data to visualize results under the user viewpoint along with the original scheme. Advancement towards ontology development [Goal 0.4] is necessary to reach this goal.

Goal 0.4 To construct an ontology of formal representations for chemical processes and their participants allowing analysis and efficient classification of each reaction example under several formal viewpoints.

Formal viewpoints over chemical processes will enter the shared vocabulary [Goal 0.1], and, at the same time, as a framework, they will also structure the related dictionary [Goal 1] and contribute to its harmonious development. Example of few formal viewpoints are: (a) Equation (formula to formula) (b) Redistribution (atom-to-atom mapping) (c) Generic Reaction (d) Named Reaction (e) Mechanism (f) Catalytic Cycle (g) Functional Group Interchange (h) Reactivity Table (i) Synthetic Scope Table (j) Multi-Step Synthesis (k) Retrosynthesis. Reaction participants or 'chemical actors' will be classified according to their role and category under each formal viewpoint. Process related concepts will be named under the appropriate formal viewpoint.

Goal 1 To design and launch an interactive Dictionary of Organic Chemistry (iDOC) as an EnCOrE component

iDOC will be centered on the chemical reaction language, initially directed towards construction of a shared vocabulary [Goal 0.1], intended to become a reference to initiate ontology construction [Goal 0.4], .

Goal 1.1 *Structure and text interface*: to design and to test an interface for 'word from scheme' and 'scheme from word' information requests, first, on the dictionary content, and second, on the encyclopaedia content.

Goal 1.2 To give words found in scientific literature their domain specific meaning (Synthetic Organic Chemistry), and to identify and to define concepts for EnCOrE encyclopaedia

Goal 1.3 To define a XML representation structure for domain specific chemical reaction schemes

CMLReact is under construction by CML promoters (Murray-Rust, Rzepa) but even if it might become a standard, chances that it would fit requirements of the rather small synthetic organic chemists community are small. Several distinct kinds of schemes are found in chemical literature, and should be described from the same standard.

Goal 2. To design and to set-up an informal learning service on the Web based on a virtual laboratory on the Grid (publication vs. collaboration network)

To build an informal learning service where chemists will learn about chemistry seen under the information viewpoint, constructing interactively the information structure from essential concepts eligible to build consensus based ontologies, enriching and feeding future evolution of knowledge resources available by exposition of area of controversy

The informal learning resource published on the Web is the dictionary that chemists will construct collectively from chemical literature resources shared in a peer-to-peer 'private' network, following their workflow, and through constructive interactions. Learning means learning of users when they search the dictionary, and learning of authors about their own language and about techniques and concepts required to contribute to the dictionary. See Goal 2.3.

This goal relies on advancement towards Goal 2.1. Experience accumulated working towards this goal will contribute to advance towards Goal 2.3.

Goal 2.1 To design and to test workable remote collaboration technologies for chemists and to integrate them into a workflow

This goal will contribute to reach Goal 2. Remote collaboration technologies that are likely to help are enhanced presence, private and shared memory of agent interactions, forums, messaging and instant messaging, shared editing of a document, versioning technologies, audio and video conferences.

If we need to focus on a core, it would be the interface surrounding a document, from where an author would send message about it, or would initiate an instant messaging conversation about it, and from where a reader would participate to a forum about it. Use of video and audio mediated presence or conferencing is important but can be seen as an option offered to participants. Their use would be promoted by definition of a model workflow, as a groove in which further contributors would discover why and how each communication channel could be used (tutorial).

Goal 2.2 To integrate communication tools to promote interaction between users (or user and artificial agents) and to promote their use as the source of data, information, and knowledge

... each time it is required to set-up the information service, either 'as it is' or after rewriting, re-recording, keeping the dialectic template as the basic information structure. See Goal 3.

Goal 2.3 To promote computer mediated remote constructive interactions in the scientific context

To move further from extensive use of e-mail and attached documents, eventually using the revision mode in Microsoft Word with little chance that the other can manage this complex edition feature, propositions in this scenario are 1) visualization of consensual and controversial zones in the document, i.e. a dictionary article 2) addition of comments attached to the document elements 3) explicit typing of speech acts in scientific instant messaging See Goal 3.

Goal 2.4 To contribute to the development of a generic tuneable scientific service from Goal 2

Genericity of the service requires ability for the new community of users to define their own documents structure and presentation, to change the interface language and the assistance system, to define their publication workflow, etc. Scalability of the service requires growth of the storage capacity along with the number of participants [peers] and growth of the maximum number of simultaneous clients supported by the server and its mirrors.

It would be used in every domain having a need to develop a common dictionary or a glossary, or other shared resources of informal learning. Reformulation of the service description would be:

'An information service with a virtual shared laboratory in an underlying shell where scientists or authors will construct collectively an informal learning service from a shared corpus of reference, following a publication protocol, leading to publication on the Web, welcoming addition of comments once published, allowing evolution of the contents'

Goal 2.5 To develop models to enhance informal learning involved in conception and use of the dictionary

See Goal 5, and Project Related Learning

Goal 3 To promote use of written dialogues in the scientific context

Written dialogue is seen as a guide for writing and for planning. As a file, written dialogue is always stored and can be easily reused [accessibility scale: i) to participants only ii) to peers in the virtual laboratory iii) to everyone]. It can become a 'document' after publication "as it is" or after rewriting and referencing. Due to its dialectic structure, it is potentially a rich knowledge resource about the service use, evolution, content, etc.

Production of written dialogues through computer mediated communication stresses the linguistic capabilities of participants to adapt their 'speech' to this new situation, to fit with the rate of typing, to ensure good reception of their message. One way awaiting exploration is the introduction of typed speech acts that will structure text by constraining agents to enter into an explicit 'scientific social game' based on proposition, acceptation, controversy, asking, explaining, questioning, estimating, and delaying.

Goal 4 To design a dictionary structure helping future production of ontologies, helping ontology documentation and facilitating cross-referencing between ontologies

A dictionary can help ontology production in several ways: (i) delimitation of explicit zone of consensus in the dictionary (ii) structure of the dictionary article promote identification of important relationships between terms (synonymy, antonymy, hyponymy, hyperonymy, meronymy, holonymy, etc) (iii) significations of polysemous words can be discussed and organized in the dictionary before choosing terms in the ontology referring to the adequate meaning.

Goal 5 To drive 'meta-technolect learning' or learning associated with study and use of language of a scientific domain (synthetic organic chemistry) in the dictionary (iDOC) – in complement to study of concepts, theories, and results in the encyclopaedia (EnCOrE) – and directed towards enhancement of information and communication by computer mediation

A way to drive 'meta-domain learning' for juniors would consist in practicing within their virtual laboratory, to define a word, following a method proposed by seniors (dictionary editors), allowing interaction with other juniors, and their professor, their work eventually ending in the 'primitive soup', the public junior's dictionary where seniors will learn much and may borrow starting material to construct the published senior's dictionary.

Goal 6 To design a generic dictionary structure fragmented into units allowing comprehensive storage, selective and tunable visualization, and facilitating contribution

An electronic dictionary can store various facets of word related knowledge, and separation of the article document into fragments leads, by application of appropriate filters, to selective visualization of several kinds of dictionary: a translation dictionary if one select only translation elements, a synonym dictionary if one select only synonym element, a citation dictionary if one select only example elements, etc. Cutting the dictionary article in rather small elements ease evaluation of content, augments chance to collect helpful reader comments and to converge towards a representative piece of collective writing.

1c Opportunities and "return of value"

EnCOrE should represent a free entry to specialized knowledge in synthetic chemistry, introducing unique search system integrating textual and structural forms in the query, and interacting with user to assist elaboration of query, using iDOC as a reference for written language, and interaction between text and structure in language.

EnCOrE will enhance use of scientific information resources in organic chemistry, eventually revealing new area of knowledge by showing interconnections that we are not aware of, after comprehensive cross analysis of textual and structural datasets.

As a precursor, EnCOrE may promote free access to scientific literature in a domain that is quite conservative.

IDOC will contribute to elicit the conceptual frame required to define conventional and essential standard representations for chemical reactions and to shape "fuzzy concepts" in synthetic chemistry.

Initially dedicated to chemists, development of SEES'2 service would be an opportunity to design a generic tool for the important activity of building dictionaries in other domains. Supporting dictionary construction and evolution as a service, the envisioned technology would benefit to any domain having a rich language to analyse, knowledge to share within and outside the community. It is also an opportunity to elaborate and disseminate methods and software to enhance remote scientific collaboration.

Dictionary should help in construction of ontologies, and thus, it would be a key step towards assistance and automation of information search processes.

Studies directed towards reusing of scientific correspondence would be an opportunity to set-up methodologies to promote dialogues or forums as an efficient source of meaning and knowledge for a third party seeking information by computer mediation.

Development of XML as a data representation language would allow to constitute a document standard including both text and chemical structures in the same file, it would be a major advancement for the chemical community, rendering searchable on the Web most of the current structurally based chemical information hidden behind proprietary databases or in chemical figures and schemes stored as images.

2 Client, Customer and other Stakeholders

2a The client is the person/s paying for the development, and owner of the delivered system.

The 'delivered system' has been understood either as 'the service' (the dictionary service that is not reducible to a product) or as 'the software and maintenance' that would support 'the service'

About 'the service', funds for its very initial conception have been provided so far by FNRS, FUNDP [Partner n°19], CNRS [Partner n°20], ICSN, and European Union (by ELeGI).

For developing content and maintaining 'the service' {for author contributing in content, editor managing, and administrator setting-up and maintaining the service}, funds should come from the concerned community. For chemists, one can imagine to obtain funds from a hypothetical iDOC or EnCOrE society collecting funds from chemical national and international societies, and chemical industry corporations.

Concerning 'the software', question of ownership is open at this stage. The European Union (EU) is a good candidate for ownership since (1) EU will be the main financial contributor to the software development (2) As an international institution, EU would promote dissemination of the developed software within scientific communities.

2b The customer is the person/s who will pay for the SEES' service.

Consultation of the service should be free of charge* for individual end-users. However, for construction and maintenance of the service (the dictionary authors, editors, administrators), funds may need to be collected. Customers that may supply funds to develop service content are university libraries, national chemical societies, international chemical societies (IUPAC), or chemical corporations (Sanofi-Synthélabo).

(*) Value of a dictionary is generally much higher than the one of a typical scientific publication; simply since much more are likely to use it. Still, especially at the beginning, an author might expect less benefit and more criticism from contributing to a general article in an unknown dictionary rather than to a specialized paper in a well known scientific review. Thus, the need to give authors and editors a retribution for their work is an open question. Retribution rises two questions: 1) Piece based payment of an article doesn't fit with the open and dynamic nature of the dictionary (product vs. service), payment would then correspond to service given in setting-up or maintaining an article, as an author or as an editor, etc. 2) Access to the dictionary should be free to ensure its growth and guaranteeing its legitimacy to represent the community, thus collecting funds should occur at a collective level rather than at the individual end-user level.

2c Other stakeholders

National research foundations like FNRS (Belgium) and CNRS (France) may participate in the conception and technical maintenance of the service.

National foundations wishing to promote their language may also fund translation of terms defined in the dictionary.

Expected iDOC or EnCOrE contributors will come from academic institutions (researcher, assistant professor, full professor) or chemical industry (research scientists), they will create content as they already contribute to specialized scientific publications, without expecting much financial retribution, although some retribution might be necessary, especially at the beginning.

Few individual potential EnCOrE contributors are following:

- Bertrand Castro (Professor, Sanofi-Synthélabo)
- Ian Fleming (Professor, Cambridge University)
- John A. Gladysz (Professor, Erlangen University)
- Floris Rutjes (Professor, Nijmegen University)
- Pierre Sinaÿ (Professeur, Ecole Normale Supérieure)
- Emmanuel Theodorakis (Associate Professor, University of California in San Diego)
- Boris Vauzeilles (Chargé de recherche, CNRS)

3 Users of the Service

3a The users of the service

Users for the service envisioned in SEES'2 are 'chemists' or 'scientists asking questions pertaining to chemical synthesis'.

For the generic service, users would be 'scientists' or 'authors' or 'community members' depending on level of genericity reached by the software.

Chemists - users and their general behaviour

The following assumptions are based on a personal observation of Synthetic Organic Chemists (designed here after as 'S. O. Chemists' or 'Chemists' for short) behaviour and few interviews. Emphasis is on information resources that they use or would not use. [We plan to complete this study by submission of a questionnaire to chemists to verify if these assumptions are valid, and to learn what would be the chemist anticipated behaviour when faced to the project goals, methods and technologies]

- Junior and senior S. O. Chemists use various and complex specialized information systems. These 'tools' control a specific apparatus in their laboratory (NMR spectrometer, UV spectrometer, HPLC controller, mass spectrometer, robot for parallel synthesis, etc.)

- Few S. O. Chemists have already conceived and built programs managing molecular formula related calculation, or have set-up bibliographic databases.

- Few S. O. Chemists perform molecular modelling calculations.

- Almost all S. O. Chemists are now expert users of presentation and molecular drawing software.

- Chemists write scientific publications without expecting retribution, but those who wrote a book usually expect to sell it.

- Chemists may hold patents for a few of their results.

- Chemists follow the current literature at the library or on their personal computer.

- Almost all chemists now use reaction databases to search what has been done around their project; they appreciate the huge amount of time saved in searching; but, as some of them complain, they regret the lack of contextual information coming with query results, they regret that their searching mind now focuses on the various causes of human introduced system errors while they lost some use of their serendipitous finding eye that would allow learning while they were browsing paper volumes, they miss time to investigate further in the library; they sometime prefer to perform laboratory experiments before searching for precedents when required.

- Chemists attend symposia where they (typically, juniors) present posters or (typically, seniors) present conferences about their last results.

- S. O. Chemists discuss chemistry with others on blackboard or paper, and with difficulty by phone.
- Very few chemists use instant messaging in their professional activities.
- All chemists use e-mail, especially to write their publications.

3b The priorities assigned to users

Chemists - users described by abstract system roles

Summary: An Anonymous Reader can access the public version of the dictionary on the Web. Once identified, a user can select a role from those available according to its status in the dictionary. An Identified Reader can tune the service and follow up his/her own interactions with the dictionary community. Higher involvement in the dictionary with roles such as Author, Partner, Reviewer, Editor, Chief Editor, and Administrator gives access to a confidential sphere where the dictionary is actually made on a Grid-based peer to peer network, and that is called the virtual laboratory.

Reader (Anonymous or Identified Reader)

The expectations of Readers are to find a definition for a word, to initiate search of the dictionary by simple search of entries, by browsing an index, by a combined search of words present in the inner structure elements of the dictionary.

Inside the dictionary article dedicated to a word, they expect to find one or several clearly identified meanings, they expect to find comments to learn about the limit and the context of validity of each definition. More accurately, they expect to know in a meaning what is essential and subject to consensus, and what is a variation subject to controversy.

They expect to learn how they can enter the dictionary virtual laboratory by becoming an Author for instance.

Reader expects to submit comments pertaining to a section of the dictionary article that they will select in a tree representation of the document structure.

They expect to see public dialogues about a word sense or about the dictionary article.

Readers expect to see and to participate to forums about a word sense or a dictionary article.

Identified reader

Readers expect to be or not to be personally identified by their login and password. As an Identified Reader, they expect to have the ability to express their preferences for the service behaviour, to choose whether to see or to hide several article sections, for instance those that are still in progress, to select a profile to adapt the nature and number of the displayed section.

Identified Readers expect to be informed when, originally added as a background comment signalled by an icon on the dictionary article, their comment has been modified or moved by the article author or editor.

They expect to keep control of their comment, i.e. to modify or remove it from the public shell.

They expect to learn about the service publication license and to express their acknowledgement before publication of their comment (either once for all or each time).

Contributors

The contributors are much more than 'end-users' since they will mainly construct and maintain the service. They expect to have additional abilities to build and manage the *dictionary. They mainly produce and exchange information within the virtual laboratory.*

<u>Authors</u>

The priorities assigned to Authors are:

- to find a personalized working environment and allowing to ease the word meaning definition process
- to add items in the article example collection
- to organise the article content
- to edit and publish their dialogues
- to contribute to their article forums.

They will expect to find help to use the service, to understand what they have to do to construct the dictionary, to see a task sheet attached to their article project.

They expect to find back their previous work and interactions.

They expect to know how to reach a partner and when they can interact with her/him to discuss their work before publication.

They expect to know how to submit an article to evaluation by the dictionary contributors.

They expect to be informed when comments are added to their article, when inquiries are made for discussions about their article, when messages are posted into the article or in sense forum they are in charge of.

They expect to select and eventually modify from background comments, dialogues, and forum messages, those to be published at the front of the dictionary article.

<u>Partners</u>

They expect to be able to see the Author work before publication, they don't expect to modify the body of the Author work, but they expect to edit, modify and submit comments for any section of the article.

They expect to be able to schedule a dialogue by instant messaging to discuss about the article, to post a message to the Author only or to post a public comment in the article forum.

They expect to be able to modify their contribution to the dialogue before publication, and to express their agreement before its publication

<u>Editors</u>

Same as Partner but in addition the editor expects for the article s/he's in charge of:

- to invite Authors to write an article,
- to be informed when an Author submits an article to publication,
- to be informed of the corrections and additions made to an article,
- to read the article before its publication,
- to invite Reviewer(s) to read and judge an article,
- to control the publication state of articles,
- to edit the article task sheet,
- to see and propose items in the dictionary task sheet.
- to moderate the article forum

<u>Reviewer</u>

Same as Partner, but dictionary Reviewer expects to have a room where s/he can write, save, modify and post to Editor and/or Author a decision about publication an entire article or one of its sections.

Head Editor

Same as Editor, but can invite an Author to become an Editor, can manage the dictionary task sheet, can edit the roles available to contributors (in the 'name | login | roles' table), can invite one Editor to moderate the dictionary forum.

Administrator

Can do all that is required to solve any kind of problem in the information service, its main role is to maintain the service integrity, to manage the login list, to proceed with removal of pages that would contain offensive or irrelevant content.

3c User participation

In the specification phase, user participation will help to define more accurately the service functionalities. It has been planned to test a working situation between a dictionary Author and a Partner. The dictionary demo article will be accessible in an intranet; the Author will modify it while the Partner interacts by instant messaging (BuddySpace will be the instant messaging service). Expectation from this testing experience is to know if and how chemists can actually collaborate on a document from remote places, with effective use of written dialogues and will allow to set-up a method based on authentic procedures. Insertion of text extracted from authentic written dialogues, as comments or scientific conversations will enhance the original model document and will involve user in the service definition.

When the service will be functional, users participation will be essential, since in the service perspective, contributors are users. They will participate to service evolution through their comments (see reader's priorities) or by entering the virtual laboratory as authors, partners, reviewers, or editors.

Project Constraints

4 Mandated Constraints

4a Solution constraints

A specific requirement for chemists is to be able to see, to search, to draw, to store, and to exchange chemical structures and reaction schemes, especially in the context of instant messaging since this functionality would be an attractive innovation. Chemical structures and reaction schemes will be part of the dictionary and might be used by chemists to find words.

In EnCOrE, molecular modelling computation using the Grid functionality will allow the user to compute and visualize 3D molecular structures. In general, each time an author would submit an article where chemical computation was performed by some freeware, the service would allow the reader to actually perform the computation using the Grid.

4b Implementation environment of the current system

Synthetic chemists use both Windows and Macintosh environments on their personal computers, this may lead to the conclusion that Java technology may be the most appropriate, or may be not? (We lack the technical expertise on this point).

Use of XML as a data representation language would allow to constitute a chemical document including both text and chemical structures in the same file (using CML, and its variants like CMLReact that remains however to be fully defined.)

A server already hosts the EnCOrE project presentation web site [http://www-encore.enscm.fr], it is located at ENSCM in Montpellier (Claude Laurenço's research group). The server will host iDOC demo version in an intranet section. Philippe Jauffret (Ingénieur de recherche, CNRS) maintains it.

4c Partner applications

Chemical drawing and visualisation software

ChemDraw, ISIS-Draw, and, ChemSketch are software for edition of molecules and reaction schemes. Basic versions of ISIS-Draw and ChemSketch are freeware. They allow import and export of molecules in various formats. One of the most widely used formats to represent molecules is mol, a 'matrix in a text file'-based format from MDL. JME is a Java drawing interface that also produces SMILES, a linear string-based human readable chemical structure representation.

An XML based format exists for molecules, it is named CML but it is not yet useful since common drawing tools cannot open yet CML files. Jumbo 3 use JME applet to draw molecules and can produce their CML representation, and allows also the reverse operation, i.e. produce a drawing in the JME applet window from a CML text (text must be pasted in a browser window).

One of the most popular tools to visualize molecules on the Web is Chime from MDL. However, if it is excellent to show animated 3D structures, the 2D representation is very poor. Marvin is a Java-based software allowing both 3D molecular model manipulation and 2D drawing for molecules and reaction schemes. It is free to include in open Web sites but it is not open source.

For synthetic organic chemists, 2D representation is the major one (since involved structures may be very complex, only 2D schemes allow rapid perception of changes in chemical structure and surrounding environment involved in reaction). Molecules in reaction schemes are drawn following tacit conventions for projection, with adequate orientation, with selection of explicit and implicit atoms, with use of group shortcuts, etc. In summary, there is a layer of presentation specific to reaction scheme that need to be applied to the juxtaposition of independent molecules, and that affect, depending on their role, each individual molecular representation and their position in the scheme. Each scientific publication has its own editorial preferences for presentation of chemical schemes, and provides parameters for one or several drawing programs.

Molecular modeling

Much software is available to perform Molecular Mechanics (MM) or Molecular Dynamics (MD) calculations, some of those can run on PC's and may answer synthetic chemist needs. One program recommended by Industry is CACHE from Fujitsu. Successive versions of the program MM1, MM2, and MM3 are mostly cited in academic contributions.

Chemical databases

MORESY is a reaction database developed by one of our partner (Philippe Jauffret, SIC laboratory, CNRS) and that can be accessed via a prototype java-based interface, to be installed on the client computer. Its original feature is its coding system that represents reactions by dynamic bonds (mapped relationship between reactant bond and product bond).

Retrosynthetic analysis

RESYN Assistant is another software developed by our partner (Claude Laurenço, SIC and LIRMM, CNRS) that is written in Java. Its purpose is to assist chemists in planning a synthesis. The program algorithms allow identification and classification of transformation features and of functional groups defined as a hierarchy of frequently encountered reacting substructures. It could be useful at the searching interface of EnCOrE, participating to the logical analysis of user query.

Knowledge structuration

MIDES is simple prototype software programmed in Java (Fabio Paraguaçu, Professor, University of Maceio). Its interface displays knowledge under four modes of expression, allowing to build a hierarchical tree of concepts, to link concepts with explicit relations, to make causal hypotheses about concepts, and to elaborate generic questioning schemata instantiated with concepts. It has been used in iDOC to conceive document structure of the model dictionary article. Its role in iDOC or EnCOrE would be to assist Authors or Editors to organise article content, to produce generic questions and answer to be used to assist the searching and learning processes.

Strength of MIDES is simplicity of use and its ability to explicit by relations, causal hypotheses, and generic question shemata, allowing expression of tacit knowledge otherwise lost in the traditional hierarchical document tree.

Weakness of MIDES is its lack of interaction with current standards of text document, blocking reusability of encoded knowledge. Missing features are to import a txt, html, pdf, ps or xml document into its hierarchical tree viewer, to save models as reusable XML files.

4d ELeGI related software

Tool	**Usage** (whether, how, why, by whom)
GRASP	
IWT	
Finesse	
Virtual Control Laboratory	
BuddySpace	At this stage, iDOC group has been set-up in BuddySpace for a few involved in dictionary conception and specification. As an instant messaging system, BuddySpace will play a significant role since written dialogues will participate in the dictionary conception as a

	building material, within the virtual laboratory, and, eventually, on the published dictionary as well. BuddySpace will allow memorizing written dialogues. Written dialogues will be eventually modified and published with the dictionary article or in the helping section of the service. For editor and authors, written dialogues, as a memory of interaction will also help organizing and driving dictionary conception.
Kmi Stadium	Maybe useful to present the dictionary to incoming users. Dictionary editors will explain (1) Structure of the dictionary in its reading interface (2) How to contribute to the dictionary as a reader or as an author (3) Methods to write a definition
Magpie	Loading the dictionary in the web browser like magpie loads ontology would allow anyone surfing on the web to access easily to the senses defined for word present in the dictionary. However, it would require careful analysis of word context to detect if the word has been used as a word from the domain or in another domain, or in the general domain.
Madkit	
Strobe	
Webra	
DYXWEB	Possible. It is a potential starting point to set-up the dictionary prototype collaborative site. Its use has two prerequisites: (1) development of the XSL file controlling the presentation of the dictionary prototype and (2) development of the DTD that controls the dictionary structure and the article structure. The question is whether several functionalities can be added or not: (1) integration of forums (2) integration of written dialogues from BuddySpace (3) role specific editorial abilities (4) evolution towards a dual Peer-to-peer / Web service (internal work in the virtual laboratory on a 'private' Grid network and publication on the Web)
...	

4e Anticipated workplace environment

The users (chemists, other scientists) will use the service on the Web under various computer environments, and from various countries and institutions. The work required from dictionary contributors is typically of the kind that scientists will do either in their labs or at home. The interface language will be English. When using instant messaging, the user may require knowing the other's local time prior to schedule a conversation or before attempting to interact with them.

Readers should be able to access the Web service without special installation (however, existing browser plug-ins like Chime, may be required). Contributors would access iDOC or EnCOrE after obtaining and installing a software bundle.

4f How long do the developers have to build the system?

This information can be provided after the detailed functional requirements specification.

4g What is the financial budget for the SEES?

ELeGI (EU) funds

The allocation of effort of partner 19 (FUNDP) in Work Package 4, estimated at task level and corresponding to the first 18 months of the project is 7 person-months.

Other funds

Funds from FUNDP and FNRS cover computer investment and travel expenses in and from Namur.

5 Test-Bed Design

5a Pedagogical / didactical approach

Approach	**Usage** (whether, how, why, by whom)
Collaborative learning, cooperative learning, social learning, project related learning	Learning is the main aim of an encyclopaedia. It will neither been done traditionally as in schools or universities nor as in e-learning models. In EnCOrE we will not favour the traditional "old fashioned" tutor-pupil-tutor relation. Encore is the teacher as well as the pupil. EnCOrE intents to favour learning in Organic Chemistry intuitively, at any time, at any age, at any level from beginner to highly educated research scientists. It should answer the questions via a powerful interface implying a mixed textual and substructure search engine with built in data-mining support. Knowledge is transmitted by using predefined context-dependant classifications available in various plans or through the dictionary (iDOC). Encore is also a pupil that will be feed continuously by the chemist community under the supervision of an internationally recognized editorial committee. New subjects will be continuously introduced at two levels (Junior and senior), as texts, chemical equations and new entries in the dictionary. At many occasions such as in building a new entry in the dictionary, emphasis will be put on the use of software's favouring a collaborative work between scientists through discussions, controversies and consensus phases. The minute of these dialogues will be part of EnCOrE and accessible through the dictionary. It is believed to be an original valuable teaching tool.
Constructivist learning	At many occasions, such as in building a new entry in the dictionary, the service will favour collaborative work between scientists through discussions, controversies and consensus phases. This will allow "teachers" to learn more. "Learners" will construct the answer by formulating his/her query. The answer is unique for each learner.
Experiential learning, active learning, Problem based learning (PBL)	
Personalised, individualised learning	
Ubiquity and accessibility (anytime/anywhere)	
Contextualised, adaptive, situated learning	
...	We intent to perform experimental learning through access to dialogues related to the construction of the dictionary. We also imagine allowing the "learner" to have access, via EnCOrE, to sessions in which a teacher, a learner and a candid scientist question an "author-teacher" on a specific subject.

5b Learning contents

What is acquired by learning, the learning content, is a mix of '*pure knowledge'* and *ability to perform activities* in relation with that knowledge. Learning is easy to define and to evaluate if juniors learn from seniors something that has already been taught many times or something that enable performance of well-identified tasks. Antagonistically, learning content is difficult to define when there is an intricate relationship between learning contents and the learner, especially when learning occurs for an undefined amount of time.

Learning content in EnCOrE deals 1) acquisition from knowledge contents 2) acquisition of metalinguistic abilities to use language of organic chemistry, in its traditional form or in new forms developed along with emergence of information technologies.

For juniors or seniors users searching a dictionary, knowledge eventually acquired is personal and unpredictable but is always made of small units, each time one understands and learns about word/concept meaning or about relationship between few words/concepts. As a metalinguistic resource, a dictionary helps in acquisition of the essential ability to find a word for an intended meaning in a given context. Other examples of abilities to be improved are, especially for juniors:

- to find a non-ambiguous word, to produce meaningful and clear sentences, avoiding misleading interpretations (knowledge of word meaning, inside the technolect and in general language)
- to know each concept origin, related rules and area of validity, and related key examples (knowledge of concept, mainly inside the technolect)
- to master the art of finding keywords to input in search engines, and using meta-linguistic resources like dictionaries or nomenclature and its set of rules, and ontologies in a near future.

For these abilities, acquisition occurs over a long period, by direct solicitation of social environment (laboratory peers or tutors), and by individual search from dictionaries or other reference documents.

In iDOC, process by which Contributors study words allows them to learn about their own language. It is not a kind of teacher learning since nobody knows accurately *what should be known* before they start, although what they search is intended to become *something that should be known*; it is not a traditional researcher learning since it does not pertain to the research community primary object of study; it is a researcher meta learning where *what would be said to be previously unknown* is seen with a shift in the object of study, from the primary object of research to the language itself that is used in its study. Production of this researcher meta learning activities would be dictionary articles, encyclopaedia articles, and ontologies.

Once this process is achieved, informal learning may occur when work is published. Then, Readers will eventually learn from the contributors work. Reception from readers will contribute to explicit *what has to be known* and *what should be studied* by feedback via comments and dictionary forums. A completed and commented article would thus be eligible to enter as learning contents as a reference.

5c User support

User of the service will log in to access to a personalized service. User should be able to access to his/her personal data used by the service and be able to modify or remove them.

User would be able to set-up a reading level parameter to control assistance in search and extent of information disclosed at first sight.

5d Training needs

Use of a tutor agent has been proposed to train users in their first use of communication software like instant messaging and videoconferencing (See 11c, Ease of Learning)

5e Organisational aspects

Specifications on this topic are in progress.

5f Economic aspects

Specifications on this topic are in progress.

5g Quality Aspects

Specifications on this topic are in progress.

5h Technology

Functional requirements to Grid technology	
Functionality	**Usage** (whether, how, why, by whom)
Mass calculation	
Distributed resources	
Peer-to-peer	To set-up a private network for work on the dictionary excluding the reader and involving author, partner, reviewer, and editor. The published dictionary would be on the Web; the working environment would be in a peer-to-peer private network. Sharing of bibliographic resources on the private network would be the basic principle to constitute the reference corpus for the dictionary. The peer-to-peer network should be kept private for at least three reasons: 1) the scientific publications to be shared are protected by copyright 2) in progress material should not be published 3) conversations between peers remain private unless they decide to publish them.
Discovery and brokering	
Metering and accounting	
Service Level Agreement Negotiation	A level value would allow reader to adapt number and nature of displayed elements
Monitoring	
Data, information and knowledge management	
Virtual organizations and groups	Two important levels of virtual organisation are 1) Editorial community 2) Reader community
Load Balancing	
Fault tolerance	
Advance Resource Reservation	
Notification/Messaging	Notification of article submitted to publication, invitation to write an article, invitation to a conversation, to schedule a video conference, etc.
Workflow management	For the Editor, the task is to monitor the publication process. For the Author, the task is to follow the article publication protocol
Certification	
Authentication, Authorization and Accounting (AAA)	The internal work on the dictionary is not public, and access to the dictionary requires the author to be identified, the right to access an article in progress is reserved to the author only, or to an invited partner (can see and add comments, cannot modify the article body), the submitted article can be accessed but not modified by reviewer and editor, the published article can be partly modified by adding comments and messages in forum, the

	published article body can be modified by entering a cycle of internal work initiated by the article editor or the dictionary editor.
Trust Management	
Digital and intellectual rights	Traditionally, dictionaries are a collective piece of writing, and the digital version would be as well. In fact, to sign a dictionary article would stop its evolution and is contrary to the essence of a language dictionary. A license like the one proposed by Creative Commons for open content might fit the project requirements. Acknowledgment of author contributions would be made for the whole dictionary and not at the article level. Sharing of resources protected by copyright in the private peer-to-peer network of the dictionary virtual laboratory may require a legal investigation.
...	

Communication and collaboration activities to be supported by Grid services	
Functionality	**Usage** (whether, how, why, by whom)
EMail	As a complement to other communication tools
Discussion forums	Forums will be attached to each article and to the dictionary. The editors will moderate public forum. Internal forums will not be moderated. Readers, Authors, Editors will contribute to the discussion about the dictionary use, structure, and content, about the sense defined in the articles. These interaction traces will allow authors and editors to correct and to adapt the content to the reader, to adjust the service to meet with user behavior.
Instant Messaging	For instance an Author request for help from a Partner via instant messaging. Readers would not use it unless they wish to be more involved in the dictionary construction. It will be mainly used between Author and Editor, Author and another Author, Author and Partner, Editor and Reviewer, Editor and Head Editor, etc.
Chat	
Audio conferences	May be used when videoconferences are unavailable.
Video conferences	Will be used in the virtual laboratory for editorial activities pertaining to the dictionary construction and evolution. Video broadcasting and video enhanced presentation (KMi's Stadium) may also be used in the recruitment and training of Authors.
Application sharing	The peer-to-peer based virtual laboratory environment should allow sharing of communication and collaboration activities, in particular to solve the difficulties in discussion about hardly printable information resources like an ontology in Protégé, an analysis made by ReSyn Assistant, a database system interface, a MIDES model, etc. For instance, working simultaneously in various computer environments, one would expect to see and to act on the shared application state while others would see the shared work, interact and request the 'hand' to do the job, would see and act on their own application state, would propose to share their application state, etc.
Shared editing of documents	Typically in the Author-Partner interaction about the dictionary article content.

Shared collection of structured information (databases)	The dictionary will be based on a corpus of texts from the scientific literature that will be accessible for internal work only (copyrights). Another important and specific kind of structured information are figures (chemical structures, ORTEP diagrams, other explanatory figures) and schemes (equation, reaction, transformation, mechanistic, retrosynthetic, and other forms accounting of structure to structure chemical transformation)
Shared structuring of knowledge (ontologies)	Not yet, only anticipated. The dictionary will be a first step towards ontologies, and its design will anticipate this in order to enhance future ontology construction.
Shared maintenance of knowledge (resource centres, repositories)	As a service, the dictionary should be dynamic in its essence, to allow its construction, its evolution and maintenance. It is a shared resource for a scientific and technical language (a technolect) used to access related knowledge resources (the encyclopaedia EnCOrE). The dictionary is a repository for meanings of words in the community. It is a resource centre for those who need a service to improve their use of their own language, i.e. those who search a meaning for a word or a word for a meaning, and eventually for chemists, words for a scheme and a scheme for words. In the term 'knowledge repositories' the word knowledge does not designate 'what the user wants to know' but, tacitly, 'what has been selected and organized to augment the probability to meet with interest of hypothetical users'. As a knowledge resource, an encyclopaedia attempts to integrate knowledge in a network of concepts, and try to account for a reality by illustrations and developments. Although sharing with encyclopaedia the word-based indexation principle, a dictionary (of language) is not a 'knowledge repository' but an essential component to enhance use of the language required to set-up and to access knowledge resources.
Shared projects (planning of tasks, timelines resources)	Interaction by instant messaging needs to be scheduled. The submitting protocol for article needs some timeline.
Collaborative simulations, games	
...	

6 Relevant Facts and Assumptions

6a External factors that have an effect on the product or service, but are not mandated requirements constraints.

Such factors may come up during the detailed functional requirements specification.

6b Assumptions that the team are making about the project

A single-article dictionary mock-up has been made [available on ELeGI Portal]. Several assumptions may thus have been made about this part of the project.

Functional Requirements

7 The Scope of the Work

Specifications on this topic are in progress.

8 The Scope of the Service

8a Service Boundary

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

8b Use case list

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9 Functional and Data Requirements

9a Functional Requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9b Data requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

Non-Functional Requirements

10 Look and Feel Requirements

Specifications on this topic are in progress.

11 Usability Requirements

11a Ease of use

Readers should be able to start using the service without reading any documentation, but will probably need some readings to go further. Installation of browser plug-ins to draw or visualize chemical schemes is already common in the community.

Authors should be able to set-up their private workspace in the virtual laboratory following simple instructions. Software should be easy to install.

11b Personalization and internationalisation requirements

International language and domain typography

The language of interface and content will be English.

Like other scientists, chemists frequently use many Greek letters and unit abbreviations from other languages like Å, the typical atom and bond size unit (10^{-10} m). Beside schemes, chemists may enrich text by using arrows to represent transformations: ketone → alcohol or **11** → **12**, to state a retrosynthetic relation between a target and retrons: **1** ⇛ **2** + **3**, to explicit reactions: $CH_3\text{-}CH_2Br + Mg \rightarrow CH_3\text{-}CH_2MgBr$, to explicit mesomeric forms: $^{+}CH_2\text{-}CH{=}CH_2 \leftrightarrow CH_2{=}CH\text{-}CH_2^{+}$, etc.

Configuration according to system roles

Identified reader

By login and password identification, readers may configure service according to their preferences, changing the service behaviour, presentation and displayed content. For example, they may select a profile to adapt the nature and number of displayed element (see Goal 6), or build their own profile according to their needs.

Contributors

Authors

The priorities assigned to Authors are to find a personalized working environment and allowing to ease the word meaning definition process, to see a task sheet attached to their article project. They expect to find back their previous work and interactions. They expect to be informed of their partner's presence. They expect to be informed when comments are added to their article, when inquiries are made for discussions about their article, when messages are posted into the article or in sense forum they are in charge of.

Partners

They expect to be able to see the Author work before publication. They expect to be able to modify their contribution to the dialogue before publication.

Editors

Same as Partner but in addition the editor expects for the article she/he’s in charge of to be informed when an Author submits an article to publication, to be informed of the corrections and additions made to an article, to see the publication state of articles, Reviewer

Same as Partners, but dictionary Reviewers expect to have a specific room where they can write, save, modify and post to Editor and/or Author a decision about publication an entire article or one of its sections

Head Editor

Same as Editor, but can invite an Author to become an Editor, can manage the dictionary task sheet, can access and edit the roles available to contributors (in the 'name | login | contributor roles' table), can access and edit the 'forum | moderator name | moderator login' table.

Administrator

Can do all that is required to solve any kind of problem in the information service, its main role is to maintain the service integrity, to manage the login list, to proceed with removal of pages that would contain offensive or irrelevant content.

11c Ease of learning

Initiation to communication and remote collaboration technologies like instant messaging, videoconferences, and whiteboard is difficult since they require someone to interact with in the short but indispensable testing and training phase. A solution to promote use of these technologies would be to conceive an artificial agent that would interact with user in a tutorial. Since conversation with computers has not yet reached the level expected by otherwise brilliant filmmakers of the last century, the agent would simply drive 'conversation' by submitting tasks or dialog options to the trainee.

11d Accessibility requirements

Specifications on this topic are in progress.

12 Performance Requirements

Specifications on this topic are in progress.

Addition of new authors or editors to the peer-to-peer network should contribute to scale up the storage capacity. Their electronic library will contribute to a corpus shared within the 'private' working network (the virtual laboratory).

13 Operational Requirements

13a Expected physical environment

User will use their desktop computers (mainly Windows and Mac PC's).

13b Expected technological environment

Specifications on this topic are in progress.

13c Partner applications

See section 4c.

13d Productization Requirements

Readers should be able to access the Web service without special installation (however, existing browser plug-ins like Chime, may be required). Contributors would access iDOC or EnCOrE after obtaining and installing a software bundle.

14 Maintainability and Support Requirements

14a How easy must it be to maintain this service?

Public service maintenance

Minimum continuous fixed effort for service running is to guaranty Web access to the published documents. This implies maintenance of servers by Administrators. Indexes, and other pages allowing searching the service should be updated automatically when contents are added. The service home page should display information about the last changes, events, debates, etc. from automatic procedure and under supervision of a service Editor. Additional effort depending on the number of Readers is the moderation of article comments and forums messages, an activity devoted to each responsible (Author or Editor).

Virtual laboratory maintenance

An optimal ratio between Editor and Author should be searched and adapted to allow each Editor to manage the publication processes.

14b Are there special conditions that apply to the maintenance of this service?

The service (dictionary or encyclopaedia) should have an evolution mechanism allowing each existing article or new article to enter in a writing or re-writing phase in the virtual laboratory before being published or re-published.

14c Supportability

Specifications on this topic are in progress.

14d Portability requirements

See section 4b.

15 Security Requirements

15a Access requirements

Two main zones are concerned:

Zone 1. The Web Service

Access to the Web Service is public and either anonymous or identified. Only the public zone is available to readers. A private zone is accessible from the Web to contributors; it is called the virtual laboratory.

Zone 2. The Virtual Laboratory

In general, access is restricted to identified users under one of the contributor role. Inside the virtual laboratory, there is a gradation of access from zone 2A to 2C depending on the document maturity and expressed willing to shared discussions, etc:

Zone 2A is a private zone accessible to the identified user only (work in progress, notes, etc)

Zone 2B is a private zone accessible to a set of identified users (discussion, shared work in progress, etc)

Zone 2C is a fully shared zone accessible to all in the virtual laboratory sphere but hidden from the web service zone (shared discussion, submitted work, forums, etc.)

15b Integrity requirements

If one modifies the internal organisation of an article, changing description or order in the description of senses, then one can affect another article content that would refer to the modified.

Thus, a mechanism to ensure coherence of the dictionary is required to follow internal cross-referencing. At origin of the modification, the source article responsible would be warned of the presence of affected pages elsewhere, and these affected pages would be automatically modified after simple acknowledgment of each of their responsible.

15c Privacy requirements

The virtual laboratory is a private zone dedicated to contributor work. Inside this private zone exists more restricted area for the working environment of each participant that would expect his or her privacy to be guaranteed, and would invite a few to share selected documents.

15d Audit requirements

There are currently no special audit requirements foreseen.

15e Immunity requirements

Specifications on this topic are in progress.

16 Cultural and Political Requirements

16a Are there any special factors about the service that would make it unacceptable for some political reason?

There are currently no special factors foreseen.

17 Legal Requirements

17a Does the system fall under the jurisdiction of any law?

The right for contributors to share copyright protected publications in the virtual laboratory zone may require a legal expertise (it exists an unknown limit to the number of virtual laboratory participants sharing a protected resource)

In the public Web service, introduction of published examples requires a citation protocol.

17b Are there any standards with which we must comply?

Organic chemistry nomenclature follows a set of rules published as standards by IUPAC. A program sponsored by IUPAC and developed by ACD Labs allows to automatically generating name from structures.

Another interesting initiative sponsored by IUPAC is the development of a coding system that attributes a unique identifying code to each chemical structure (IUPAC Chemical Identifier – IChI). The IChI system, intended to be free to use, should be an alternative to the Chemical Abstract Services Registry Number (CAS – RN) that allows identifying substances (borrowing of RN by information systems has been restricted by CAS).

Project Issues

18 Open Issues

18a Issues that have been raised and do not yet have a conclusion.

In a peer-to-peer implementation, to maintain integrity and access to shared material in the virtual laboratory imposes to set-up a relay mechanism that allow to let others access to shared resources even when the peer computer where resources are stored is offline.

One solution is to set-up a storage service that can be hired by peers or maintained by them if they have the material and abilities to do so (rather unlikely in the synthetic chemists community)

19 Off-the-Shelf Solutions

Specifications on this topic can be made after the functional requirements specifications in Task 4.3.

20 New Problems

There are no problems affecting current environments or existing systems foreseen.

21 Tasks

21a What steps have to be taken to deliver the system?

Step 1. To produce an intranet version of the Web service, as a working mock-up for the dictionary. It will show a "demo" article and will allow testing of interactivity offered to readers (comments, forums). It will also serve as a support to test available communication technologies to be integrated in the final virtual laboratory and to explicit protocols.

Step 2. To produce a prototype for the virtual laboratory as a peer-to-peer (Grid?) service allowing interactivity in relation with the virtual laboratory project content (dictionary or encyclopaedia or ontology): to edit articles, to enter a virtual presence sphere (BuddySpace, Hexagon), to add comments to article, to enter into dialogue, to contribute to forums, to perform and edit dialogues.

Step 3. To test installation of the peer-to-peer service for new users

Step 4. To produce several "Published" articles through interactive testing of the peer-to-peer virtual laboratory, involving few partners.

Step 3. To test and to define publication protocols, evolution behaviour of the service.

21b Development phases

Phase 1. Development and testing of the Web service mock-up

Phase 2. Development and testing of the Virtual Laboratory

Phase 3. Development and testing of publication protocols and service evolution

Phase 4. Testing and development of the service documentation

22 Cutover

Specifications on this topic are in progress.

23 Risks

Specifications on this topic are in progress.

24 Costs

Specifications on this topic are in progress.

25 User Documentation

Public trace of interactions between users will be a precious source material for building the service documentation.

25a The plan for building the user documentation

Several editors will be in charge of user documentation, for the Web Service, and for the Virtual Laboratory. They will contain a section of 'Answered Questions' made by organisation and rewriting of dialogues between previous author, partner, administrator, and beta testers of the system.

One solution to gather interactions about service use would be to identify request for service help from written dialogue with explicit speech act (for example, content of the typed speech act 'ask' or 'explain' contain an explicit reference to a service command or content (service URL)).

B) SEES #2
Feasibility Analysis

1 Specification Status

1.1 Summary of the goals

1.1.1 Goals

Goal 0 **General objective of the EnCOrE project is « learning and training of students and researchers in Organic Chemistry » by use of an intelligent information service based on an e-encyclopaedia.**

Goal 0.1 To develop a representative shared vocabulary for knowledge organisation in Organic Chemistry

Goal 0.2 To design the EnCOrE querying interface using chemist's natural language, integrating chemical structures into a text based query

Goal 0.3 To construct an interface that would enhance input, retrieval, and visualisation of chemical reaction information from databases

Goal 0.4 To construct an ontology of formal representations for chemical processes and their participants allowing analysis and efficient classification of each reaction example under several formal viewpoints.

Goal 1 **To design and launch an interactive Dictionary of Organic Chemistry (iDOC) as an EnCOrE component**

Goal 1.1 *Structure and text interface*: to design and to test an interface for 'word from scheme' and 'scheme from word' information requests, first, on the dictionary content, and second, on the encyclopaedia content.

Goal 1.2 To give words found in scientific literature their domain specific meaning (Synthetic Organic Chemistry), and to identify and to define concepts for EnCOrE encyclopaedia

Goal 1.3 To define a XML representation structure for domain specific chemical reaction schemes

Goal 2. **To design and to set-up an informal learning service on the Web based on a virtual laboratory on the Grid (publication vs. collaboration network)**

Goal 2.1 To design and to test workable remote collaboration technologies for chemists and to integrate them into a workflow

Goal 2.2 To integrate communication tools to promote interaction between users (or user and artificial agents) and to promote their use as the source of data, information, and knowledge

Goal 2.3 To promote computer mediated remote constructive interactions in the scientific context

Goal 2.4 To contribute to the development of a generic tuneable scientific service

Goal 2.5 To develop models to enhance informal learning involved in conception and use of the dictionary

Goal 3 **To promote use of written dialogues in the scientific context**

Goal 4 **To design a dictionary structure helping future production of ontologies, helping ontology documentation and facilitating cross-referencing between ontologies**

Goal 5 **To drive 'meta-technolect learning' or learning associated with study and use of language of a scientific domain (synthetic organic chemistry) in the dictionary (iDOC) – in complement to study of concepts, theories, and results in the encyclopaedia (EnCOrE) – and directed towards enhancement of information and communication by computer mediation**

Goal 6 **To design a generic dictionary structure fragmented into units allowing comprehensive storage, selective and tunable visualization, and facilitating contribution**

1.1.2 Comments

The goals of SEES #2 are ambitious and fits perfectly with the concept of “Service elicitation”.

EnCOrE will represent *a unique search system* integrating textual and structural forms in the query and would be also, an opportunity to *design a generic tool* for the important activity of building dictionaries in other domains.

The software developed in this framework will permit to enhance *remote scientific collaboration.*

EnCOrE seems to be a precursor by promoting free access to scientific literature. The domain being quite conservative; will the encyclopaedia be accepted well by the other actors of the Organic Chemistry ; industrials, laboratories, private companies, scientists… ?

1.2 Relevance of the initial specifications

The initial specifications are relevant enough to ensure a first step toward the next phase, i.e. the detailed software requirements specifications.

Some chapters would have been able to be informed; but globally all necessary information can be found in the document.

The actors of the sees are numerous and some could be regrouped.

2 Organisational and pedagogical feasibility

2.1 Overall summary

The learning scenario is very unique and innovative; learning is understood as a side effect of authoring and collaboration processes. The main focus is on collaborative work situations embedded into an environment where subject expertise as well as work situation and technology-related skills are integrated.

Complex virtual collaborative work situations call for new didactic models as well as powerful tools for synchronous and asynchronous collaborative work experiences. Therefore, this SEES will benefit from the results of other work packages of the ELeGI project and it will deliver highly valuable findings about technology integration and methodology adaptation for informal learning processes in a Grid-based environment.

The process-related achievements and findings of SEES #2 can be transferred to other subjects and knowledge-building processes and therefore contribute to valorizing the European learning communities.

2.2 Motivation

The main interests from the organisational point of view:

The main goal of SEES #2 is the conception of an interactive encyclopaedia for organic chemistry produced by collaborative construction within a virtual laboratory on the Grid and evolution on the web.

The main organisational interests are:

1. **Knowledge construction and dissemination** using electronic media within the chemist community.
2. **Expertise integration** by using different elements like scientific experiments, chemical equations and textual explanations and models.

Knowledge construction is a learning process. From this process, authors and other parties involved in the knowledge construction process will improve their subject knowledge as well as improve their work situation and technology-related skills, like communication, collaboration and ICT. Readers like junior scientists or students will profit from the delivered information for their own research and studies. The European community of organic chemistry in general will benefit from the e-encyclopaedia.

2.3 Organisational and pedagogical analysis

2.3.1 Learner/user-centred aspects

Summary of the analysis of the main motivational aspects:

Motivation is always a main factor for the success of any kind of learning experience. Motivational processes have not been fully specified in SEES #2, and we will summarise the factors that require further specification in the following.

Different user types require different motivational factors:

Identified readers will be motivated to use the service if a large number of entries of good quality can be found. Furthermore, in order to use the system, the user interface must be easy and intuitive to use. Information services to overcome possible knowledge gaps have to be a part of the encyclopaedia.

The authors will be motivated (they are professionals/researchers in the area) if some kind of reward (this can be financial benefit, reputation, a certification of their knowledge and competences) is introduced. Furthermore, experienced authors must support the authoring process. Authoring guidelines, workflow and timelines should be clearly defined.

Editors, reviewers and partners will be willing to participate if, again, some kind of reward is provided. The reward may be financial, or an effective increase of their personal knowledge and of their reputation, and a certification of their expertise.

2.3.2 Learning environment

Summary of the analysis of the main organisational aspects:

The learning environment has been developed according to user and subject needs. A more detailed profiling of the different users could deliver further important information for a better adaptation of the knowledge construction environment to the special needs of the different participants. The learning targets are well defined.

The necessary easy and intuitive-to-use user interface will support the different users to deal with the learning environment. However, more detailed support and guidance strategies as well as tools to help the users to deal with the system should be considered. This is even more important with regard to the high heterogeneity of the target group.

The clear definition of the roles of the different actors ensures a frictionless knowledge construction process. The interaction process among authors, partners and editors has been described. The negotiation and consensus methods require more detailed specification, since negotiation and consensus building will have a predominant role within the process.

Summary of the analysis of the main support aspects:

Effective and appropriate support systems for the different user types are specified in detail. This is absolutely crucial for the successful development of the encyclopaedia. In particular authors and reviewers must be strongly supported in their knowledge building and editing activities. Provision of technical support for all other users is extremely important.

Systems and services to support communication and collaboration among users are planned. The mechanisms to promote group building and cohesiveness are not specified enough.

The initial testing and training phase requires some add-ons; the simplified interaction practice with a non-human agent is not sufficient to train the different users with different ICT, communication and teamwork skills. The introduction of a tutorial or training session for the different targeted users should be considered.

Summary of the analysis of the main evaluation aspects:

A close formative evaluation system for the encyclopaedia building process is needed in order to identify the weaknesses and strengths of the work process. All users have to be involved in this evaluation process.

A quality monitoring process should be implemented to guarantee a high quality encyclopaedia. Content and delivery quality are the crucial aspects for reputation and use of the encyclopaedia.

2.4 Peer comments

We believe that the objectives of SEES #2 are organisational and pedagogical feasible. The Grid technologies allow the interactions among several resources and the collaboration among researchers.

We think that the achievement of a interactive dictionary will foresee a study regarding the knowledge representation and in this case the product of WP5 of ELeGI, regarding the knowledge representation will be very useful.

Furthermore the idea regarding the creation of a virtual laboratory on the Grid will allow to use concretely the advantages and potentialities of Grid, with a approach based on the collaborative work. Also in this case, the studies provided by WP5 of ELeGI will be able to be exploited; in fact they deal with didactical models for virtual scientific experiments (VSE).

3 Technical feasibility

Partners 19 & 20 propose to address in a first part, the goals 0 & 1 to achieve the realisation of the Interactive Dictionary of Organic Chemistry (iDOC). We think that these goals are perfectly reachable and feasible technically. However, it will be better for the overall project to realise also the goal 2 : ILS based on a virtual laboratory on the Grid.

The prototype of the EnCOrE project could be realised, in a first time, with the meaning of web services construction and in a second time with Grid services.

The interest of this testbed is that it uses services and not much more infrastructure; so it can be developed, implemented and tested on a restricted configuration of machines because of the “services oriented nature” of the application itself.

3.1 Summary of Grid functionalities required and Tools

- Peep to Peer
- SLA / negotiation
- VO and groups
- Notification/messaging
- Workflow management
- AAA

The Peer to Peer functionality will be used in a private manner to build the encyclopaedia. We remind that SLA means negotiation of the level of service, monitoring of the service, and finally evaluation of the achievement of the service level objectives. In the context of EnCOrE, the SLA could be useful for the determination of the level of functionalities or/and the nature of authorised researches.

The other Grid functionalities required are well detailed in the document (3) and are perfectly justified.

Molecular Modelling Computation will use the Grid functionalities and infrastructure to allow the user to compute and visualize 3D molecular structures.

3.2 Peer comments

EnCOrE intends to implement a generic tuneable scientific service which should be applicable for collaborative dictionary building in other scientific domains. This raises two issues: the ownership of the software and its flexibility. Ownership by EU has to be further cleared within the ELeGI consortium, as it regards software components provided by the ELeGI partners for the projects duration. But this a general issue for all SEES who need a sustainable use of ELeGI software. Concerning flexibility, the services must allow both generic and domain specific usage. For an intuitive and efficient use in EnCOrE, they should be as close to the chemists demands as possible (e.g. by integration of the shared editors with chemical modelling and visualisation). Other scientific domains may have totally different requirements. Therefore the developed tools must be highly configurable - probably being development frameworks, with a base installation and configuration for generic use. This will need a careful analysis and an additional workload should be calculated to satisfy the genericity.

The SEES intends to use a great variety of remote collaboration techniques (enhanced presence, shared memory of agent interactions, forums, (instant) messaging, shared editing, versioning technologies, audio and video conferences). As the intended users are also juniors using iDOC probably in a virtual seminar with restricted time for getting familiar with the collaboration software, we recommend a tight integration and harmonisation of these tools in terms of user interface and behaviour.

An In-depth view of the overall structure of iDOC and EnCOrE is required, before this feasibility evaluation can be completed. The level of modifications of software systems and/or prototypes can only be anticipated given the functional and technical descriptions of both available and new (aggregated) systems.

Concerning the question on the implementation environment, we think that Java will be the most appropriate technology for platform-independent frond-ends. On the other hand, the Grid technology applied in ELeGI will be based on GRASP which uses intensively Microsoft's .NET framework. Therefore some back-end services of iDOC will need this platform, too. An alternative for running all on the ENCORE project server may be to use a common GRASP implementation provided by an ELeGI partner.

Other platforms may be needed to integrate functionalities of 3rd party programs as services. The presented partner applications (MORESY, RESYN, MIDES, ...) need a broader description, particularly from the technological standpoint, which is essential in order to evaluate the technological feasibility of their integration. Experiences and implementation strategies developed in WP8 for the integration of commercial calculation and simulation software in VClab may help on that task.

For Molecular modelling, the program recommended by Industry is CACHE from Fujitsu. Successive versions of the program MM1, MM2, and MM3 are mostly cited in academic contributions. It has to be clarified, what run time platform is needed for CASHE, what feasibility options are for making it Grid aware for E-LeGI software architecture in terms of business value. In addition, modifications typically complicate the process of upgrading the system and require a considerable amount of rework.

Part IV: SEES #3a (e-Qualification)

A) SEES #3a
Analysis and Requirements Specification

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Version History

Version	Comments, Changes, Status	People
2	Final proposal – Step 1:	Guy Gouardères, Kazis Banyulis, Stefano Cerri, Liana Razmerita
2	Second proposal – Step 2:	G. Gouardères, K. Banyulis, P. Aniorte, S. Gouardères, Liana Razmerita

Project Definitions

1 SEES Glossary

Term	Definition
Cognitive Overload	We consider cognitive overload due to four types of causes: too much information, too much information demand, the need to deal with multi-tasking and interruption, and the inadequate workplace infrastructure to help reduce metacognition , from David Kirsh, A Few Thoughts on Cognitive Overload, in *Intellectica (2000)*.
e-Porfolio	The electronic portfolio differs from its paper cousin primarily in that the portfolio materials are created and stored in a digitized form with students often collaborating electronically on projects and sharing their work with other students and the instructor during the course of the semester. (Hawisher and Self in "Wedding the Technologies of Writing Portfolios and Computers" and from <u>Situating Portfolios</u> 308) . The ePortfolio tells its observers (authorized) what is valued by the participants who shaped it..
e-Qualification	e-Qualification is used to designate the successive construction of knowledge from an initial state of knowledge to an expert knowledge state through several reviewed states…Accrediting qualifications and recognising awarding bodies are at the heart of the global e-qualification process to ensure that there are a wide variety of high quality qualifications available to learners, and that these qualifications are reliable and true indicators of an individual's level of attainment in the subject concerned.
e-Assessment	According to D. Healey e-Assessment is marking student answers to free form, short essay questions. For Kenney-Wallace, a "mixed economy" with multiple-choice questions, machine-marked essays and multimedia material to analyse and comment on. The recent introduction of a formative test (called a "progress test") has only added to these challenges. Computerising the progress test offers obvious advantages to Dundee, particularly in terms of providing rapid feedback to students. However the progress test itself requires marking of free-text responses. Objective testing using multiple choice questions is not an acceptable option.
Application sharing	A software (or feature of a teleconferencing application) that enables the participants of a **teleconference** to simultaneously run the same application. The application itself resides on only one of the participants sites and can be controlled by anyone (one at a time).
Chat	**Synchronous** text-based communication between 2 or more participants who exchange messages by typing them on their computer. It is based on Internet and used in the framework of a **teleconference**.
cognitive characters	A social user modelling perspective (based on the study of personality) to complete the learner model of the student.
Collaborative learning	A pedagogical situation in which the learning process is based on the communication (synchronous or/and asynchronous) between learners. In Distance Learning, collaboration between learners and between teacher(s) and learner(s) implies the use of networked

	software to interact together with the same object The various types of asynchronous systems--e-mail, listservs, and conferencing--allow participation from different locales and at times convenient to the individual student. Synchronous tools, such as chat rooms, voice-based teleconferencing, or video conferencing, allow tutors and students to interact at the same time but from different places. Problem occurs when effective communication is *not happening virtually*, which is leading to fragmentation of a learning community with feelings of isolation and confusion among some students.
Computer-based Training (CBT)	The learning process is based on the execution of a special program (tutorial, instructional multimedia…) on a computer. The learner learns by dialoguing with this software (answering questions, making decisions, moving in a scenario, etc.), it can include more or less multimedia or hypermedia elements.
Computer Mediated Communication (CMC)	Communication based on the computers features (emission, reception, storage and routing of messages). CMC includes information retrieval, e-mail and computer conferencing
Computer Managed Instruction (CMI)	Software for the management of a **CBT** environment: users administration, evaluation, results tracking, resources management, etc.
Computer Supported Collaborative Work (CSCW)	It is a field of research that examines how technology affects group interaction, and how technology can be improved to facilitate this type of group work.
Open and Distance Learning (ODL)	Learning processed without the physical presence of the participants together (trainers and learners) and following flexible modalities (in term of location, time, rhythm, methods, etc.) to facilitate its accessibility.
Computer Managed Instruction (CMI)	Software for the management of a **CBT** environment: users administration, evaluation, results tracking, resources management, etc.
Learning Objects	The question of 'What are Learning Objects?' and draft appropriate answers has to be fulfilled by actors of the informal learning SEES with the aim to describe a datastructure which allows explicitly modelling diversity in the field of learning by including role-based attributes for each class of Learning Objects. (ref. Objects on the Semantic Web Explicitly Modelling Instructional Theories and Paradigms, byH. Allert, C. Richter, W. Nejdl)
P2P Networking	P2P Networking is an software architecture that enables other applications to use Peer-to-Peer functionality. A wider range of P2P-architected applications will appear and compete for attention with traditional desktop and client/server systems (see § 5)
Transactional distance	Moore (1993) recognized that in a course high in structure there is generally little dialog between educator and learner and transactional distance is maximized. Conversely, as dialog is increased, the structure decreases, thereby minimizing the transactional distance between educator and learner. Saba & Shearer, 1994 supported the concept that the distance between teacher and learner in distance education was not a geographical distance, but a pedagogical distance determined by the

	balance of structure and dialog.
Virtual classroom	A Distance Learning pedagogical situation in which a lesson is diffused to a group of learners not physically together with communication based on audio, video or computer tools. It tends to reproduce the traditional classroom.
Whiteboard	A software (or feature of a teleconferencing application) that enables the participants to work together on a common area of the display (writing, drawing and pointing).
Multiple-User Dialogue (MUD)	A virtual space where users can have real-time interaction with one another (in the form of avatars). **Chat** is the usual communication medium. The participants are communicating by sharing the same context and the main utilisation is for social role-playing

General Guidelines

2 Global introduction for SEES #3

2a The context

Nowadays the Web offers its users unequalled oportunities for teaching, learning and searching for information. Meanwhile access to work groups, communities of practice or virtual organizations remains difficult. Unless specifically being aware or registered, it is not always effortless for a net user to find a community that shares his centers of interest. Moreover, most information requests send back considerable volume of data that must be sorted out. More or less relevant information comes from distinct sources with different presentations or contents to assess. The variety of sources of information increases cognitive overload and transactional distance (Moore 1993), and therefore it limits to a certain extent the efficiency of web based training systems..

The trend of the research is the transition to the Grid model network; in this model computers are connected into a system more complex than Internet. This evolutionary new world should adapt its structure to the dynamic state of computer entering or leaving the Grid. In such a system, the nature of several services offered by Internet evolves and computer based training is transformed by the multiplicity of controls that occurs. Therefore, appropriate learning services for the Grid should be developed. The idea of **Grid learning services** (GLS) has been introduce by a collective of researchers as a part of the ELeGI project objectives (Gouardères 2004a) to study all these transformations brought by the new open distributed network.

2b E-Qualification as inevitable Grid Learning Service

advice and support must all be relevant, reliable and consistent. However, in most cases, institutions may not understand how to monitor and maintain quality in ODL context.
The objectives are to propose a new approach for quality insurance in ODL that we call e-Qualification and to implement it within the “advanced service-oriented Grid based software architecture for learning”.
Nowadays, accreditation is a part of quality assurance certifying the result of a quality assessment mainly for increasing Visibility and Reputation of the ODL institution.
As a first consequence, institutions wish to keep control of the quality issue in the e-learning process in terms of security, auditing and accreditation. Thus, the Quality Issue is usually measured in the end of the educational process (e.g. as the results of any evaluation test) and it is often too late.
This is why the original goal for e-Qualification - "defining and building generic Grid services for continuous qualification of human learning - remains for us the fundamental work within SEES #3.

There is an increasing need of the relations between technologies and human factors, that implies “Users in the loop” in order to identify, define, implement and validate on-line (i.e. real-time assessment) the quality issue according of both 3 dimensions: **The Social Dimension & Community-Definitions, The Technological Dimension, The Educational dimension**.

In this work, our main preoccupation will be the influence that multiplicities of resources and learners communities can have on Grid learning.

The focus question about applications based on Grid Learning Services is now: how a virtual community space can be built dynamically to limit cognitive overload and to reduce transactional distance?

This is the main reason why ELeGI has adopted ***a socio-constructivist approach***: learning in people is denoted by the learner's autonomous construction of knowledge, in a social context.

- The socio-constructivist approach applies both to learning domain specific knowledge and skills (eg: Physics, Chemistry, Training in Aeronautics, ...) as to learning transversal knowledge and skills (collective learning of how to collaborate: the Pays Coeur d'Hérault VIAD, collective learning on how to collaborate for building a specific Ontology: ENCORE, ...).
- The socio-constructivist approach applies both to Informal Learning (learning without a curriculum, out of formal "courses": VIAD, ENCORE are some examples ...) and to Formal Learning (the 2 SEES in Greece, but also the e-assesment work of OU that applies LSA to texts emerging from students engaged in a Open University).
- The fact that the socio-constructivist approach is adopted does not mean that it is equally understood by everyone. We are used to learning models based on curricula (we learn how to perform well in clearly defined situations: the curriculum defines them!) NOT on learning as a side effect of communication and collaborative processes. The last type of learning shows aspects that are really at odd with the previous one: for instance people "learn" how to be creative (in the class, or at the University there is NO way to measure and prize creativity, what is obviously more and more an essential feature for adaptation and for success in a rapidly changing Society, Economy…

Must e-Qualification be limited to informal learning?

According to the Vocational Evaluation and Career Assessment Professionals association (VECAP) and others international Educative Commission from UNESCO and ILO (International Labour Organization), the following seven principles have to serve as guides to best practice across settings.

1. A variety of methods, tools and approaches should be used to provide accurate vocational evaluation and assessments. A broad range of questions must be posed to determine what makes an individual, as well as his/her abilities and needs, unique. Separating an individual's attributes into categories, such as interest, aptitude or learning style preferences, help organize assessment.
2. Vocational evaluation and assessment information should be verified using different methods, tools and approaches. Using alternative methods or approaches to validate findings can usually be achieved by (a) observing an individual's demonstrated or manifested behaviors, such as performances on actual work; (b) using an individual's self report or expressed statements; and/or (c) administering some type of survey, inventory, structured interview or test.
3. Behavioral observation is essential in any vocational assessment process. Behavioral observation (e.g., observing physical performance, social characteristics, interactions with people and other aspects of the environment) occurs throughout the assessment process.

   The observation process can be
   (a) informal or formal,
   (b) occur in a variety of environments,
   (c) made by a variety of people and
   (d) should be documented and presented in an objective, non-biased manner.
4. Vocational evaluation and assessment may be an on-going and developmental process in career development. However, individuals, especially those with disabilities, may need evaluations/assessments of varying degrees given at different

junctures over their career lifespan.

5. Vocational evaluation and assessment should be an integral part of larger service delivery systems. Vocational evaluation and assessment should be the basis for planning needed services, resources and support. Therefore, it can be an integral part of the total service delivery system. Vocational evaluation and assessment information should be interpreted and conveyed to the consumer as well as others within the system.
6. Vocational evaluation and assessment requires the collection of input from a variety of individuals and requires an understanding of how to use the results of the assessment process. An interdisciplinary team approach allows for the effective use of information which can be translated into effective planning, implementation activities (e.g. placements, support service, counseling) and fulfilled vocational development for consumers.
7. Vocational evaluation and assessment should be current, valid and relevant. Vocational evaluation and assessment is grounded in **career, vocational and work contexts**.

Conclusion for e-Qualification contexts: Informal learning contexts have to be extended to all contexts that have the purpose of training (where learning occurs as a side effect of doing something interactively). But, in every case studies, we leave to teachers and educationalist the job of giving sense to the measured difference between expected performance on tasks predefined by a curriculum (like in Asimil) and real performance on tests (like in TesTool).

In that perspective we intend to use e-Qualification as an embedded Grid Learning Service which give assessment reporting by "continuous monitoring" and the corresponding "continuous evaluation" for a continuous qualification and this for both informal and formal learning.
Because for both the two contexts "e-qualification requirements straight from the beginning" and the qualification process is equally crucial: in fact, it comes down to "design for testability" but not testability of the performance of the computer tools, but testability of the adequateness between the expected EFFECT of the tool on learners, and the real effect, as it is continuously monitored.

What to monitor, how to define the expected effects and how to define the difference between expected and monitored (measured) is the issue to attack the SEES #3. This will obviously be very different from a context to another SEES.
The pending problem to define the criteria for testability monitoring evaluation and qualification in scenarios of informal (or formal) learning, remain under responsibility of each team putting in place the corresponding SEES (like VIAD and ENCORE, for informal learning or Asimil and TesTool for formal ones).
What is expected from e-qualification objectives and outcomes is that a scenario independent architecture for the services associated to continuous evaluation and qualification is produced, and then the Grid services themselves to be associated to any scenario designed according to the testability requirements you have produced and transmitted to the SEES actors.

The needs and requirements from the SEES Actors must be validated by a Validation Plan (See § 11) to be useful to

- The electronic portfolio (ePortfolio) as basis for the building of a collective intelligence (individual-centered and socio-distributed): must be viewed as a local knowledge self-assessment prosthesis, and
- The e-Qualification process, which uses the reflexive outcomes (among others) from the "mirroring" in e-portfolio feedback to develop new services offered by agents for assessment and accreditation of learners (nodes) to qualify as members of an

organization.

To sum up: E-qualification suggests to estimate simultaneously (i.e. real time assessment) these three dimensions from an immediate feedback supplied by the Grid Computing technologies

a) e-Qualification is a SEES : i.e. a scenario, not a demonstrator
b) It is a scenario which meets the needs & requirements from informal learning
c) This scenario is unusual (particular) one because it aims to do assessment (in fact, to estimate) the outcomes and issues of other informal SEES like VIAD or ENCORE
d) Unfortunately, up to now, these SEES have not produced any outcomes or results. Consequently, to launch a concrete plan for SEES #3, we have to base the analyse on previous issues gained from the FP5 ASIMIL project, in the context or European VET (Vocational Environment for Training) as the most of innovative and futuristic perspective in e-Training (CF. Cordis Asimil FP5 Project (http://www.cordis.lu/ist/projects.htm).
e) Six international experts appointed by the EC - greeted the hudge efforts to standardize the concrete and operational prototype (: Domain (Aeronautics international norms like JAR or FAR), CBT (AICC compliant), Intelligent Agents (FIPA compliant), Distributed Simulation (HLA compliant) and Virtual Reality (VRML), Learning Objects (IEEE norms) and so one, …eventually, - consider as excellent the global performance of the prototype together with the formal assessment of the training process, but they have outlined the lack of unformal evaluation of the contexts and the global sides effects of socio-cultural considerations.
f) Why e-Qualification? Their conclusions put forward that performance evaluation (student e-assessment) is not sufficient to lend weight to unformal (and probably formal) accreditation of an e-Training system. Finally, most of the credible, holistic evaluation of e-learning has been based predominantly on an evaluative approach based on systems theory or using a positivist-rationalist approach. This is actually the case in most evaluations of VET programmes but the limitations of `systems theory evaluation' (feedback and error detection) may be more significant in e-learning than in traditional learning. The relevance of this approach, particularly at policy level should be challenged and alternative theoretical bases explored using some of the models generated by (Van der Knaap P., 2004), (Kirkpatrick 1975), (Hughes J. 1993, 2002) (Scrivens M.): *Evaluation lags behind because most e-learning programs are only evaluated at the lowest level of Kirkpatrick's classic evaluation model, simply finding out if learners (and sometimes instructors) like elearning (Rossett, 2001).*

2c Opportunities and "return of value"

The Educational Dimension

- We will develope new e-Portfolio concepts that we later use as technological frame for the evaluation of a virtual community auto-organization learning on Grid.
- New issues for oversimplified inherent problems on the web such as cognitive overload and transactional distance.

The Social Dimension & Community-Definitions

- The possibilities offered by the Grid as social organizer structure supporting human learning.
- The opportunity to "practice" as often as needed or desired with immediate, personalized, content-based feedback
- For the teaching institution: Quicker results, successive construction of accreditation scenarios,
- Obvious renown founded on tangible measurements of e-assessment efficiency and

accredidation issues

The Technological Dimension

- The improvement of the computer-Grid interactions and the versatility of knowledge sharing by and the proposal of a model of a Learning Grid interface
- GLS interoperability test-beds
- GLS composition as new services offered by agents test-beds

e-Qualification: Global surveys

Organization VLO and global identification of a group of people (Virtual Community).

The ILO (International Labour Office) from its InFocus Programme on Skills, Knowledge and Employability, Geneva, has enacted Revised Recommendation concerning Technical and Vocational Education[8] (2001). According to the selected objectives listed above, this Recommendation applies to all forms and aspects of education that are technical and vocational in nature, provided either in educational institutions or under their authority, by public authorities, the private sector or through other forms of organized education, formal or non-formal, aiming to ensure that all members of the community have access to the pathways of lifelong learning.

This implies that disseminated communities around the world should, through the exchange of good practices and methods, aim to apply relevant and appropriate internationally recommended standards and norms relating in particular to:

a) systems of assessment/evaluation;
b) scientific and technical symbols;
c) occupational qualifications and certification;
d) equipment and technical standards;
e) information processing;
f) equivalencies of qualifications implying standardization of curricula and testing, including aptitude tests;
g) occupational safety and security through testing of materials, products and processes;
h) environmental protection and conservation.

The main activity of the SEES #3 e-Qualification is project is an inclusive and comprehensive evaluation of several case-studies for the development of e-science in distributed virtual lab, Virtual Technical and Vocational Education at a distance, Virtual communities for sustainable environment training for e-Learning qualification conformance and quality assurance. The e-Qualification process is based on the emergent outcomes of a consensus-building exercise that draw upon the various approaches to qualification definition (applied both to users, software and organization evaluation and assessment) to guarantee good quality assurance practice currently used by a broad range of stakeholders in education and training in the public and private sectors.

In fact, in order to get to a comprehensive e-qualification framework, all the different "cultures of assessment and quality" of the different users groups (industry, academia, professional development, students, etc.) are invited to contribute to e-qualification definition not only in terms of technical solutions, but also as far as the different quality concepts, principles, habits and visions are concerned.
The e-Qualification SEES #3 outputs, apart from the establishment of the Learning Grid

[8] According to the purposes of this Recommendation "technical and vocational education" is used as a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. Technical and vocational education is further understood for informal learning to be: a-an integral part of general education; b-a means of preparing for occupational fields and for effective participation in the world of work; c- an aspect of lifelong learning and a preparation for responsible citizenship; c-an instrument for promoting environmentally sound sustainable development; d- method of facilitating poverty alleviation.

Qualification procees per se, aim at meeting the varying needs of two different groups of stakeholders.

The broad ELeGI virtual E&T community:

- Learners
- Teachers, trainers, practitioners and learning managers
- Policy makers
- Research actors

The European e-learning market supply side actors:

- ICT producers
- Design & development actors
- Publishers and multimedia/web producers

3 Overview of the Learning Grid and related e-Qualification Problems

3a Grid: a Virtual Social Organizer for Learning

The concept of Grid finds its origins in researches aiming the development of infrastructure for the high-performance distributed computing. The associated technologies were developed with the worry to share the latent calculation power of connected computers. So, the Grid appears like a complex set of interconnected computers comparable to a virtual macrocomputer. One of the objectives of this technology is the dynamic and secure creation of groups of coordinated individuals or institutions. That aggregation of computers representing relations between the nodes permits to compare the Grid to a social organizer allowing different groups to collaborate for common interests. They share a set of computer resources (materials, software, data or services) distributed on a local or wide area network independently of technological choices.

With the Open Grid System Architecture, many approaches to Grid have been design and many services have been considered (Foster & al. 2002). However several points remain to be solved in order to transform the Grid into a mirror of knowledge. These concerns are related to semantic Grid, ontological Grid:

- permit the identification and the aggregation of autonomous community from P2P to $(P2P)^n$, that we explain later,
- matchmaking construction of ontologies while maintaining their dynamic evolution,
- differentiate data integration from processes fusion,
- manage local and collective intelligence related to social computing.

3b Grid Learning Services for Virtual Leraning Communities

The current evolutions of e-Learning are more and more influenced by the large scale development of "à la carte" learning. As a consequence of the needs for ubiquitous learning, both the construction of content and the availability of “telepresence” have been substantially improved, stepping back from classical tutoring towards generic technology enhanced learning. With these objectives, the "Learning Grid" paradigm aims at making use of the collective intelligence and the personalized uses of a range of available and potential Grid services rather than just taking advantages of the performance capabilities and the multiplying effects of connectivity. Consequently, these services are significantly centered on exchange, negotiation and dialogue within and among virtual, evolutionary and pervasive communities, whose underlying universal driving mechanism is learning.

This ubiquitous learning, both collective and individual, involves actors (and machines) in shared universes generating more and more communications, but not necessarily better mutual understanding. Virtual universes may well emerge, worlds including simulations where one can only act by means of artefacts: the issue is to define and control the conditions for these virtual world to be effective sources facilitating human learning.

The human being might lose his/her cultural rooting, human relations, and sensitiveness. That is why this intelligence on the Grid should not develop independently from the socialization deriving from practice and uses but also, above all, without a particular care to the processing of emotion (emotional intelligence).

The ELeGI project lays particular emphasis on a synergic approach, sometimes called "human centered design", to replace the classic, applicative approach to learning. Nevertheless, this ethno-centered vision must be come with a techno-centered evolution of services, semantics and standards as a new class of components playing a prominent role in meeting pedagogical goals of novel learning situations. The way to meet this strategic and innovative breakdown follows the multiple paths of a global challenge:

- the collaboration in the Semantic Grid as a basis for e-Learning augments existing collaborative environments,

- the prominent role of ontologies which are used to exchange structure and promote enhanced process tracking forces reflections and agreements on the semantics of the concepts at hand. A dual vision mixes ontological competence for domain knowledge dissemination and retrieval with an ontology based user modeling approach for the personalization of Grid learning services as presented in (Razmerita and Gouarderes, 2004)

- the omnipresence of agents as an ubiquitous layer for dynamic service generation and deployment deals with multiple goals and assignments;

- cognitive environments as a structure to represent the partners in conversations embodying agent's knowledge evolution through time require new linguistic abstractions compliant with the separation between programs and their evaluation context;

- customizing the services for individual students supports the observation of changes in a learner's knowledge as a function of the instructional history as well as the reverse vision promoting Grid services as learning agents;

- the fusion of Grids and P2P networks as platforms for "novel" and "different" forms of socio-constructivist learning suggest new needs for mixed communication and computation architectures.

The macro-analysis of such a structure enables to remark that members of the organization can be geographically dispersed but they will reach resources for which they are authorized. So the virtual communities will only be created according to poles of interest that unite human users or software agents. In an educational context, we observe that registration is generally the means by which one adheres to a group (be it relevant or no for what he wishes to do), it must be put the trust in his hosting community. With the infinite number of virtual organizations that can exist on the Grid, changes of state (birth, growth, disappearance) for a group must be considered. Unless specifically being aware, it won't be easy for a user "U" to find a learning community (R1 or R2) that shares his centers of interest (figure 1). All users are Supplier and Customers are been working at the same time; they must identify themselves as such: that is the mirror effect. A "Matchmaker" process assigns every exchange to the predefined classes.

Grid learning services have been initiated to satisfy those constraints with particular goals to bear in mind: 1) content-access to educational material, 2) finding of relevant material, 3) detection of changes and trends, 4) providing of subjective view, 5) visualization of results and 6) reflecting changes in sharing knowledge.

As far as learning is concerned, with users who may be geographically dispersed, any solution should take into account related problems like cognitive overload and transactional distance. *See GLS04 Workshop at* http://www.itsconference.com.br/content/itsprogram.html

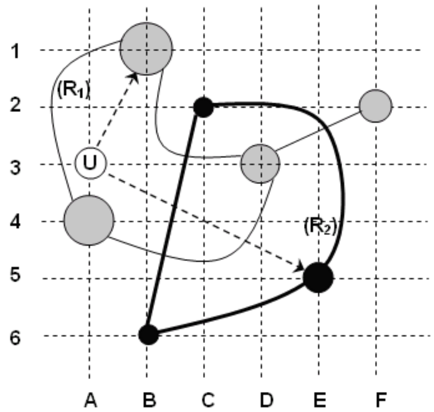

Figure 2. *Representation of two virtual communities $R_1(A_4, B_1, D_3, F_2)$ et $R_2(B_6, C_2, E_5)$*

Transactional Distance on the Grid.

With the substantial increase of information nodes and the multiplicity of computers that enter or get out of the Grid the utilization of that technology as a support for learning may convey cognitive overload or transactional distance during learning processes.

The origin of the transactional distance concept is assigned to Moore. In his works, he establishes that in distance learning, distance is not linked to the geographical separation between the teacher and the learner, which refers to space and time, but to the psychological space created between the teacher and the learner. He called it the transactional distance (Moore 1973, 1993). This new theory puts forward the hypothesis according to which transactional distance is a function of two variables: dialogue and structure. Dialogue refers to the nature and the quality of communications between the teacher and the learner while structure relates to the rigidity of the course, the organization of the instruction and teaching strategies.

Various reflections on Moore's findings have been issued. To illustrate the concept, Saba and Shearer have proposed a dynamic system model examining the relation between dialogue and structure in distance learning (Saba & Shearer 1994). They state that: 1- when dialogue increases, transactional distance decreases; 2- when the structure is complex, it reduces dialogue; 3- the more there is structure, the more the distance is increased. More analysis has been done and raised the point that transactional distance exists in all types of teaching or learning, but remains more important when technologies are used for training (McIsaac 1996, Faust 1999).

More than Internet learning techniques, the Grid learning approach is multifaceted. Therefore, learning virtual organizations on the Grid will not escape this theory for many reasons attached to its nature: 1) the great number of resources, communities, services and treatments; 2) the heterogeneous nature of the network; 3) the dynamic creation of new nodes with different knowledge level, and more. This is why, letting members of the virtual community to find their way is a load affecting their cognitive state, and this is substantial enough to reroute them.

Fitting up virtual learning communities with a bunch of Grid Learning Services

With the substantial increase of information nodes and the multiplicity of computers that enter or get out of the Grid the utilization of that technology as a support for learning may convey cognitive overload or transactional distance during learning processes.
The challenge will be to offer on the Grid, new services permitting to individual users or group of users to manage or share their work through a card supporting the structure and the dialogue aspect of a training system (See Grid-e-Card, R. Yatchou & al, 2004). The requisite cognitive resources for learning will be strongly dependent on the knowledge level of the learner and the strategy that he adopts for learning. Therefore, it seems very important to design a policy permitting to appraise the acquaintances of a member in order to connect him dynamically to the community that best correlates his knowledge or objectives. Our suggestion is to use a set of agents that handle user's electronic portfolio (e-Portfolio) as knowledge prosthesis and make the most of e-Learning qualification (e-Qualification) processes as aggregation methods to dynamically gather people in virtual organization.

4 The multiple aspects of the e-Qualification requirements

To achieve the multiple aspects of e-Qualification process, the idea is to create a composite Grid-interface as a ubiquitous map that allows a user to flow in the Grid virtual organizations which accept him according to its characteristics and behaviours. The strategy is based on the utilization of the user's e-Portfolio as input to a set of agents that works as e-Qualification actors to dynamically constructs a virtual community. Firstly we will describe the two concepts (e-Portfofolio and cognitive characters (Razmerita, 2004) and later we give the system architecture and the inherents tools and integration (interoperability) problems.

Portfolios have been used for many years as a means to keep collection of best work or important documents. That practice has been kept with electronic technologies and derived to e-Portfolio. According to Barrett a classroom portfolio can be seen as a purposeful collection of student work that exhibits to the student (and/or others) the student's efforts progress or achievement in a given area (Barrett 2004).

4a E-Qualification: educational perspective

Despite the numerous hesitations on the profits extent that e-Portfolio can bring to teaching or learning, the concept knows an increasing interest. For some years, several workgroups have been working with the goal to present a comprehensible conceptual and functional view of e-Portfolio. It emerges from researches that roles and e-Portfolio applications are numerous. It bears knowledge and cognitive characters (ePortConsortium 2003). So, in a learning context it can be used:

- to organize the presentation of works,
- to offer a context for discussions,
- to present revisions and reactions of teachers,
- to assess progress and of realizations,
- to recognize faculties and to take decisions.

Therefore, sharing e-Portfolio can help to learn. In current life, people generally share their books or documents. They go to the library or bookstore when there is no alternative. Nevertheless, the sharing of knowledge on the Grid raises the problem of identification and authentication of actors.

One of our preoccupations is the analysis of the collective behavior resulting from interactions between several nodes of the Grid. They communicate together and coordinate their activities to build an organized learning community. Hence, neutral machines wishing to enter in a community must qualify themselves. Contrary to the present access methods based on login and password, the use of the e-Portfolio as ubiquitous knowledge prosthesis in an electronic passport permits efficient access authentication and recognition of the community members. This is done by matchmaking of information through the “nomadization” of members’ e-Portfolio designed as a set of tables analogs to those of the "casual trainee" in ASIMIL (see figure 3).

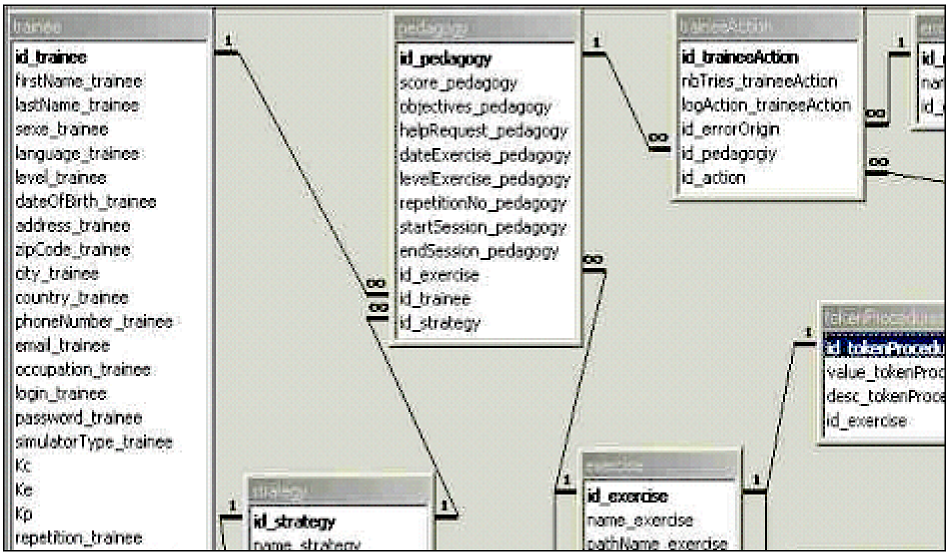

Figure 3. *An e-Portfolio can be designed as a functional set of tables (ASIMIL[9]) – Partial view*

An e-Portfolio is personal and it may serve various personal, professional learning objectives. The progressive digitization of all types of work and great capacities of networks permits to overcome the limitations of file size and to extend possibilities of e-Portfolios interactions. Its assessment enables to capture the evolution of knowledge, the centers of interest and its owner's performances and behaviours. That is why the contribution of e-Portfolio in building Grid learning services is interesting. It is a basic characteristic whose analysis permits to solve problems related to dialogue and structure through users’ categorization.

Nevertheless, there are problems to develop Learning Grid e-Portofolio (Gouardères 2004a):

- Programmability and Dynamic Composability of Grid Applications,
- Automated mapping of today’s applications and optimized performance,
- New paradigms of applications: e-Qualification, and identified bottlenecks as lack of:
    - automated composition, partitioning and mapping of applications,
    - easy programmability of Grid applications,
    - flexible middleware for guaranteeing performance.

To summarize, you cannot put the focus on your Working Group "Right on Mark" without having previously fixed the milestone. The Grid-e-Card will tackle some of these problems. Its main goal will be to answer the identification and authentication requirements of the system through a dialogue process which eventually accepts a member in the community or not. The use of Grid e-Card will considerably limit the cognitive overload and reduce the

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[9] **A**ero user friendly **SIM**ulation based on distant **L**earning, -European FP5 project IST-1999-11286FP5 1999-2003 - http://www.cordis.lu/ist/projects.htm

transactional distance in a learning on-demand process. This will be done by the e-Learning qualification procedure: the e-Qualification (Gouardères 2004a).

4b Social perspective: e-Qualification strategy for self-organisation in the Grid

The word "**eQualification"** has been used for the first time by the Darmstadt Institute[10] as a reference to quality of service (QoS). Others use it to mean that one has the skill to work on Internet as an electronic media. Terminologies are various and today that notion is at crossroads of several disciplines: pedagogy, ergonomics, cognitive sciences, social studies and judicial. It context is the individual or global assessment of human actors, of architectures or devices. That notion has been extended to the Grid and redefined as **e-Qualification** to designate the successive construction of knowledge from an initial state of knowledge to an expert knowledge state through several reviewed states as shown by figure 4 (Gouardères 2004a). In fact it is not a re-definition of "eQualification" but a new Scenario (e-Qualification) which as poorly to cope with the earlier approach in the literature. This definition is , at the moment, ELeGI specific .

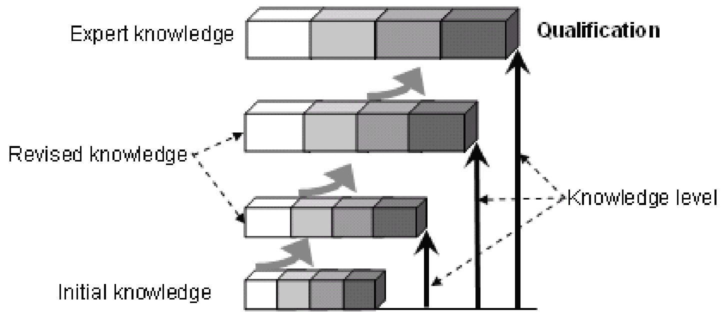

Figure 4. *Successive construction of knowledge during e-Qualification*

The e-Qualification process can be applied at four levels:

1. The user's e-Qualification which consists as well in the identification and the characterization of the human profile (linked e-Portfolio) in a learning context: expertise (acquired knowledge), achieved performances (mastered knowledge no), behaviors and psychological features observed.

2. The e-Qualification of the system (or device), based on the assessment of the gap between predicts and what is observed. But the problem of interfaces and those related to adaptability are yet to be solved despite the multiplication of sensors permitting to raise the user's returns.

3. The e-Qualification of practices and dialog that design cognitive architectures for peer-to-peer dialog to extract the chain (vector) of determinants driving to the selection and the execution of the most applicable actions in a given context.

4. The e-Qualification of services, based on the assessment of the demand and the degree of their utilization.

The main phases of the e-Qualification process are:

- Observation of users in the loop acting in virtual community,
- Monitoring dialogs and recording of such interaction
- Debriefing on-line which allows pedagogues to evaluate and credit human learning,

[10] EQualification Framework – Internet-based framework for teaching/learning software in the domain of professionnal learning, training and qualification (http://www.darmstadt.gmd.de/delite/Projects/EQualification/index.htm)

(knowledge and skills).

The e-Qualification process helps the self-organization of nodes by the dynamic classification of people who enter the Grid according to their need in their activity domain. The social organization is build distribution of control, local interaction and by the construction of a cognitive virtual structure (chain) facilitating the dialogue peer-to-peer. Therefore, it is an essential component that guarantees that a virtual organization member can understand the needs of another member and that he can also be understood.

4c Grid Learning Services based on $(P2P)^n$ dialogue:

This problem is a consequence of the social dimension for the analysis of dialogues when using the e-Qualification perspective. This problem is technically complex because it lies with the confluence of two streams PKM – Personal Knowledge Management and P2P- Peer-to-peer Computing. In fact, mixing P2P systems and Personal Knowledge Management allows to design a New Collaborative Model, (like the one used in the ASIMIL project, see below § 6a). Asimil propose :

1. a new collaborative model for knowledge environments
2. Integrating personal knowledge management concepts with P2P-systems technology, together with
3. A new model for educational Intelligent Training

The current version of the ASIMIL project deal with a simplified P2P collaborative technology premised on individual users voluntarily making computer resources available, resources such as files, computing services (simulation, VR), and users networked team (several heterogeneous teams of 1 to 4 trainees), through their internet connections. This version is monitored by agents and moderated by a cooperation between the instructor and the various pedagogic agents attached to each team. The question of how to evaluate the subsequent dialogue between the user and the system is generally known as "the lookup problem".

For a more efficient ELeGI version of this operational ASIMIL mock-up and in addition to the correct handling of the "lookup problem", we require a P2P network which shares these resources among equals and where is little or no central control. That implies that the nodes in the network play the role both of a client and a server and, consequently, needs the use of a Grid learning architecture.

Some Tools[11] and models to illustrate the lookup problem solution

An immediate and smart solution is provided by EDUTELLA for Web Services (a software infrastructure for query processing designed for applications in university settings. The infrastructure is based on RDF and other technologies designed for the semantic web, Nedjl 2002). In this case EDUTELLA must deals with P2P Networking services on the Grid with the aim to enable other applications to use Peer-to-Peer functionality.

To achieve this goal, a wider range of P2P-architected applications will appear and compete for attention with traditional desktop and client/server systems. Among these advanced architecture, we have selected :

- **An Agent-Based Approach for Trustworthy Service Location_** P. Yolum M. P. Singh . This framework accommodates the following important properties of open information systems. One, the peers can be *heterogeneous*. The peers can offer services or follow policies distinct from all others. Two, each peer operates *autonomously* based on its local policies. Three, the peers can *adapt*. Each peer can arbitrarily modify its offerings and their quality, its policies, and its neighbors.

[11] Kenneth A. Berman and Fred S. Annexstein, Department of ECECS, University of Cincinnati

- **P-Grid: A Self-organizing Structured P2P System, (and Gridella),** K. Aberer & al. École Polytechnique Fédérale de Lausanne, P-GRID is an unstructured peer-to-peer lookup system which resolve search requests by flooding techniques.

Extending the P2P architecture with these two improvements enforces the common continuing “Lookup Problem” in P2P. There are two version of this lookup problem; we call them the “titled” and the “untitled” versions.

In the “titled” lookup problem the user know, by "mirroring" the reflexivity of P2P networking feedback, the name (or part of the name) of the title and submits that to the system. We will propose the Grid-e-Card solution to develop this solution (see, § 5)

In the “untitled” version, the user relies on a system that uses functional ontologies or meta data issues, but personalization and user modelling are all important to consider as part of the solution (Razmzerita et al., 2004).

4d e-Qualification "lookup problem" dedicated to e-Assessment (at OU-UK) or formal learning

Considering the particular context of e-Assessment for formal learning dialogue (i.e. Open University Curriculum for eLearning Computer science courses), D. Haley and B. Nuseibeh have proposed an original e-Assessment framework for both formative and summative assessment based on the Latent Semantic Analysis[12] perspective (see initial SEES #3b_ REQ_V1 and revised versions uploaded on the Project Portal)

Another challenging perspective has been proposed for eLearning (or eTraining) based on Intelligent tutoring systems : noteworthy works in the field of E-learning and text recognition lie with the "Dominant Meanings Classification Model" for Web Information (Abdel Razek, 2004)

5 Technical perspective: Assembling P2P services, integrating the tools on Grid Platforms

The e-Qualification process is merely based on the Grid communications protocols. Standards of communication approach are based on the information theory paradigm. In this approach the act of the communication takes place because it exists an emitter, a receptor and a transmission channel of information. In the Grid all the nodes are neutral and can be as well a supplier or customer according to the level of knowledge. Therefore, absence of communication will isolate the member and increase the transactional distance. As there are too much nodes and resources the supervision of the dialogue between agents will be leave to a service like MIC* (Gouiach & Cerri 2004) while the service composition is supervised by a real time P2P-Review

The P2P communications have brought many innovations leading to the personalization of requests (individual). That personalization makes sharing of knowledge delicate; therefore "On demand" ontologies (Park, 2003) are necessary for ubiquity. When coming to the Grid, people will have things “to share” or “not to share”. Nevertheless, the decision belongs to the newcomer who interacts with agents to choose what to share and with whom. Many approaches for the sharing of resources exist: CPU cycles (Seti@home), Storage (OceanStore), Data (Gnutella, Kaza), Combination of resources (GriPhyN, EUDataGrid).

5a e-Qualification and the Agent Communication Problem: From P2P to (P2P)n with the Grid-e-Card

The functional structure of the Grid-e-Card leans on a set of agents that assures a set of

[12] statistical natural language processing technique

dialogue facilities in the Grid. Such an approach will be useful in building distributed systems with complex load-balancing requirements. The same mechanism could also be used to replicate agents without their explicit knowledge. This would allow the support system to replicate agents and execute them possibly on different hosts for safety, redundancy, performance, or other reasons.

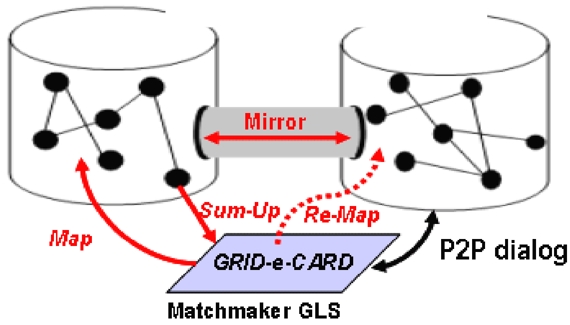

Figure 4. *Interoperability process between communities*

The representation of exchanges among subsystems components reveals global activities taking place in the system. On one hand we have learners who come to the Grid. On the other hand, there is a network of peer who has already been qualified. Anyone is connected to the Grid through his Grid-e-Card (figure 4).

A human agent is associated to every user Grid e-Card and communicates with his (P2P)i community to launch a matchmaker process. It will answer identification and authentication requirements of the system through a dialogue process which in the end accepts a member in the community or not. A mapping process will indicate people who are communicating in a P2P dialogue. This task can be carried out by mapping "presence" -- whether you are at your computer at any given moment in time -- Nevertheless, the solutions given by The L3S Research Center (Germany): Edutella & Super-Peer collapses when applying to the Learning Grid because of the transience of the connectivity that does not guarantee the "peerness" of P2P conversations, and we must overcome the difficulty by the matchmaker process.

The matchmaker process analyses the content of the messages with the human agent and enables the categorization of agents in the virtual organization according to the relevance of their knowledge in the e-Portfolio or the objective of the new member in the loop. The efficient characterization of message content is a difficult activity that appeals a complex mechanisms. The adoption of a social behaviour by an agent must make him able to reason on the knowledge states of other members he is associated with, and take into account his own knowledge that other agents will like to share. Bayesian networks are used for this purpose. This functionality is called the mirror effect which displays the state of the newcomer in relation to others, as a feedback evaluation and when it is carried out successfully, the "sonnet" (Sum-up+Acknowledgement+alarm) as an "epilogue" will generate an alarm indicating that someone has entered the community, A broadcast of his knowledge level is sent to other members' agent to inform them of the presence of a newcomer. Then, many agents will be activated.

For the Grid-e-Card to be affordable the e-Portfolio abstraction will not be based on the content but on metadata describing the resources managed by peers. So, we consider two main strategies to support communications between members of the community:

The direct access by message that permits 1-to-1 assessment in order to establish a P2P communication.

The access through the use of a whiteboard (as opposed to blackboard) where the knowledge of members wishing to participate in the network is written. The reading of the whiteboard by an agent permits to identify members whose knowledge must be increased by a peer-to-peer review as implemented in ASIMIL (Gouardères 2004c).

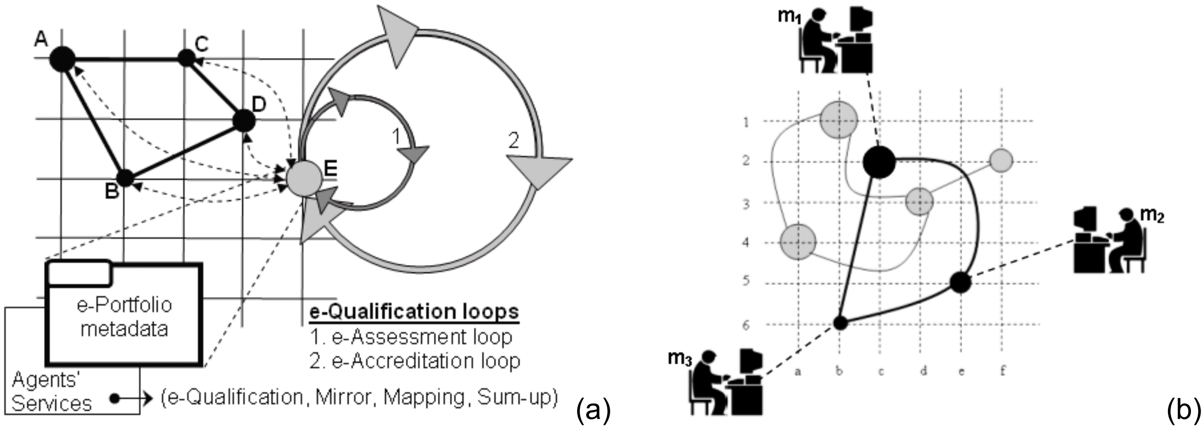

Figure 5. **a.** *Loops e-Qualification (P2P)^n* - **b.**.*P2P communication after e-Assessment*

The second dash mentioned above occurs when the Grid-e-Card is plugged, that is when someone wants to enter an organization. An example of such situation is given by figure 5a, where a new node (E) wants to join the group “ABCD”. In agreement with the purposes of the approach consisting in sharing resources and knowledge, many P2P requests will be simultaneously activated and processed by broadcasting messages to all members of the group (first dash above), in many sub-networks: the (P2P)n. As the Grid is a neutral substratum for the replication and the propagation of (P2P)n exchanges. The question is now, how to pass from (P2P)n to (P2P)^n? or in other words, from one-way to two-way P-GRIDs. As stated below by the supervision of conversations between agents (like in MIC*) that has to be achieved through real time P2P-Review. To support that view, we need a new functional structure called **Grid-e-Card**.

As an illustration, figure 5b present two virtual organizations where people (m1, m2, m3) interact in a local P2P with the size of nodes corresponding to the level of knowledge one has built successively during the learning process, those with more knowledge will have more P2P communications than others. Thus, the coordination of actions between members is the result of all P2P dialogues. Other approaches can be investigated like the supervised P2P overlay network from the SPON4 Model where each node continuously informs its virtual community about its current position and that virtual home responsibilities are exchanged whenever nodes exchange positions, which allows (P2P)n responsibilities (De Riley & Scheideler 2004). This is the EDUTELLA P2P networking approach (Nedjl, 2002).

5b Needs and Requirements as outcomes from the multiple aspects of e-Qualification: the global framework

As we have learned from the history of the Internet, adoption is a better predictor of software longevity than perfection, and as the P2P movement matures, users will not adopt applications that embrace decentralization for decentralization's sake. Instead, they will adopt those applications that use just enough decentralization, in just the right way, to create novel functions or improve existing ones. A one way oriented solution: The P-GRIDs & GRIDELLA. What we need is a two-way P-GRID: (P2P)^n.

The Problem of the Matchmaker between two one-way P-GRID community "Get the focus of your working Group Right on Mark!" How can the system/planner/network manager get this information?

if lucky, can gather data about users otherwise, users must be given incentives to reveal relevant information to the planner mechanism design: Alerts to encourage users to mutual trust, and to join the group : trustworthiness. For all these reasons e-Qualification must take into account the following four dimensions of the Learning Grid scenarios.

Instructor communities can be enabled to share educational resources such as

1. lesson plans
2. sample assignments
3. curriculum
4. etc.…

Virtual Learning organization communities

1. Instructor(s) can more easily make documents and information available to students,
2. Distance learning. Geographically dispersed Virtual communities have access to information.

Students Communities

1. Students can share with each other with respect to the higher educational experience and personal interests.
2. A P2P student community can quickly disseminate electronic information faster than otherwise possible.
3. Low barriers to communicate with other students would support their research and publication efforts.

The scientific research community

1. Share information about the latest research
2. Share computational resources.
3. Grid-based collaborative tools
4. Grid Computing for high computational needs.

Selected Test-beds

6 ASIMIL Accreditation (UPPA software architecture and tools)

ASIMIL is an operational mock up based on a Semantic Web perspective. The objective is to e-assess the training of pilots or mechanics (students) in aeronautics by application of cognitive models through the usage of a multi-agent based ITS (Intelligent Tutoring Systems). More particularly, the debriefing architecture deals with models of human error and application of multi-agent technologies to diagnose human error and underlying cognitive gaps. The model of reasoning based on qualitative simulation supplies a wide variety of parameters as the base for pedagogical evaluation of the trainee. The experimental framework is simulation-based ITS (or CBT), which uses a «learning by doing errors» approach. The overall e-Qualification process as framed before (§ 5.b) is intended to be used in the perspective of e-accreditation of training, which seems to become unavoidable in the context of globalisation and development of e-learning in aeronautic companies.

6a Possible scenario for the accreditation process in ASIMIL

The experimental framework for the ASIMIL Training system is simulation-based intelligent a peer-to-peer review process which is performed by autonomous agents (as Knowledge, Ergonomic, Psychologic). Each agent scan separately a common stream of messages coming from other actors (Human, intelligent agents, physical disposals). They performs coalitions to supply a given community of users (Instructors, Learners, Moderators,…) with diagnoses, advices and helps among actors in the community.

This MAS architecture is called ASITS (Actor Specification for Intelligent Tutoring Systems) (and is directly adapted from ACTORS by including a cognitive architecture based on ACT-R/PM (Byrnes, 2001) that specify the role of the cognitive resources in the high level cognitive tasks and adopt proposals exchanged at the time of a conversation.

Within the ASITS agent's framework, ACT is for "Adaptive Control of Thought" (Anderson, 1993) preferred to "Atomic Components of Thought". R stands for "rationale accepted as Revision or Reviewing" and PM stands for "perceptual and motor", monitoring of task.

In ASIMIL, we have moreover needed to control several methods of parallel dialogue and exchanges (Messages - texts, word -, orders - mouse, stick, caps -, instructions, alarms - visual, sound -...).(see Figure 6). The knowledge that must be provided to ASITS' agents to complete a model of a person in an environment is essentially of two types: declarative and procedural. Declarative knowledge, is represented in symbolic structures known as *chunks* and procedural, sometimes referred to as “Know-how,” knowledge, is stored in symbolic structures known as *production rules,* mostly used to find overlays between produced chu*nks*.

We have used the ACT-R/PM as inference engine for the global ASITS architecture (module of cognition connected to perception-motor module) and a strong psychology theory, on how interaction occurs. Furthermore, ASITS architecture (Agent Team) allows producing concurrent diagnostics in real-time, according to the following high-level communication loop:

- Perception: PM, The agent perceives its environment continuously to sense any new situations.

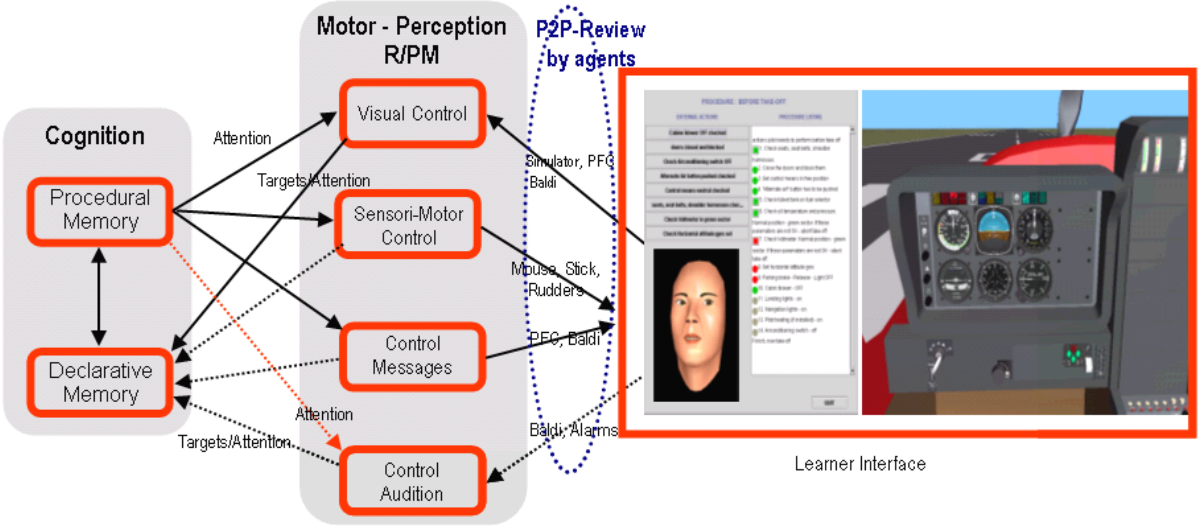

Figure 6. *Cognitive control of dialogue's modalities by ACT-R/PM model in ASIMIL*[13]

- Reason for goal selection: R, The agent infers the next goal, based on its goal model, knowledge, and the perception of its environment. (R', same for an action selection).
- Act: The selected actions are executed.
- When a coalition is gained the characteristics will be sum up in a vector which is broadcasted to others agents and coalitions for searching P2P cooperation and bests overlays fitting in what we call a Focused Crawling between potential chunks
- The final matchmaking process results from the moderation between coalitions proposals by subjective clustering. (Iterative re-qualification of the influence of each coalition in a selected chunk).
- When an assessment is done by one of the actors, he/it can recover the chunk (as a sonnet = Abstract + Acknowledgement + notification) to update his knowledge and an alarm is broadcasted to launch the P2P review again.
-

6b Implementation environment of the current system

Currently, the mock up is centered on an Agent server platform (JADE) tremendously limited (limited number of agents, no broadcast messaging, …).

ASIMIL 2.1 Web Version

Agent Server	Jade	Corba	
CBT sever	Java application	Java application	Web service (Java servlet container)
Simulation	Matlab	C++	C++ application + Java library
Talking Heads "Baldi"	TCl/Tk, Java scripts	Java applets, TCL scripts	Two Web interfaces, (Learner, Instructor)

[13] ACT-R/PM architecture is presented on the left part of figure. ASIMIL interface – on the right part (System of procedures follow-up on the left, flight simulator on the right and an animated agent (Baldi))

6c Example of Grid Learning services development

As previously stated § 4c, the improvement of informal eLearning e-Qualification in ASIMIL lies with the real-time assessment of the confluence of two streams PKM – Personal Knowledge Management and P2P- Peer-to-peer Computing. This perspective seems the most appropriate to evaluate the e-Qualification of a New Collaborative Model for e-Accreditation of pilots and mechanics by using an ELeGI version of the ASIMIL operational mock up (i.e. an improved version based on Grid Learning Services).

We have selected two possible avenue of development to inter-operate PKM with $(P2P)^n$ computing:

- **An Ontology based user modeling** (Razmerita & al. 2004): is a Self-organizing Structured P2P System. This solution is adapted from the Gnutella & Gridella models by adjonction of two services : a- a functional ontology editor to enable P2P dialogues, and, b- user modelling process for PKM objectives.
- **An Agent "Peer-to-Peer" review on Grid for Trustworthy Services** This framework accommodates the following important properties -a) One, the peers can be *heterogeneous* (but identified within their virtual community which can offer services or follow policies distinct from all others communities), b- Two, each peer operates *autonomously* based on its local policies, -c) Three, the peers can *adapt*. Each peer can arbitrarily modify its offerings and their quality, its policies, and its neighbors.

6c.1 Ontology based user modeling

The first ideas of using ontologies for learner modeling have been reported in the late ninties.. Kay (2001) also argues for the use of ontologies for reusable and “scrutable” student models. More recently the idea of using sharable data structures containing user’s features and preferences are proposed in order to enable personalized interactions with different devices for the benefit of the users. For this purpose, a user ontology structured conceptualized according Information Management System Learner Information Package (IMS LIP) has been proposed as a platform for communication in Razmerita (2003).

Ontology based user modeling requires a referential structure which can be static (e.g the abstract concepts of IMS LIP) and an adaptive part which need to evolve according to the user’s progress in learning according to his goals, domains of interest which need to be updated. In this context we can argue that human learning meets machine learning. Recent research work include efforts towards automatic ontology evolution. (Park et al. 2003)

For the ASIMIL scenario only a part of the proposed user ontology is necessary. In a second phase the user ontology has to be mapped to the domain ontology. The non-taxonomic relations are usually connecting users with domain specific concepts. These relationships are very useful for reasoning and inferring new knowledge. For example matchmaking agents can retrieve the “like minded” users, interested in a certain domain, and map them into a community of practice. From a more learning centered scenario, based on the learning goal of the user and the metadata of the learning objects the pedagogical agent can propose various learning object that fit the learner objective and expertise.

6c.2 Peer to Peer networks and Agent "Peer-to-Peer" review on Grid

The scope and reach of peer to peer networks has increased significantly since the success of user friendly file sharing networks such as: Kazaa, Gnutella and Napster. The two main models of file sharing applications can be classified in two categories: centralized applications (Napster) versus decentralized applications (Gnutella). These popular applications brought a new perspective on the use of peer to peer (P2P) and file sharing systems. Moreover they have been adopted as a model of communication for the Grid computing infrastructure. In a P2P communication mode the users decide what resources they want to share or not.

7 TESTOOL e-Qualification (from Kaunas University)

7a Presentation of the TestTool4 objectives

TestTool4 is a distance testing system, it allows to create textual and graphical tests and publish them in internet. The Testool current architecture is based on Web services intended to do learner assessment on line. e-Assessment of the learner is restricted by using only drag and drop exercises.

To lead to e-qualification, we need to improve:

A - e-Qualification of learner according to different points:

1- we need exercises based on others techniques than drag and drop (clicking, writing, ...)

2- we need to take account the learner's profile (historic, level...)

B- e-Qualification of the environment software : with an analysis of learner feedback to detect problems due to the interface, the software in a QoS perspective

C- Evaluation of the objectives appointed by the teaching institution (Kaunas University)

The system consists of 3 parts:

- **Author tool** is used to create variants of the question. The created variants are saved to the file, which later can be uploaded to TestTool4 server. The administrator uses uploaded variants to form questions and tests.
- **Administrator tool** is used to administer the TestTool4 system. The web browser interface allows the administrator to manage the system users and their groups, upload question variants, form questions and tests, set exams and monitor testing results and statistics.
- **Student tool** is used to take tests. It's a Java program that delivers questions of the chosen exam to the student.

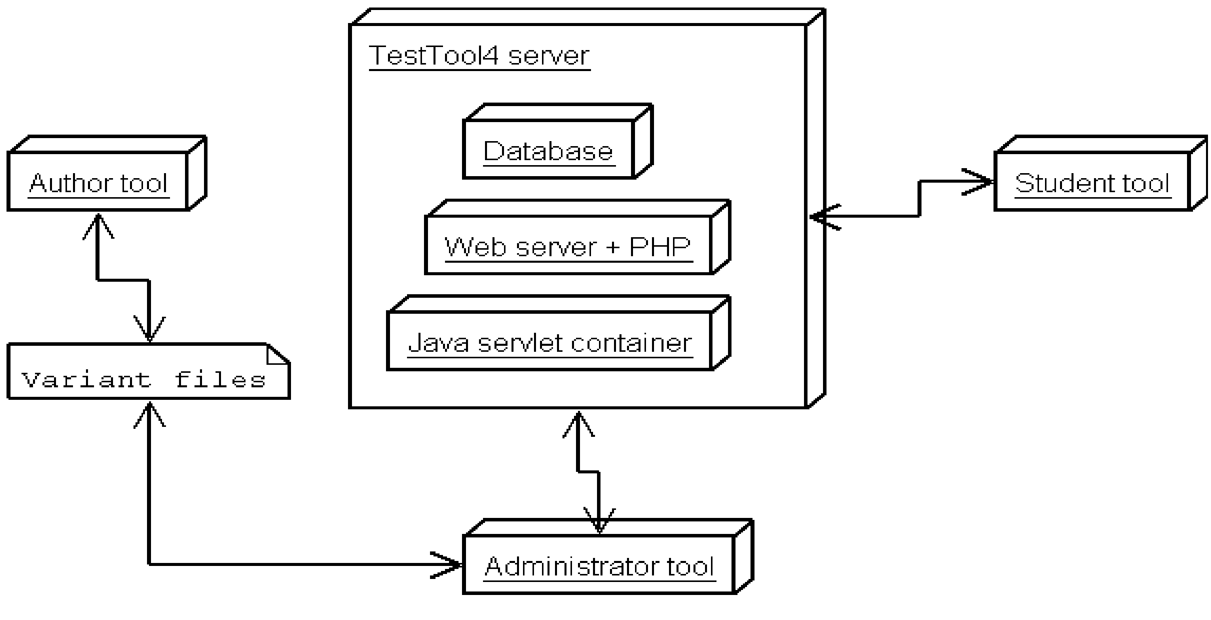

Figure 7: TESTOOL architecture

7b Implementation of the current system

	TestTool3 Oracle version	TestTool3 MySQL version	TestTool4
Server	PL/SQL	PHP	Web service (Java servlet container)
Author tool	Java application	Java application	Java application + Javascript converter *(new author tool in development)*
Administrat or tool	Perl (2 separate web interfaces)	PHP (2 separate web interfaces)	PHP (single web interface), multiple owners of objects, improved objects selection for assignment and deletion, user list insertion, course sertificates, theory URLs
Student tool	Java applet with direct connection to DB through JDBC	Java applet with connection to server side PHP scripts	Java Web Start enabled application with connection to web service, question navigation, possibility to view true answer, resetting answer to default state

7c Possible scenario for knowledge evaluation on TESTOOL

These are the main steps of constructing the knowledge evaluation test:

- Create the question variants with **author tool**.
- Use **converter** to convert each variant file.(*This is a temporary requirement until the new **author tool** is created.*).
- Use **administor tool** to form tests and register students.
- Student takes tests using **student tool**.

7d Example of Grid Learning services development

Evidence-centered design (from Using Evidence-Centered Design to Develop Advanced Simulation-based Assessment and Training, Malcolm I. Bauer and al.)

A simulation that includes assessment must elicit behavior that bears evidence about key skills and knowledge, and it must additionally provide principled interpretations of that evidence in terms that suit the purpose of the assessment. Figure 8 sketches the basic structures of an evidence-centered approach to assessment design (Almond, Mislevy, & Steinberg, in press). Working out these variables and models and their interrelationships is a way to answer a series of questions that Sam Messick posed (1994) that get at the very heart of assessment design:

- "What complex of knowledge, skills, or other attribute should be assessed?" A given assessment is meant to support inferences for some purpose, such as a licensing decision, diagnostic feedback, guidance for further instruction, or some combination. Student-model variables describe characteristics of examinees—knowledge, skills, and abilities, which we will call *knowledge* collectively for short—upon which these inferences are to be based. The student model expresses the assessor's knowledge about an examinee's values on these variables.
- "What behaviors or performances should reveal those constructs?" An evidence model expresses how what is observed in a given task constitutes evidence about

student-model variables. Observable variables describe features of specific task performances.

- "What tasks or situations should elicit those behaviors?" Task-model variables describe features of situations that will be used to elicit performance. A task model provides a framework for characterizing and for constructing situations with which a candidate will interact to provide evidence about targeted aspects of knowledge.

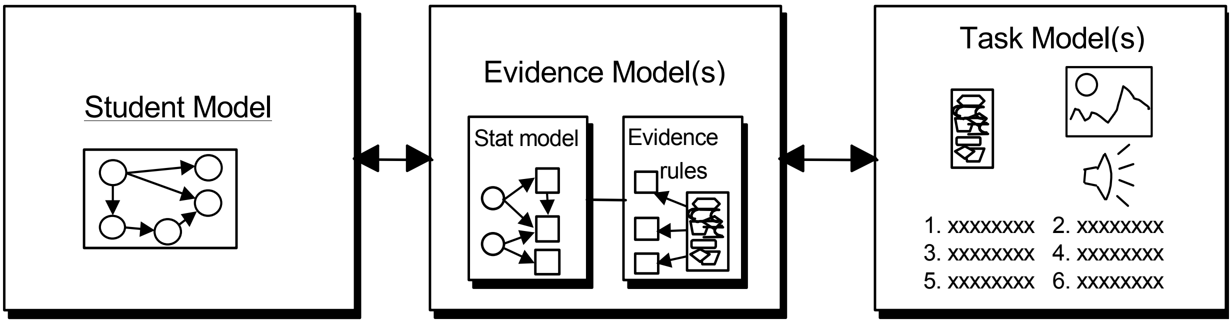

Figure 8: The Three Central Models of an Evidence-Centered Assessment Design

ELeGI development and identified milestones

8 Constitution of a community (installation) which will become a Virtual Learning Organization VLO

8a Different case studies: Informal versus formal e-Qualification

The main activity of the SEES #3 e-Qualification is project is an inclusive and comprehensive evaluation of several case-studies for the development of e-science in distributed virtual lab, Virtual Technical and Vocational Education at a distance, Virtual communities for sustainable environment training for e-Learning qualification conformance and quality assurance. The e-Qualification process is based on the emergent outcomes of a consensus-building exercise that draw upon the various approaches to qualification definition (applied both to users, software and organization evaluation and assessment) to guarantee good quality assurance practice currently used by a broad range of stakeholders in education and training in the public and private sectors.

In fact, in order to get to a comprehensive e-qualification framework, all the different "cultures of assessment and quality" of the different users groups (industry, academia, professional development, students, etc.) are invited to contribute to e-qualification definition not only in terms of technical solutions, but also as far as the different quality concepts, principles, habits and visions are concerned.

8b Identification of a group of people

The e-Qualification SEES #3 outputs, apart from the establishment of the Learning Grid Qualification procees per se, aim at meeting the varying needs of two different groups of stakeholders:

The broad European E&T community:
- Learners
- Teachers, trainers, practitioners and learning managers
- Policy makers
- Research actors

The European e-learning market supply side actors:
- ICT producers
- Design & development actors
- Publishers and multimedia/web producers

More precisely:

1- Virtual organizations for **<u>Informal Learning are related to :</u>**

- Alphabetisation for Durable Development -refers to SEES #1 or VIAD
- Learning and Training of Researchers in Organic Chemistry refers to SEES #2 or ENCORE
- e-Qualification (by Open Universities), refers to SEES #3 or e-Qualification and should deal with ASIMIL informal Learning Objectives

2- Open Distance Learning Organization are involved for **Formal tests & validation, like TesTool4,** others…. (we plan for the future some additional tests as "short essays" in student's answers propose by OU-UK and user's characters tests by University of Mons).

Learners and trainees:

a- For VIAD & ENCORE, Please refers to the SEES #1 & 2, Needs and Requirements Reports

b- ASIMIL, for an informal appraisal of collective behaviors introducing by the sharing of sophisticated training tools at a distance . The TRAINEES are students from several technical courses (Instiut universitaire de technologie: mechanical enginnering, maintenance), Schools of engineers (ESTIA Bayonne, IMA or Idc Bordeaux,..). The Trainees are also professionals from aircraft manufacturers or AirLinks. They have been teached by both formal and informal learning, and there is a need for e-Qualification for credentials and accreditation of informal Training.

c- TESTOOL : Students from technical & Vocational courses selected by University of Kaunas

9 conception / specification / implementation / customisation of a bunch of services

As an example , of Grid Learning Service for e-Qualification see § 5.a, Grid-e-Card.
Adapted from J. Hughes[14] and to cope with the ELeGI project consideration of humans at the centre, we consider learning is clearly a social, constructive phenomenon. It occurs as a side effect of interactions, conversations and enhanced presence in dynamic Virtual Communities: experimental research concepts integrating new powerful developments of services in the Semantic Grid. This give rise to several considerations :

9a The question:

However, what is known about these innovative approaches to training has been limited by the shortage of scientifically credible evaluation. Is e-learning effective? In what contexts? For what groups of learners? How do different learners respond? Are there marked differences between different ICT platforms? Does the socio-cultural environment make a difference? Considering the costs of implementing ICT based training, is there a positive return on in vestment? What are the perceptions of VET professionals? What problems has it created for them?

9b The observation:

Although recent attention has increased e-learning evaluation, the current research base for evaluating e-learning is inadequate...Due to the initial cost of implementing e-learning programs, it is important to conduct evaluation studies. (American Society for Training and Development 2001). The Capitalisation report on the Leonardo da Vinci 1programme, one of the biggest sponsors of innovative e-learning projects in European VET, also identified the lack of systematic evaluation as being the major weakness in e-learning projects.

9c The context : Basic Principles

We recognise that the purpose of evaluation may be primarily developmental, concerned mainly with improvement and learning, or may be concerned with accountability and justification and more inspectorial in focus. However, we believe that in both cases

- Evaluation is an essential element in the design and planning of any e-learning programme

[14] Framework for the Evaluation of E-Learning Jenny Hughes *CRED - Centre for Research in Educational Development* Graham Attwell KnowNet*, Pontydysgu, and* ITB, U. Bremen , Paper presented to a seminar series on Exploring models and partnerships for eLearning in SMEs, held in Stirling, Scotland and Brussels, Belgium, in Nov 2002 and Feb 2003

- Evaluation is integral to e-learning activities and not `bolted-on'
- Evaluation should span the whole lifecycle of the programme and should be formative as well as summative.
- Evaluation should be client centred, based on a non-dependency relationship and leading to long term client autonomy and sustainability
- Evaluation should recognises the diversity of stakeholders and respond to their different needs by offering a wide range of evaluation products, tools and processes.
- Evaluation is a skilled intervention and a specialist field of knowledge and practice
- Evaluation should be ethical, professional and responsible

Evaluation should be informed by a range of different approaches and theoretical perspectives to ensure congruence between the evaluation process and the policies, processes and practices being evaluated. Thus, the evaluation of e-learning should make use of the opportunities created by the technologies.

10 Proposal for a Framework for e-Qualification development of a bunch of services:

A new framework over several e-learning evaluation projects, five major clusters of variables have emerged; individual learner variables, environmental variables, technology variables contextual variables and pedagogic variables. Each of these can be disaggregated into more precise groups and further disaggregated until individual variables can be identified and isolated.

a) Individual learner variables include

- physical characteristics (e.g age, sex, physical abilities)
- learning history, (negative / positive experience, level of attainment, duration, recency etc)
- learner attitude (positive / negative)
- learner motivation (high / low)
- familiarity with the technology

b) Learning environment variables include

- the immediate (physical) learning environment
- the organisational or institutional environment
- the subject environment the

c) Contextual variables include socio-economic factors (e.g. class, gender,) the political context

(e.g. who is funding /paying for the e-learning and for what reason ?) cultural background (e.g. how highly is learning / e-learning valued ?) geographic location (e.g. country, language, urban/rural)

d) Technology variables include

- hardware
- software,
- connectivity,
- the media
- mode of delivery,

e) Pedagogic variables include

- level and nature of learner support systems
- accessibility issues.
- methodologies

- flexibility
- learner autonomy
- selection and recruitment
- assessment and examination
- accreditation and cetification

Evaluation from pedagogical and technological point of view will be done by the SEES actors within the several Grid Learning services launched from the implementation of the previous framework.

Evaluation of exploitation phase based on the RECORD of the sessions (statistics and qualitative analysis)

We have proposed Validation Plan in the report version a Grid of evaluation and a stepping od 1 to 9 stages to validate the successive outcomes of the conception / specification / implementation / customisation of the bunch of services for the e-Qualification process. (For more information please refers to this document on the Project Portal) To sum up :The Validation Plan of pedagogical, technical & organizational enhancements develops inside the process tending to define the e-Qualification Needs & requirements to be evaluated and validated on two test-beds TESTOOL & ASIMIL . This process can be visualised as follows:

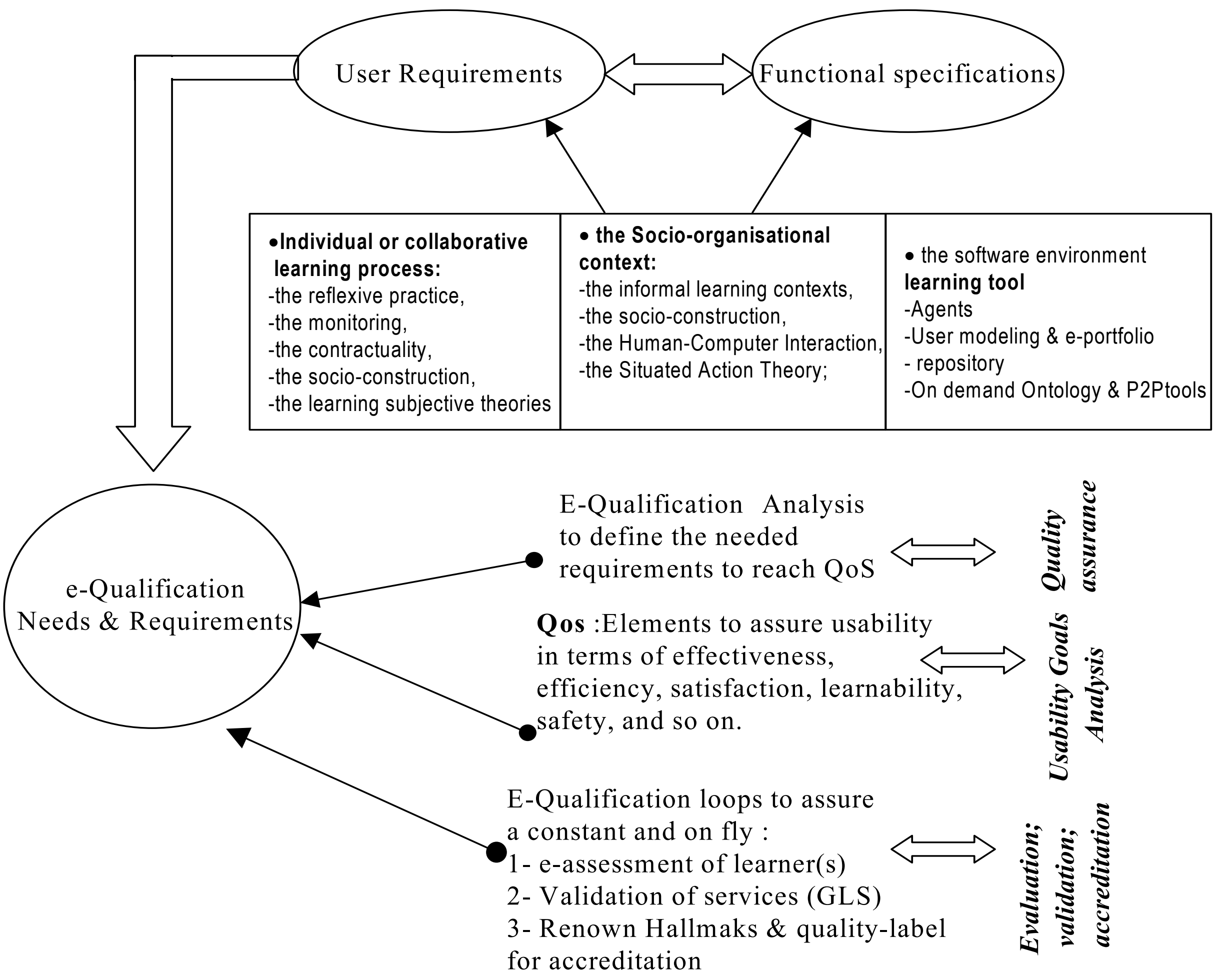

Figure 1 – e-Qualification General Framework for Needs & requirements

We can consider the beginning of the “process” coinciding with *User Requirements* collection of data, being e-Qualification process depending on users’ point of view, and specificity of each selected test-bed, especially in this phase. Having analysed in a shallow scan the global the requirements, and considered the corresponding *functional specifications*, we can develop a more sensitive description of *e-Qualification requirement for each specialized test-bed*

11 The steps of the Validation Plan:

1.	Consolidation of Step1 to Step2 Needs & Requirements
2.	Pedagogical Conceptual Framework
3.	Avoiding ambiguity: what to evaluate?
4.	Analyzing the frame.
5.	Technology changes : from « Web Based Training» to « Grid Learning Services »:
6.	Functional simplification of the Pedagogical Conceptual Framework
7.	Evaluation and Validation.
8.	The three perspectives of evaluation and GLS tasks.
9.	Verifying the coherence with the project.
Validation Plan: some remarkable steps.	
Practical indications.	
10.	Qualifications.
11.	Questions.
12.	Special interest chapter on On demand & Personalized Ontologies

Adaptation of the bunch of services will be proposed after the assessment of the validation plan.

ELeGI related software and identified problems

Among the technical challenges and the innovation related activities, we will address the following points:

- demonstrate a migration path for existing advanced learning environments towards an open potentially interoperable set of components and services.
- design a service oriented Grid based software infrastructure characterised by a high level of abstraction.

This will allow us to access and integrate different technologies (to propose emergent protocols of co-operation in heterogeneous and dynamic contexts), resources and contents that are needed in order to realise the new paradigms and learning approaches for implementing effective learning. This process will be driven by the pedagogical needs and scenarios associated with the first objective. More precisely, we will address:

- OB3. design, develop and validate a Grid based software architecture for exploiting the new technology enhanced learning approaches.
- OB11. demonstrate and validate how Grid technology facilitate the realisation of new learning paradigm and the implementation of Virtual Learning Communities.
- OB12. demonstrate, customise and exploit new or re-engineered learning systems and solutions for citizens and organisations.
- OB13. demonstrate and validate how Grid technologies, can facilitate the implementation of Ambient Intelligence for Learning.

OB14. facilitate the exploitation of European cultural and scientific resources though the Learning Grid infrastructure.

12 Mandated Constraints

The Grid will incorporate the technologies to enable the development of “super applications” composed of large numbers of heterogeneous software components interoperating upon a distributed computing infrastructure of diverse computing platforms, communication links, data sources, and other distributed resources (e.g. the Internet or the World Wide Web).

Software components will consist of “conventional” software applications (including legacy applications), object-oriented components, software agents.

These super applications will ultimately be dynamically tailored to a user’s problem/task at hand. They will configure and reconfigure themselves on the fly (based on user tasking), with little or no programmer effort required to assemble the components.

Components will be able to describe their interfaces to other components and to organise themselves into teams to accomplish specific tasks, negotiating the particular interfaces (languages, protocols …) among themselves. Components will come together in novel, highly customised configurations and teams. Users may participate in these teams as well.

Super applications will coexist with one another, sharing computing, communication, and data resources on the Internet, WWW, or other environments. They will have to avoid harmful states and behaviour (such as deadlock), be robust and fault tolerant, be secure …

A major goal for the Grid is to facilitate interoperability among components from heterogeneous environments. These components will discover each other at runtime on the Grid, via federated directory services. They will then have to establish communication, negotiating among communication languages and conversation protocols to support the kinds of semantically rich, extended interactions. This is particularly true in situations where the components are not pre-configured, but must organise themselves and adapt to changes.

The Grid will focus on interoperability, and need sophisticated mechanisms for representing, storing, negotiating, and modifying on the fly conversation protocols. The E-LeGI project aims to propose technologies and approaches to these challenges, by considering Grid Services as a convergent evolution of Grid Computing and Web Services:

- from « Grid Computing » to « Grid Services »: Supposes an evolution from a Computing resources oriented Grid to a Service oriented Grid.
- from « Web services » to « Grid Services »: Supposes an evolution from services dissemination to services integration based on OGSA.

13 Solution constraints : OGSA Architecture

Four main layers comprise the OGSA architecture:

- Resources: physical resources and logical resources
- Web services, plus the OGSI (Open Grid Services Infrastructure) extensions that define Grid services
- OGSA architected services
- Grid applications

This development as a part of SEES #3 deal with the third layer. We can note:

- Dynamic and potentially transient nature of services in a Grid. In a Grid, particular service instances may come and go as a) work is dispatched, b) as resources are configured and provisioned, c) and as system state changes. Need interfaces to manage their creation, destruction, and life cycle management.
- Grid services can have attributes and data associated with them. In object-oriented programming, objects have behaviour and data. Likewise, Web services need to be extended to support state data associated with Grid services.

14 Semantic Grid interoperates services on demand.[15] Interoperability Constraints

The Semantic Web is an extension of the current World Wide Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation. It focuses on the representation of data and seeks to create a machine processable Web. It is led by W3C plus a large number of researchers and industrial partners. It is based on the Resource Description Framework (RDF).

A Web Service is a software system designed to support interoperable machine-to-machine interaction over a network. It provides the definitions (and infrastructure) to allow applications to remotely exchange XML messages with each other. A program sends a request to a remote Web service containing an XML message and (optionally) receives a response.

Semantic Web & Web Services complement each other. Web Services meet immediate

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[15] *About Grid program execution services, Grid program execution class is unique (high-performance computing, parallelism, and distributed collaboration). This class of services is central to Grid computing (Community Scheduling Framework (CSF) announced at GGF 8 in Seattle in June 2003)*

technology needs. Semantic Web has potential for future growth. Semantic Web Enabled Web Services (SWWS) will transform the Web from a static collection of information into a distributed device of computation on the basis of Semantic Web technology making content within the World Wide Web machine-processable and machine-interpretable.

The Service Oriented Architecture (SOA) is an example of a composite computing model ("an architecture that uses distributed, discovery-based execution to expose and manage a collection of service-oriented software assets"). In this model, capabilities (i.e. software assets) should be dynamically discoverable. It should be a clear separation of the software's capabilities and its implementation. It should be possible to quickly assemble impromptu computing communities with minimal coordinated planning efforts, installation technicalities or human intervention.

Semantic Web technologies are evolving the Grid towards the Semantic Grid to yield an intelligent Grid which allows seamless process automation, easy knowledge reuse and collaboration within a community of practice.

Service discovery in large scale, open distributed systems is difficult because of the need to filter out services suitable to the task at hand from a potentially huge pool of possibilities. Semantic descriptions have been advocated as the key to expressive service discovery, but the most commonly used service descriptions and registry protocols do not support such descriptions in a general manner.

There is, as yet, no common standard for describing Grid resources. Different Grid middleware systems have had to create ad hoc methods of resource description and it is not yet known how well these can interoperate.

This brings a strong requirement for a secure and interoperable Grid system which is open at the standards level and can be used by other Grids. The intention is that the system should employ flexible negotiation techniques to enable other parties to join with ease. This raises a spectrum of interoperability challenges, some familiar (resource description, workload estimation, quality of services) but others which are evidently beyond current off-the-shelf solutions. These include representing quality of service for collections of related jobs which are embedded in complex business processes, and the need to describe the semantics of multiparty negotiations including hierarchical conversations.

References

Aberer Karl, (2001). *P-Grid: A Self-Organizing Access Structure for P2P Information Systems*, Sixth International Conference on Cooperative Information Systems (CoopIS 2001), Trento, Italy, Lecture Notes in Computer Science 2172, Springer Verlag, Heidelberg, 2001.

Abdel Razek M, Frasson C., Kaltenbach M. (2004) Dominant Meanings towards Individualized Web Search for Learning Environments In:George D. Magoulas,Sherry Y. Chen (eds.):: Advances in Web-based Education: Personalized Learning Environments, IDEA Group Publishing, USA.

Anderson, J. R. (1996). ACT: A simple theory of complex cognition. *American Psychologist*, 51, 355-365.

Byrnes M.D, , Anderson J.R., (2001). Serial modules in parallel: The psychological refractory period and perfect time-sharing, Psychological Review, 108, 847–869. 2001.

Barrett Helen C. (2004). *Differentiating Electronic Portfolios and Online Assessment Management Systems*, Conference SITE 2004 March 1-6, 2004 * Atlanta, Georgia.

Bauer, M., Williamson, D., Mislevy, R., & Behrens, J. (2003). Using Evidence-Centered Design to Develop Advanced Simulation-Based Assessment and Training. World Conference on E-Learning in Corp., Govt., Health., & Higher Ed. 2003(1), 1495-1502. [Online]. Available: http://dl.aace.org/13955

De Riley & Scheideler (2004). *Guaranteed broadcasting using SPON: Supervised P2P overlay network*, In 2004 International Zurich Seminar on Communications.

ePortConsortium (2003). Electronic Portfolio White Paper, Ver 1.0, nov 2003

Foster, I., Kesselman, C., Nick, J. and Tuecke, S., (2002). *The Physiology of the Grid: An Open Grid Services Architecture for Distributed Systems Integration*. Open Grid Service Infrastructure WG, Global Grid Forum,.

Gouaich A., Cerri S.A., (2004). *Movement and interaction in semantic GRIDs: dynamic service generation for Agents in the MIC deployment environment*, 7th HLRS Metacomputing and Grid Workshop, April 26-28, 2004, Stuttgart, Germany.Gouardères, G., (2004a). *e-Qualification : from e-Assessment to e-Accreditation*, In European Learning Grid Infrastructure, Integrated Project FP6 #002205, 1st ELeGI Meeting in Barcelona, March 1-3, 2004

Gouardères G., (2004a). *Grid Learning Services 2004 Workshop to be held with ITS2004 Maceio Brazil, http://www.info.uqam.ca/%7Enkambou/gls/gls04.ht*

Gouardères G., (2004b). *Architectures cognitives, Agents Emotions et Grille,* 72e conférence de l'ACFAS, 10-14 mai 2004, Montréal.

Hughes, I. & Large, B. (1993). Staff and peer-group assessment of oral communication skills. *Studies in Higher Education*, 18, 379-385.

Hughes J., Attwell G., 2002, Framework for the Evaluation of E-Learning, ECER Conference September 2002: Lisbon

Kay, J, (2001). Scrutability for personalised interfaces, ERCIM NEWS, Special Theme Issue on Human Computer Interaction, 46, July, 49-50.

Keller R. J., Watkins R (1995); What Works and What Doesn't: Evaluation beyond Kirkpatrick, Performance and Instruction 35 (2)

Kirkpatrick D (1975); Techniques for Evaluating Training Programmes

Kitamura, Y. and Mizoguchi, R., "Ontology-based Description of Functional Design Knowledge and Its Use in a Functional Way Server," *Expert Systems with Application, 24, 2*, pp. 153-166, 2003.

Moore M.G., (1993). *Theory of transactional distance*, In: Desmond Keegan (Ed.), Theoretical principles of distance education.

Nejdl W., Wolf B., Qu, C. & al., (2002). EDUTELLA: A P2P Networking Infrastructure Based on RDF. In Proceedings International WWW Conference (11), Honolulu, Hawaii, USA.

Park Y., Byrd R.J., Boguraev B.K., 2003, *Towards Ontologies On Demand*, IBM T.J. Watson Research Center 19 Skyline Dr., Hawthorne, NY 10562, fyoung parkg@us.ibm.com,

Razmerita, L., (2004), User modeling and personalization of the Knowledge Management Systems, book chapter, in Adaptable and Adaptive Hypermedia, to be published by Idea Group Publishing, UK.

Razmerita L. Gouardères G. , 2004 Ontology based User Modeling for Personalization of Grid Learning Services, Grid Learning Services 2004 Workshop to be held with ITS2004 Maceio Brazil, http://www.info.uqam.ca/%7Enkambou/gls/gls04.ht

Rossett, A. & Sheldon, K. (2001). Beyond the Podium: Delivering Training and Performance to a Digital World. SF: Jossy Bass.

Saba F., Shearer R. L., (1994). Verifying key theoretical concepts in a dynamic model of distance education. The American Journal of Distance Education. 8 (1), 36-59.

Schoder D. & Fischbach K., Peer-to-Peer Prospects, CACM, Vol. 46, No. 2, pp. 27-29, February 2003.

Scrivens M. Evaluation Core Courses; http://eval.cgu.edu

Talia D., Trunfio P., `Toward a Synergy Between P2P and Grids', IEEE Internet Computing, vol. 7, no. 4, pp. 94-96, 2003.

Yatchou R., Gouardères G., Nkambou R. , 2004 Ubiquitous Knowledge Prosthesis for Grid Learning Services: The Grid-e-Card, Grid Learning Services 2004 Workshop to be held with ITS2004 Maceio Brazil, http://www.info.uqam.ca/%7Enkambou/gls/gls04.ht

B) SEES #3a
Feasibility Analysis

1 Specification Status

1.1 Summary of the goals

1.1.1 Goals

The objectives are to propose a new approach for quality insurance in ODL (Open & Distance Learning) that is called e-Qualification and to implement it within the "advanced service-oriented Grid based software architecture for learning".

Three different dimensions are targeted by this SEES:

- The educational dimension
- The social dimension & community-definitions
- The technological dimension

1.1.2 Comments

Concerning the technological dimension, the concept of Grid Learning Services (GLS) seems to be very interesting to explore by defining and developing new services for the Grid.

The introduction of agents oriented technology in the Grid neighbourhood is extremely beneficial with the development of that new technology.

Moreover, the proposal of the definition of ***a model of a Learning Grid Interface*** seems to be an added value in the framework of the E-LeGI project.

The concept of dynamicity in the VO is completely interesting and we think that it is worth to be explored.

1.2 Relevance of the initial specifications

The initial specifications are relevant enough to ensure a first step toward the next phase, i.e. the detailed software requirements specifications.

2 Organisational and pedagogical feasibility

Overall summary.

As a part of SEES #3, SEES #3a plans to develop and test Grid-based ongoing evaluation-services for formal and informal learning processes in an open and distance learning context. The present SEES shows a complete new approach for evaluation, guidance and quality insurance. Its main aim is to improve learning quality and efficiency through Grid-based services of any form of eLearning.

SEES #3a it is not a learning scenario per se. It can be seen as a meta-level system to facilitate user profiling and evaluation, to evaluate a certain learning system, to support learning-community building and to assess, give feedback and validate users' knowledge acquisition.

E-qualification services may enhance the quality and efficiency of every kind of open learning community, by increasing the transparency of knowledge acquisition through synchronous assessment and evaluation services. SEES #3a is very innovatory and its results may provide valuable results for new and more effective forms of organisation of virtual learning communities.

The services developed in the context of this SEES will be appropriate to a diversity of application areas.

One crucial aspect to take into account is the protection of data secrecy. Users of a certain service need to be absolutely sure, that all profiling data will be handled confidentially. Furthermore users should have the right to decide which data may be collected, when a certain learn or work process should not be monitored and which kind of data should not be at all monitored or recorded. If these aspects are not considered the most part of the potential users may not accept the service.

Testbeds developers, that will contribute to the development, use and testing of the eQualification services need technical, pedagogical and ethical support in order to adapt the system into learners/users needs.

2.1 Motivation

The main interests from the organisational point of view:

The present SEES shows a complete new approach for assessment and quality insurance in an open and distance learning context. New methods and approaches for ongoing vocational evaluation shall be developed. The transparency of knowledge acquisition through synchronous assessment and evaluation services shall be made possible.

Ongoing evaluation and assessment will take place by continuous monitoring and evaluation and will applicable for formal and as well as for informal learning processes. In order to achieve this aim generic Grid services for continuous qualification of human learning will be defined and build.

Learners/users may practice as often as they need and want, the system will provide immediate and personalized feedback. The pedagogical effectiveness of any kind of open and distance learning community may be increased.

2.2 Organisational and pedagogical analysis

2.2.1 Learner/user-centred aspects of interest

Summary of the analysis of the main motivational aspects:

The different users perspectives shall be analysed

System user: the quality, efficiency and accuracy of the e-qualification system will be decisive for users-motivation. Therefore this process must be carefully developed and implemented. Some important rules have to be followed with a special focus on clear evaluation criteria and good quality feedback to users.

Learner in an eLearning community: To have the chance to practice and get individualised feedback as often as one need rises learning motivation. To feel permanently observed will probably drop motivation and rise the fear of failure. An automated transparent monitoring process might create some resistances on learners' side. To know that ones learning and work is being monitored and evaluated by a machine may raise fears of failure. The learner needs to be the one to decide, if his practising and working process will be monitored or not.

Summary of the analysis of the main support aspects:

No support strategies for all kinds of services' users have been specified.

Testbeds developers, that will contribute to the development, use and testing of the eQualification services need technical, pedagogical and ethical support in order to adapt the system into learners/users needs.

Summary of the analysis of the main evaluation aspects:

The major clusters of variables identified in the e-qualification framework are a good starting point for the development of the Grid-based services needed for e-qualification. Redefinition and refining of the framework should be done according to the continuous evaluation process of the testbeds.

A formative and summative evaluation concept should be developed in order to evaluate the acceptance of the service by the different users with a special focus on personal and emotional aspects.

2.3 Peer comments

The objective of SEES #3a, regarding the e-qualifications is very interesting in order to limit the cognitive overload and to reduce the transactional distance.

We think that this objective is feasible but very demanding. We believe that studies regarding the knowledge representation and learner (community) profile will have to be carried out, in order to make the exact match among demands and education material.

Furthermore some parameters for pedagogical and technological aspects will have to be defined in order to evaluate in the same way the education material. Than some rules will have to be established in order to provide individualized and personalized learning material to each learner.

Finally studies regarding metadata will have to be developed in order to label the available education material.

3 Technical feasibility

Like it is written in the document, some technical constraints must be analysed in detail in order to make the proof that this SEES is feasible technically :

- Programmability and dynamic composability of Grid applications,
- Automated mapping of today's applications and optimized performance,
- New paradigms of applications: e-Qualification, and identified bottlenecks as lack of:
  - automated composition, partitioning and mapping of applications,
  - easy programmability of Grid applications,
  - flexible middleware for guaranteeing performance.

Nevertheless, some aspects like the acceptance of a user in Virtual and Dynamic Organisation have been explored in the GRASP project; It seems to be like the negotiation phase in the SLA monitoring.

Despite the demanding features of the Grid infrastructure, services and performances, we are confident about the technical feasibility. The risk is not to reach the level of performance and the necessary flexibility.

But in all the cases, the utility of the functionalities described in the document will be proven.

The mandated constraints: be robust, secure, fault tolerant, interoperable …
For the moment Grid is in a research field and can't fulfil completely these requirements almost industrials. But we keep in mind the necessity of implementing a system which should employ ***flexible negotiation techniques*** to enable other parties to join with ease the Dynamic Virtual Organisation.

3.1 Summary of Grid functionalities required and Tools

- Peep to Peer
- SLA / negotiation
- VO and groups
- Notification/messaging
- Workflow management
- AAA
- Service Composition

One of the main Grid functionality required seems to be the P2P.

TOOLS :

The integration of Grid technologies in the tools (ASIMIL and TESTOOL) and the integration of these tools in a Grid Infrastructure must be evaluated more finely.

3.2 Peer Comments

This SEES is not a typical one as it intends to provide e-Qualification as an embedded Grid Learning Service for a wide range of formal and informal learning scenarios.

ASIMIL and TESTOOL are promising Test-beds as they are well understood applications of the partner institutions, but it is not yet defined how especially TESTOOL will be enhanced or integrated with the e-Qualification services.

However, the main challenge will be the transfer of e-Qualification concepts to general services for the informal learning scenarios VIAD and EnCOrE. These scenarios have to be designed according to the testability requirements. The use of e-Qualification processes as aggregation methods to dynamically gather people in their virtual organisations has to be carefully specified, taking into account the special demands of the actors in these SEESs.

SEES #3 has a high interference with the concepts of knowledge space theory and adaptive assessments drawn in WP 10: "Conceptualisation and knowledge representation for contextualised and experiential based learning approaches". These have to be investigated further, leading to coherent concepts and services for the ELeGI infrastructure.

Part V: SEES #3b (e-Assessment)

A) SEES #3b
Analysis and Requirements Specification

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Version History

Version	Comments, Changes, Status	People
1	First proposal – Step 1: 1,2,4f,4g,20,23,24	Debra Haley, Pete Thomas, Bashar Nuseibeh
2	Step 2: 1c,2c,3ab,4a-e,f,5a-f,20,23	Debra Haley, Pete Thomas, Bashar Nuseibeh
3	Step 3: 7ab,10-27	Debra Haley, Pete Thomas, Bashar Nuseibeh

Project Definitions

0 SEES Glossary

Term	Definition
LSA	Latent Semantic Analysis
eAssessment	Automatically marking student answers to free form, short essay questions
Formative assessment	Takes place during a learning episode; for use by the learner
Summative assessment	Takes place at the conclusion of a learning episode, i.e., an exam; communicates achievement to learner and other interested people

Project Drivers

1 The Purpose of your SEES

1a The user problem or background to the project effort

Essay exams are considered superior to multiple choice questions (MCQ) to assess deeper student knowledge. MCQs, compared to essay questions, are easier to mark but are harder and more time-consuming to create.

Marking student essay answers is an enormous burden on the markers. In universities with large classes, many markers are required to assess answers in a reasonable timeframe. For instance, computing courses at the Open University in the UK typically have two to three thousand students. Using many markers is not only costly, it raises issues of reliability among the markers.

1b Goals of the project

SEES #3 plans to provide a Grid-based LSA assessment service that can be used by learners and instructors in technical and scientific domains. Both formative and summative assessment will be provided.

LSA is a statistical natural language processing technique originally developed for information retrieval but now also used to assess the meaning of text. It has been used successfully in non-technical and non-scientific domains to provide immediate, reliable, individualised, and content-specific feedback to learners and teachers. This project aims to produce an assessment service using LSA as the engine and seeks to discover any modifications or additions to LSA theory necessary for success in a highly technical domain.

Formative assessment gives the learner intermediate feedback during the course of a learning episode. Feedback will be guidance with a grade range rather than a specific grade. To validate the effectiveness of the formative assessment, we will compare students who use the system with those who don’t.

Summative assessment, which occurs at the end of a learning episode, communicates final results to learners and other interested parties. Feedback will be a specific grade together with indications of what was missing from the answer. To justify the system, we will show that the marks generated by LSA must correlate to human markers as well as human markers correlate with each other.

1c Opportunities and "return of value"

For the learner – formative assessment

- The opportunity to “practice” as often as needed or desired
- Immediate, individualised, content-based feedback

For the learner – summative assessment

- More objective grading results – the LSA system does not mark down when it is tired or mark favoured students higher
- Quicker results

For the teaching institution – summative assessment

- Lower cost to assess essays
- Quicker results

- Deeper assessment because essays can be used on exams rather than multiple choice questions (MCQs)

The work can be generalized to other domains by changing the corpus with which one trains LSA. The software itself would stay the same – it is the training documents that serve as input to the software that change according to the domain.

2 Client, Customer and other Stakeholders

2a The client is the person/s paying for the development, and owner of the delivered system.

The European Commission

ELeGI

The Open University Computing Department – Pete Thomas

2b The customer is the person/s who will pay for the SEES' service.

A university or other educational institution offering online exams and practice exams.

2c Other stakeholders

Users include teachers, learners, administrators, and system administrators.

Potential enemies are learners who don't trust the marks assigned by the system and people who currently do the marking.

At the OU, courses are developed by a team of experts – these are the people who would collaborate to build the corpora. Existing systems for eAssessment are experimental in nature and involve domains other than Computer Science. We don't plan to market the service since one of our ELeGI team members will be the first user of the LSA marking system. Offering the service to others outside of the Computing Department of the OU is beyond the scope of this project.

Learners will be involved in testing and providing feedback on the first prototypes. Teachers will be involved because one of our team members is the first user of the LSA marking system.

3 Users of the Service

3a The users of the service

Instructors will build and maintain corpora and produce practice essay questions and exams. They will need to have basic word processing skills and the ability to follow directions on a screen. Since our teachers are expert computer scientists, we don't anticipate any problems with our teachers lacking needed skills.

Learners will write essays and receive marks. They must have basic word processing skills and basic computer literacy. Since these learners are computer science students who have met certain pre-requisites, we don't anticipate any problems with our students lacking needed skills.

Systems administrators will keep the system going. They must have adequate skills in the language in which the system will be developed as well as the platform that will be used. Also, they must be familiar with Grid-based services.

3b The priorities assigned to users

Key users – teachers – if they aren't able to set up and use the system easily, they wont use it.

Secondary users – learners – they will use the system if their instructors require it for summative assessment. For formative assessment, they will use a high quality service offering accurate and timely feedback.

3c User participation

Pete Thomas – highly motivated for the system to work and willing to spend time to specify and test the system.

Project Constraints

4 Mandated Constraints

4a Solution constraints

The SEES must use a solution based on Grid services.

We assume that student essays will be supplied in digital format.

4b Implementation environment of the current system

Currently, essays are marked manually by human tutors. Different courses use different systems. Some courses offer online exams and thus digital versions are available to be marked. The course we will use to test the system offers online exams. We will use the existing server to collect the exam answers and to host the LSA assessment service. The service will run under Windows.

4c Partner applications

The work described in this document to be carried out under the ELeGI umbrella is a prototype system for one course in the computing department. If the tests are successful, the OU may choose to adapt the system for more courses. This additional work is not in the scope of ELeGI.

4d ELeGI related software

Tool	**Usage** (whether, how, why, by whom)
GRASP	SEES #3 will use GRASP for the following reasons. Its ability to overcome performance and quantity limitations by combining required resources overcomes two main drawbacks of LSA, i.e., high computational needs and need to store extremely large corpora. Its ability to provide security management across different administrative domains to ensure privacy of student information. Its functionality of charging services on the basis of effective use and effective delivered QoS provides accounting services to the institution using LSA.
IWT	SEES #3 does not need IWT to function but perhaps IWT might want to incorporate LSA assessment into its automatic student evaluation.
Finesse	No
Virtual Control Laboratory	No
BuddySpace	No
KMi Stadium	No
Magpie	Magpie has potential use as a tool for locating and sharing appropriate corpus documents.
Madkit	No
Strobe	No
Webra	No
DYXWEB	No
...	

4e Anticipated workplace environment

University and home offices for teachers. Home or business offices for learners.

4f How long do the developers have to build the system?

Eighteen months for the requirements and if approved by the EC, another 2 ½ years for the implementation. No internal deadlines.

4g What is the financial budget for the SEES?

Full time research fellow and PhD student

Part time senior lecturer

Part time professor

Half of the PhD studentship is funded by the OU Department of Computing. The remaining funding comes from the ELeGI project.

5 Test-Bed Design

5a Pedagogical / didactical approach

Approach	**Usage** (whether, how, why, by whom)
Collaborative learning, cooperative learning, social learning, project related learning	
Constructivist learning	For learners – frequent practice and feedback on quality of written essays allows learners to construct their own knowledge of the subject.
Experiential learning, active learning, Problem based learning (PBL)	
Personalised, individualised learning	
Ubiquity and accessibility (anytime/anywhere)	The service needs to be available at any time the learners or teachers wish to use it.
Contextualised, adaptive, situated learning	
...	

5b Learning contents

LSA needs an initial training corpus consisting of both general and more specific texts. The specific texts are human-marked answers to essay questions. For this SEES, the Open University will provide these answers from student volunteers.

The general texts are portions of the course textbook authored and owned by the Open University. Additionally, texts need to be gathered by using the semantic web and conversational services of the Grid.

5c User support

The developers of this SEES are the users and are thus highly motivated to ensure its success. All necessary support will be provided to both instructors and student users of the service.

5d Training needs

Students using the formative assessment service should be able to use the system with no training. This requirement implies that a well-designed user interface is essential.

Teachers wishing to use either the formative or summative assessment services need to be trained on how to select and prepare the corpus. A short tutorial or online guide should be sufficient for the training.

5e Organisational aspects

The e-assessment of this SEES is confined to a single organisation – the Computing Department of the Open University. The developer is a PhD student in the department under the supervision of two faculty members – all three of us are committed to the success of ELeGI. Our service will be tested and used for a course led by one of the faculty members. Depending on its success, other course teams may choose to use the system. However, while the adoption of our e-assessment system would be an appreciated commendation, it is not necessary for the purposes of ELeGI to involve any other organisation in the Open University.

5f Economic aspects

The obvious economic advantage of e-assessment is a reduction in cost of human markers, although some humans markers will always be necessary to calibrate and train the LSA marking system. The economy of scale is such that if more courses choose to use the service, the more the University will save. This optimistic cost forecasting does not include the cost of storing more corpora (but memory is cheap) and the cost of increasing the computing power available, neither of which we are able to estimate at this time.

We are not able to estimate the break even point with the knowledge we have now. We have some idea of the expense of grading essays by human tutors but don't yet know the expense of preparing a corpus to train LSA.

5g Quality Aspects

For formative assessment, the LSA system will be evaluated by student feedback and by any improvement on a TMA (tutor marked assessment). No formative assessment from LSA would be offered for the first TMA. Students will be offered the choice of using the formative assessment service after the first but before the second TMA. The difference in the two TMA results of students using formative assessment will be compared to students who chose not to use formative assessment.

For summative assessment, the LSA results for an entire course will be compared with the human marked exams for the entire course. The LSA results need only match (i.e., not exceed) the inter-rater reliability of the human marked exams.

To ensure that the LSA marking results do not drift away due to changes in the domain, they will need to be compared to some human marked exams every time new training documents are added to the system. The Computing Department of the OU always double-checks the inter-rater reliability because more than one human always marks each exam. Even after the LSA system is in place, we foresee human markers grading some of the exams as a double check of the LSA system. If, after adding new training documents, the correlation between LSA and human markers is lower than it was before adding the new training documents, then more than one human marker will need to mark some student exams.

5h Technology

Functional requirements to Grid technology	
Functionality	**Usage** (whether, how, why, by whom)

Mass calculation	GRASP
Distributed resources	GRASP
Peer-to-peer	No
Discovery and brokering	No
Metering and accounting	GRASP
Service Level Agreement Negotiation	The heaviest need for computational power required by the LSA algorithm occurs once - when an exam is prepared thus necessitating the system training. The computational results are then used for both types of assessment. Therefore, the time for distributing calculation would be at the system training time and requires the lowest quality of service (QoS) in terms of speed. Next, during summative assessment, which occurs once for every exam, a slightly higher (faster) QoS is needed. The highest (i.e. fastest response time) QoS is required for formative assessment, which can take place at any time during the presentation of a course and for which students are actively waiting for a response.
Monitoring	No
Data, information and knowledge management	Helpful to enlarge and increase the size and quality of the corpora documents
Virtual organizations and groups	No
Load Balancing	No
Fault tolerance	No
Advance Resource Reservation	No
Notification/Messaging	No
Workflow management	No
Certification	No
Authentication, Authorization and Accounting (AAA)	Yes
Trust Management	No
Digital and intellectual rights	Yes
...	

Communication and collaboration activities to be supported by Grid services	
Functionality	**Usage** (whether, how, why, by whom)
email	No
Discussion for a	No
Instant Messaging	No
Chat	No
Audio conferences	No
Video conferences	No
Application sharing	No

Shared editing of documents	No
Shared collection of structured information (databases)	Yes
Shared structuring of knowledge (ontologies)	No
Shared maintenance of knowledge (resource centres, repositories)	Yes
Shared projects (planning of tasks, timelines resources)	No
Collaborative simulations, games	No
...	

6 Relevant Facts and Assumptions

6a External factors that have an effect on the product or service, but are not mandated requirements constraints.

Such factors may come up during the detailed functional requirements specification.

6b Assumptions that the team are making about the project

Student essays and course materials will be available in digital format.

One Open University course will provide data for testing and training the system.

The PhD student will remain with ELeGI or will be able to be replaced.

The faculty members will remain with ELeGI or will be able to be replaced.

The Grid infrastructure will be provided by other ELeGI partners.

The confidentiality of student essays will be secured.

Knowledge about interfacing with the Grid will be provided by other ELeGI partners.

Functional Requirements

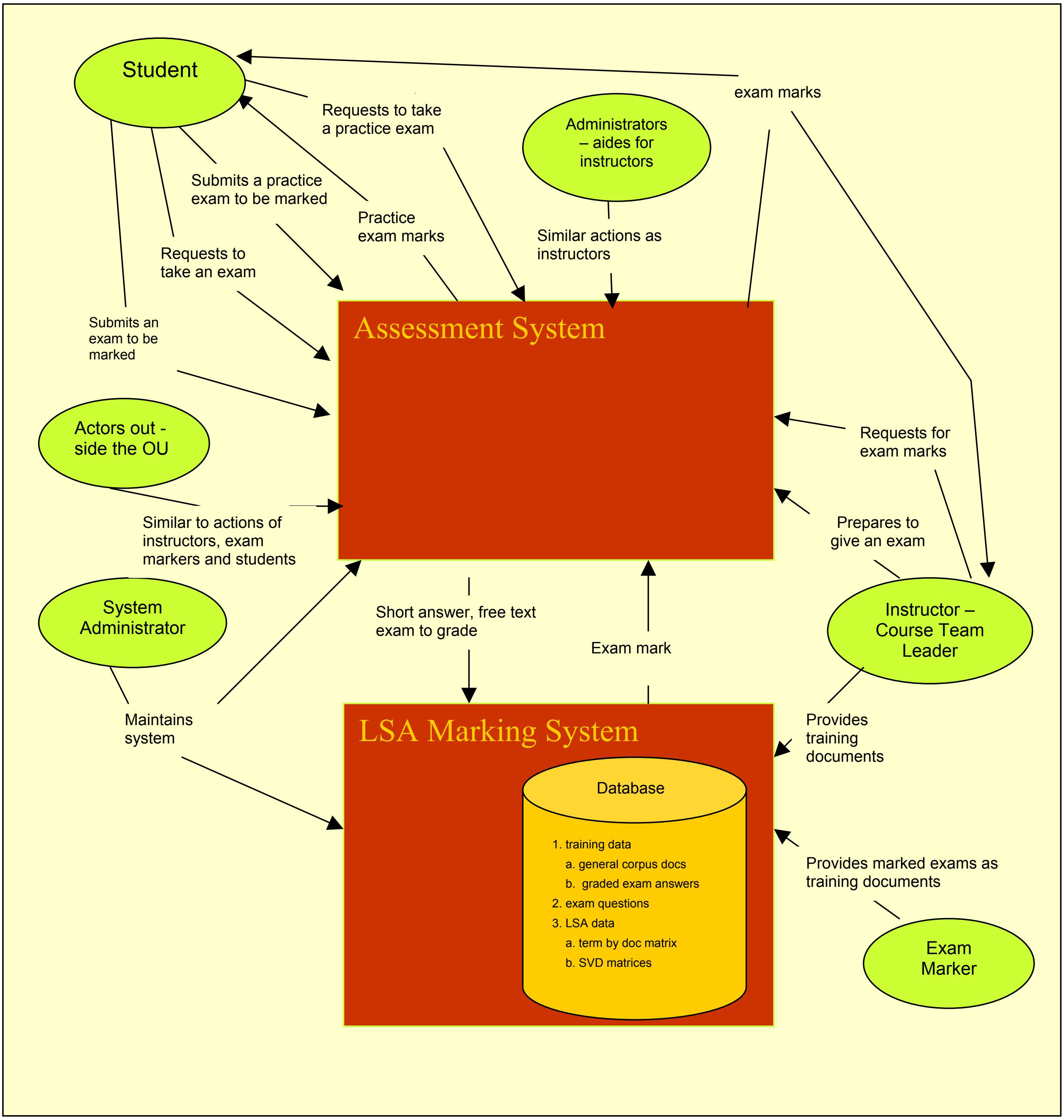
7 The Scope of the Work

7a The context of the work

The diagram below shows an assessment system and an LSA-based marking system. The work planned to be completed for the ELeGI project is the LSA marking system. There will be no direct interface between students and the LSA marking system. Instructors and exam markers will provide the training data to be used by the system.

This work assumes the existence of some system to present exams to students and receive the answers online. Any essays to be marked are passed from the assessment system to the LSA marking system. The marking system then passes the marks back to the assessment system.

This breakdown of the assessment system and the marking system shows how SEES #3 and SEES #3a are complementary. SEES #3 is working on the broader problem of providing e-assessment and the marking of non essay-based questions. SEES #3a enriches the service being produced by SEES #3 by adding the ability to mark free text, short answer essays.


Student
exam marks
Requests to take
a practice exam
Administrators
– aides for
instructors
Submits a practice
exam to be marked
Practice
exam marks
Similar actions as
instructors
Requests to
take an exam
Submits an
exam to be
marked
Assessment System
Actors out -
side the OU
Requests for
exam marks
Prepares to
give an exam
Similar to actions of
instructors, exam
markers and students
System
Administrator
Short answer, free text
exam to grade
Instructor –
Course Team
Leader
Exam mark
Maintains
system
LSA Marking System
Provides
training
documents
Database
1. training data
a. general corpus docs
b. graded exam answers
2. exam questions
3. LSA data
a. term by doc matrix
b. SVD matrices
Provides marked exams as
training documents
Exam
Marker

7b Work partitioning

Event Name	Input & Output	Affected/ Involved Actors
student requests to take an exam	out: exam questions	
student submits exam to be marked	in: exam answers; out: mark	
student requests to take a practice exam	out: practice exam questions	
student submits practice exam to be marked	in: practice exam answers; out: advice on quality of answer	
instructor requests marks	out: student marks	
create a corpus - instructor provides initial training documents	in: course text books and other relevant text	exam marker
instructor prepares for exam	in: exam questions, specimen solutions, graded exams (training data)	student
System administrators maintain system		

8 The Scope of the Service

8a Service Boundary

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

8b Use case list

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9 Functional and Data Requirements

9a Functional Requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9b Data requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

Non-Functional Requirements

10 Look and Feel Requirements

10a The interface

The interface should adhere to the Open University look and feel.

10b The style of the service

It should be serious because it involves student grades.

11 Usability Requirements

11a Ease of use

Students should be able to use the system with no training.

Instructors will need about an hour to learn what kinds of documents to train the system with, how to create the exam questions for LSA to mark, and how many human marked essays are needed.

11b Personalization and internationalization requirements

The service will be presented in (British) English only.

No personalization issues are yet identified.

11c Ease of learning

Students capable of taking a distance education course (i.e., somewhat computer savvy) should need no time to learn how to use the system.

Instructors should be able to learn what they need to set up and train the system for their course by reading an online guide.

11d Accessibility requirements

If the LSA assessment system is to be adapted by The Open University as a whole, it would need to be accessible to students with various disabilities to comply with OU policy. For example, a voice synthesizer should be available for vision-impaired students and the interface should use large areas for “clicking” for students with motor impairments.

12 Performance Requirements

12a Speed and latency requirements

For students using the service for formative assessment, the system must be fast enough that the students do not lose interest, perhaps a minute at the very most.

For summative assessment, a day is not too long to receive marks.

For instructors training the system, several days, while not desirable, might be acceptable since the training need be done only once for each exam.

12b Safety critical requirements

None identified.

12c Precision requirements

The formative and summative assessment provided by the service must correlate as highly with human markers as human markers correlate with each other.

12d Reliability and Availability requirements

The formative assessment service must be available 24 hours 7 days a week during a course presentation with very occasional down-time acceptable.

The summative assessment service can tolerate failure as long as the accompanying assessment system does not lose any of the students' answers.

12e Robustness requirements

The Grid service should stay operational even with decreasing bandwidth.

Student exams must be able to be recovered in the event of system failure.

12f Capacity requirements

The service must handle several thousand simultaneous students while they are taking exams.

Other times, some percentage of students will be using the service for formative assessment.

Instructors will require heavy computational ability before exams to train the system.

12g Scalability or extensibility requirements

Storage and computational ability as more courses use the service. We are not able to estimate them at this time.

13 Operational Requirements

13a Expected physical environment

Instructors and students will use the system indoors, in offices or computer labs.

13b Expected technological environment

The service requires the use of a computer equipped with a web (Grid?) browser and Word.

13c Partner applications

The service must interface with Open University systems that administer online exams.

The service must interface with the major web browsers.

13d Productization Requirements

For users outside the Open University, a way must be found to account for and charge for its use.

14 Maintainability and Support Requirements

14a How easy must it be to maintain this product?

Developers other than the original developer must be able to maintain the service.

14b Are there special conditions that apply to the maintenance of this product?

None identified.

14c Supportability

As long as the service remains in the Open University, no support need be provided other than the online documentation. Current users will provide informal support to future users, if needed.

14d Portability requirements

The system must be available from the major web browsers.

15 Security Requirements

15a Access requirements

Students will have access to their own scores.

Students will have access to the parts of the service that allow them to take an exam and to practice taking an exam.

Instructors will have access to all student scores in courses for which they are responsible.

Instructors will have access to the parts of the service that allow them to train the system and set up questions for the exams and practice exams.

No other access is allowed.

15b Integrity requirements

Student scores must be kept confidential.

Exam questions and answers must be protected from viewing or alteration by unauthorized users.

15c Privacy requirements

Student information must be kept private. The information includes student contact information and scores.

15d Audit requirements

The marking system must store student marks to assure that marking has been conducted fairly.

15e Immunity requirements

Not known at this time.

16 Cultural and Political Requirements

16a Are there any special factors about the product that would make it unacceptable for some political reason?

The marking service must be as accurate compared to human markers as humans markers correlate to each other.

17 Legal Requirements

17a Does the system fall under the jurisdiction of any law ?

Student confidentiality must be maintained.

17b Are there any standards with which we must comply ?

It is possible that we will want to comply with the IMS QTI specification. (See http://www.imsglobal.org/question/qti_item_v2p0pd/implementation.html), but only for the specification of the question and not for the answer because, although the IMS QTI specification allows a short essay question on an exam, there is no allowance for marking the exam: "…scoring of extended text responses is beyond the scope of this specification." (See document at same URL under **Writing a Postcard).**

Following is an example of the specification for short essay questions taken from http://www.imsglobal.org/question/qti_item_v2p0pd/implementation.html :

```
<?xml version="1.0" encoding="UTF-8" ?>
<!--  This example adapted from the PET Handbook, copyright University of
Cambridge ESOL Examinations   -->
<assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_item_v2p0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_item_v2p0
../imsqti_item_v2p0.xsd" identifier="extendedText" title="Writing a
Postcard" adaptive="false" timeDependent="false">
<responseDeclaration identifier="RESPONSE" cardinality="single"
baseType="string" />
<outcomeDeclaration identifier="SCORE" cardinality="single"
baseType="integer" />
<itemBody>
<p>Read this postcard from your English pen-friend, Sam.</p>
<div>
  <object type="image/eps" data="postcard.eps">
  <object type="image/png" data="postcard.png">
  <blockquote class="postcard">
  <p>
  Here is a postcard of my town. Please send me
  <br />
  a postcard from your town. What size is your
  <br />
  town? What is the nicest part of your town?
  <br />
  Where do you go in the evenings?
  <br />
  Sam.
  </p>
  </blockquote>
  </object>
  </object>
</div>
<extendedTextInteraction responseIdentifier="RESPONSE"
expectedLength="200">
<prompt>Write Sam a postcard. Answer the questions. Write 25-35
words.</prompt>
</extendedTextInteraction>
</itemBody>
</assessmentItem>
```

Project Issues

18 Open Issues

18a Issues that have been raised and do not yet have a conclusion.

Will LSA be successful in marking answers in a technical domain?

Should instructors have access to practice exam results?

19 Off-the-Shelf Solutions

19a Is there a ready-made system that could be bought?

No.

19b Can ready-made components be used for this product?

Not identified at this time.

19c Is there something that we could copy?

No.

20 New Problems

20a What problems could the new system cause in the current environment?

None from the point of view of computer software because the current environment consists of human markers hand-marking essays. The potential problems are lack of acceptance by human markers who might not have their contracts renewed and mistrust of the reliability of the marks by both instructors and learners.

20b Will the new development affect any of the installed system?

The current system uses at least two humans to mark every essay. In this way, the reliability of our marks is increased. The LSA service will replace one of the human markers. Thus, there will be no procedural change in the current system except that LSA marking will mean that we will reduce by one the number of human markers.

20c Will any of our existing users be adversely affected by the new development?

The workload of exam markers will be reduced. This would mean that fewer markers will need to be hired.

20d What limitations exist in the anticipated implementation environment that may inhibit the new system?

The new system requires essays to be submitted online. Not all current courses require online submittal of essays.

20e Will the new system create other problems?

Acceptance of the accuracy of the marks is a potential problem with both students and faculty. If students don't trust/agree with the LSA-generated summative marks, they will be able to request a review. Currently, several human markers grade exams and thus marks can vary. Students currently can request a review so this aspect would not change with the new system.

21 Tasks

21a What steps have to be taken to deliver the system?

To be determined after Functional Requirements are better understood.

21b Development phases

To be determined after Functional Requirements are better understood.

22 Cutover

22a What special requirements do we have to get the existing data, and procedures to work for the new system?

This is a new service – we will use new data and new procedures.

22b What data has to be modified/translated for the new system?

We will need digitized versions of course materials.

23 Risks

- Inaccurate metrics - ?
- Inadequate measurement - ?
- Excessive schedule pressure – The proposed major user of the system is part of the ELeGI project and will be able to plan the introduction of the new service when available and appropriate. The current system need not be phased out until it is clear the new service works.
- Management malpractice – highly unlikely
- Inaccurate cost estimating – If not enough resources are available, features will need to be cancelled or postponed.
- Silver bullet syndrome - ?
- Creeping user requirements – This is always a risk. However, as previously stated, the principal user is part of the development effort and thus unlikely to be unreasonable in his requirements.
- Low quality – One developer, the principal user, is highly motivated to create a high quality service because he will be the direct beneficiary of this service. The other developer is highly motivated to create a high quality service because this work will comprise part of the requirements for her PhD.
- Low productivity – The Open University has sufficient office space, computer facilities, and motivated people to ensure high productivity.
- Cancelled projects – Much, but not all, of the proposed work is funded by the EC. If the EC chooses to cancel their support, the project will be put at risk if alternate funding cannot be found.
- Losing any of the three team members – All of us can be replaced but there would be a delay in any future deliverables. D. Haley is a PhD student and the primary developer of the system. The Open University could recruit another interested student, which shouldn't be too difficult because they are able to offer a studentship. P. Thomas is a very interested and involved faculty member. He wants the system to work because he intends to use it. Another interested faculty member could probably be located because other course managers have the same problems and needs as

Dr Thomas although not the same knowledge of marking systems. B. Nuseibeh is invaluable for his higher-level advice, encouragement, and knowledge of bureaucratic necessities, not just for ELeGI but for the entire Computing Department. Should we lose Prof Nuseibeh, the department would need to fill his position quickly.

24 Costs

We are unable to provide detailed cost estimates at this time. We plan to develop this information as the functional requirements are better understood.

25 User Documentation

25a The plan for building the user documentation

We plan online documentation as part of the service.

B) SEES #3b
Feasibility Analysis

1 Specification Status

1.1 Summary of the goals

1.1.1 Goals

The goal of this SEES is to provide a Grid-based LSA assessment service. It means the automatic assessment of student's work, double checked with a human marker.

The nature of the assessment is both :

- formative assessment (used by learners during the learning period)
- summative assessment (conclusion of a learning period, i.e. exam)

1.1.2 Comments

The availability of the student essays in a digital format is not an assumption but a certainty.

Acceptance by students and human markers will have to be proofed.

Accuracy of the marks and reliability of the overall system could be a problem.

1.2 Relevance of the initial specifications

The initial specifications describe the framework in which the intended service will operate, but include yet no further description of the LSA technology. This will have to be provided for the detailed requirements specifications.

2 Organisational and pedagogical feasibility

Overall summary:

As a part of SEES #3, SEES #3b will develop and test a new service for open and distance learning. SEES #3b is not a learning scenario per se. Its main aim is to improve learning quality and efficiency through Grid-based LSA assessment services. The introduction of LSA to assess the meaning of text, with focus on qualitative rather than quantitative immediate and individualised feedback, is innovative and enhances the quality of an open learning environment. In general, the pedagogical effectiveness as well as student's motivation in any open learning community will benefit from the service.

The system has to be as precise and effective as possible in order to be accepted by both students and teachers.

The planned evaluation of the LSA assessment will give the opportunity to explore the potentials of such a system for open learning.

The testing of the system within a course of an experienced open university should guarantee good and objective evaluation results.

2.1 Motivation

The main interests from the organisational point of view:

SEES #3b aims at the development, testing and implementation of a Grid-based LSA assessment to support and improve the quality and efficiency of learning in technical and scientific domains.

Due to formative assessment and immediate feedback at the end of a pre-defined learning episode, students have the chance to practice as often they need and want.

2.2 Organisational and pedagogical analyse

2.2.1 Learner/user-centred aspects

Summary of the analysis of the main motivational aspects:

The opportunities of a quicker, objective and individualised assessment within a learning experience will motivate students and teachers to experience the advantages of such a system.

The substitution of human markers through non-human markers will have effects on the motivational and emotional acceptance of the system. During the system's introductory period, resistance on the learner but also on the teacher side will certainly be observable and may hold back the process of introduction. This resistance will prevail if the assessments are not effective enough.

2.2.2 Learning environment

Summary of the analysis of the main support aspects:

Support for both instructors and students will be provided.

Appropriate training for teachers who wish to use the assessment will be provided in order to train their skills. A well-designed user interface will ensure that students get along with the system without specific training.

Summary of the analysis of the main evaluation aspects:

A close evaluation process, in which LSA results and tutor marked assessment (TMA) will be compared, will provide sufficient results to outline the strengths but also the weaknesses of the Grid-based LSA.

A system to evaluate the acceptance of the service by teachers and learners with a focus on personal and emotional aspects should be planned.

2.3 Peer comments

The main objective of SEES #3b is very ambitious and interesting, but in the same time we think that it is very difficult, since it is very complex assess the meaning of text in automatic way.

The possibility to make several assessments during a didactic course allow to give the learner many intermediate feedbacks, in this way the learning process of student is guided and controlled. So, from a didactical point of view the objective of SEES #3b is very useful in a learning process, but the feasibility of it depend only by a technical aspect, we think that organisational and pedagogical aspects are not involved.

We believe that some studies provided by the WP5 of ELeGI, regarding the knowledge representation, could be useful in order to achieve the purpose of SEES #3b.

3 Technical feasibility

A very ambitious SEES, with some difficulties raised by the human nature.

A further description of the LSA technology and its requirements is needed to give a ruling on the technical feasibility of the integration of the LSA system in a Grid infrastructure.

3.1 Summary of Grid functionalities required and Tools

- Mass calculation
- Distributed data
- SLA / negotiation
- VO and groups
- AAA

The required Grid functionalities depend on a more detailed specification. However, two constraints are already obvious:

- The service must handle ***several thousand simultaneous students*** while they are taking exams;
- Instructors will require ***heavy computational ability*** before exams to train the system.

3.2 Peer comments

Although the detailed functional requirements of the LSA service are not yet provided, there are two essential requirements given: high computational needs for training of the system and the need to store extremely large corpora. It seems obvious to use a Grid for that purpose, because it corresponds to the background from where Grid technology is coming and for what Grid is already used. But it depends on the applicability of the LSA algorithms for distributed computation and data whether a Grid solution will be feasible.

Concerning the LSA software engine there are two options: it could be developed locally or adopted, if it is available as a commercial or academic software product. In any case it has to be implemented for deployment in a Grid infrastructure provided by other ELeGI partners (6b). GRASP is considered as a Grid service provision platform. Feasibility means an estimation how difficult it is to make the LSA software engine work in the GRASP run time environment. The detailed specification will have to provide this sort of information.

Before using the SLA Grid service, the “service” has to be trained using a corpus of documents (human made assessments) belonging to one particular domain. Therefore there have to be two separate services:

1) the training service - instructors are users of this service;

2) the LSA service itself - most probably, other instructors, which not participated in training, use it to assess new set of student answers.

It should be specified, if a solution based on Grid services will includes both services if if they integrated into one service, but available through two different interfaces.

For the primary use in OU, an ordinary web service would be enough to implement the "assessment" part of the LSA service, but if the system is designed for a broader use by other institutions, it will need functionalities provided by Grid like SLA for different QoS depending on the client organisation and assessment type, load balancing to ensure short response times for potentially huge numbers of students, fault tolerance, AAA, metering and accounting.

According to 5d, texts need to be gathered by using the semantic web and conversational services of the Grid. It looks very much like a 3rd service should exist. This should be reflected in section 5d for communication and collaboration activities, but it has to be cleared whether resources are sufficient to develope this service in the project.

A connection to SEES #3a is obvious, but taking the specific domain and the language into account, the general applicability of the LSA service implemented in SEES #3b is limited. A combination with TESTOOL for computer science courses in English language may be possible to evaluate the integration of e-Assessment and e-Qualification. If it works in this domain, it should work in other technical domains, too.

Part VI: SEES #4 (Masters in ICT)

A) SEES #4
Analysis and Requirements Specification

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Version History

Version	Comments, Changes, Status	People
1	First proposal – SEES Step 1	
2	Second proposal – SEES Step 2	
3	Third proposal – SEES Step 3	
4	Forth proposal – Revised SEES Step 3 following feedback from FIM	
5	Fifth proposal – First complete draft	

Project Definitions

0 SEES Glossary

Term	Definition
AIT	Athens Information Technology
MSIN	Master of Science in Information Networking

Project Drivers

1 The Purpose of your SEES

1a The user problem or background to the project effort

At AIT *distance learning* is part of everyday activity as AIT is offering a virtual classroom environment based on its current eLearning platform as part of the MSIN (Master of Science in Information Networking) course. The MSIN course is provided in collaboration with Carnegie Mellon University in Pittsburgh, USA. The virtual classroom is comprised by a teacher (located in a Pittsburgh or Athens auditorium), students at the Athens auditorium and students at a Pittsburgh auditorium. Additionally, tutors are present in each auditorium during lectures.

The current platform at AIT utilises videoconferencing, whiteboard and smartboard technologies to provide an environment where all participants in the virtual classroom (students, tutors, and teacher) can fully interact during the sessions. There is an internal on-going evaluation process for the distance learning program at AIT which points out the importance of *enhanced presence* in this virtual classroom in order to increase the participation of the students who are not physically located in the same auditorium with the teacher. Bringing the participation of those students up to the same level with that of the students who are physically located in the same auditorium with the teacher are requires a lot of effort, the result of which, however, is measurable. One measure that could be introduced to enhance presence is the utilisation of large screens in the back of the auditorium on which the remote students and environment will be displayed for the professor. Additionally, thorough audio coverage is a necessity. Of course enhanced presence could also be employed during lab sessions and this will be addressed according to the plans of SEES #4.

Apart from employing enhanced presence during the distance learning sessions, AIT is interested in enhancing the efficiency of *collaborative learning* sessions. These can be either among students at AIT and Carnegie Mellon working on common assignments or between students and tutors. Since tools currently used are rather rudimentary, innovative tools to enable collaborative and *experiential learning* based on the execution of *virtual scientific experiments* which often require use of *Grid* facilities is a crucial objective for AIT. That is because many of the students project require substantial computational power that cannot originate from just one or two computers. Additionally, in order to exploit further our partnership with CMU virtual scientific experiments would enable integration with the CMU CyLab research infrastructure.

Finally, AIT, outside the scope of the Master on ICT, is also performing research to investigate the impact of Grid computing and Semantic Web technologies on the automatic composition of eLearning modules to provide custom eLearning solutions in the context of *Lifelong Learning*. For this reason, the use of methodologies to increase the *motivation* of lifelong learning participants and the utilisation of experiential learning techniques together with enhanced presence tools for collaborative learning is another important objective for AIT.

1b Facilities

The current environment implementing E-Learning for the formal Master on ICT course makes use of the following facilities:

- Three large auditoriums with capacity for 100 to 200 participants, smartboards, videoconferencing facilities (big video screen-cameras-microphones accessible by all participants)

- High speed link with Carnegie Mellon 512 Kbps
- Software tools for videoconferencing and smartboards/whiteboards (Media player, etc)
- Large capacity blackboard server for digital storage of videoconferencing sessions, whiteboard, handouts and discussion lists
- Software for accessing all digitally stored material over the internet through a web-based interface
- Software labs with 35 Unix workstations and 35 PCs with access to the high-speed link with Carnegie Mellon.
- Lab facilities include:
    - State of the art instruments for characterisation of systems up to 40 Gbps, (Communication Analyser (Tektronix), Spectrum analysers, Error performance analysers, SONET/SDH testers).
    - Software simulators (OPNET, IE3D and Fidelity Zeland Software Package, ADS, Network planning)
    - Hardware kits for students' experimentation
    - A rich collection of software tools (Matlab, Rational software, Oracle, …)
- Wireless access to the Internet throughout the AIT premises

1c Distance learning sessions

The following kinds of distance learning sessions are presently implemented:

- Virtual classroom sessions take place four times per week in the fall and spring terms of each academic year, each term lasting sixteen weeks. The duration of each virtual classroom session is approximately 2 hours and comprises:
    - 20-50 students in an auditorium at AIT, Athens, Greece
    - Up to 100 students in an auditorium at Carnegie Mellon, Pittsburgh, USA
    - 1-2 tutors in each of the Pittsburgh and the Athens auditorium
    - 1 teacher in either the Pittsburgh or the Athens auditorium

    Full interaction among all participants is enabled. All participants during the sessions can see:
        - Every other participant in the session with the help of large displays
        - The presentation slides of the teacher
        - The smartboard annotations made by the teacher in real time

    Throughout the session the teacher can efficiently coordinate the local and remote interaction and maintain the overall control of the session.

    Technical personnel on both sides monitor and control the cameras, microphones and network connections.
- Offline self-learning sessions where students, typically after the virtual classroom sessions, get
    - Full access to all course material (Blackboard access)
    - Web access of the video of any session (Media player)
    - Access to discussion lists (students' forum) where they can discuss issues related to the session with the tutor and the rest of the students

- Collaborative learning sessions among students based in Athens and/or Pittsburgh using videoconferencing/whiteboard tools over ISDN and the Internet

1d Goals of the project

SEES #4, in the context of ELeGI, will develop a state of the art platform for the application, trial and evaluation of both pedagogical models and Grid-enabled technological innovation for E-Learning. The overall goal of SEES #4 is twofold:

- To elicit services applicable to formal distance learning establishing their potential on pedagogical and technological foundations and proving their value for both organisations and users in formal distance learning.
- To establish the potential of such services in terms of exploitation for different stakeholder profiles.

In this way, SEES #4 will provide a valuable insight into the suitability of novel pedagogical methods and advanced technological tools for the improvement and evolution of distance learning in particular but also of collaborative learning or self-learning as side-activities to distance learning, through trials and evaluation in a formal educational context.

Deploying and maintaining a diversity of elicited services requires a service oriented framework. Considering the potential of Grid technologies, such a framework will be realised, tried and evaluated as a Grid Service Oriented Framework.

In this context, the goals of SEES #4 can be summarised as follows:

Goal 1: Establish a specialised evaluation framework on the basis of formal distance learning scenarios. More specifically, three main scenarios are currently envisaged:

a. Formal distance learning in a virtual classroom
b. Collaborative learning activity as a complement to formal distance learning
c. Self-learning activity as a complement to formal distance learning

For each of the above scenarios, the evaluation framework will identify:

a. Evaluation use cases
b. Evaluation process
c. Evaluation criteria

Goal 2: Trial and evaluation of novel pedagogical methods for distance learning in a formal educational environment. Envisaged new pedagogical methods should make up for the physical distance between tutor and student and enhance the motivation of both parties during collaborative learning sessions but also virtual classroom sessions.

Goal 3: Trial and evaluation of Grid-enabled and other technological means for distance learning in a formal educational environment. The following kinds of tools will be evaluated:

a. Grid-enabled tools for the performance of *virtual scientific experiments* and computations
b. Grid-enabled tools for the establishment of *virtual laboratories* the facilities of which can be shared among students based at different locations. In the context of virtual laboratories, virtual scientific experiments could be deployed in the context of distance supervision of graduate MSIN projects and collaborative assignments to student groups at AIT and Carnegie Mellon

together.

c. Tools and software architectures for *enhanced presence* in the context of distance learning. In addition enhanced presence will be evaluated in the context of collaborative or self-learning sessions as a side activity to formal distance learning.

Goal 4: Perform service elicitation through the scenario specification, trial and evaluation process in order to identify services applicable to formal distance learning as well as their potential and opportunity for formal education providers and learners. In the context of a service oriented architecture the above tools, subject to evaluation, can be bundled and wrapped up as services. Fit criteria for such services are considered to be efficiency, acceptance, autonomous operation, alignment with requirements stemming from the AIT – Carnegie Mellon collaboration.

Goal 5: Quantify the exploitation potential of the elicited services for different stakeholder profiles based on the established evaluation framework.

1e Opportunities and "return of value"

Opportunity in education is mainly expressed as return on value rather than return on investment. This is due to the fact that education is critically important for individuals and society and the financial goals of educational activity are always blended and measured against the societal impact. However, the financial viability of organisations involved in education is a factor that cannot be undermined. Deploying E-Learning activity based on return on value with regard to individual learners, organisations and society assists organisations in establishing competitive advantages and therefore enhancing their financial prospects.

The opportunities for return on value that will be established in the context of SEES #4 can be seen from four different viewpoints:

- *The individual learner's viewpoint*

  Enhanced learning experience, access to remote laboratories and participation in virtual scientific experiments, efficient learning process (due to application of the ELeGI pedagogical methodologies), self-learning opportunity to complement the virtual classroom and collaborative learning experience, Personalised Learning Anywhere – Anytime. Based on experience at AIT and in the current collaboration scenario with Carnegie Mellon, it has been assessed that the real benefit for the individual learner is full participation in the Carnegie Mellon community. Learners feel members of the Carnegie Mellon community too, and are able to take advantage of the resources and expertise available in both sides.

- *The formal educational institution's viewpoint*

  Obtaining a competitive advantage through the enhancement of existing E-Learning frameworks; these will be enriched with tools supporting experiential learning, enhanced presence, virtual laboratories, and corresponding evaluation frameworks, efficiently implementing innovative pedagogical methodologies. Such frameworks have the potential to address additional learner communities and thus increase the financial prospects of formal educational institutions.

- *Other organisations using educational services*

  As the role of knowledge workers is critically important for organisations, the individual learner's advancement through E-Learning can have a direct positive impact to organisations using the services of formal educational institutions for their training needs. In addition, cost savings can be obtained and personalisation can provide for flexible learning schedules. Finally, the increased (and ever increasing) training needs of organisations can more flexibly and efficiently be addressed through innovative distance learning frameworks.

- *The society in general*

  The benefits of education for society have long ago been established. Effective E-Learning frameworks can significantly benefit both individuals of different ages or backgrounds and organisations, in diverse sectors, of different size and financial means. Therefore, the impact of E-Learning on society becomes even more powerful.

2 Client, Customer and other Stakeholders

2a The client is the person/s paying for the development, and owner of the delivered system.

The client of SEES #4 is RESIT (Research and Education Society in Information Technologies) who is operating AIT (Athens Information Technology Centre of Excellence for Research and Graduate Education). Given that both RESIT and CMU are currently investing in enhancing and improving the current platform there is a strong commitment from both sides to use the ELeGI models and services provided that those are positively evaluated in the context of SEES #4.

2b The customer is the person/s who will pay for the SEES' service.

The students of the AIT, in particular of the MSIN programme which is provided in collaboration with Carnegie Mellon, US.

Additionally, students taking professional development courses at AIT either as individuals or as employees of corporate customers. Professional courses take place at AIT or customer's premises, they are completely independent from the MSIN programme and they typically last 40 hours spread in 1-2 weeks. A list of the currently offered professional courses can be found at: www.ait.gr/profPrograms.

2c Other stakeholders

- Founding company and sponsor
  - INTRACOM
- Research and Education Partners
  - Carnegie Mellon: will use ELeGI services provided that their assessment of these services is positive in terms of added value. In this case, it is estimated that Carnegie Mellon will invest 1-2 person months of technical staff for the integration and operation of new services and 1 person month for assessment.
  - Other Greek or EU educational and research institutions
- Participating staff and users
  - Students/Users (participating in virtual classroom, collaborative learning, self-learning)
  - Faculty members (teachers)
  - Faculty or graduate students (tutors)
  - Technical Staff (audiovisual experts, virtual classroom control room)
  - Administrative staff (research and education administration, promotion and

marketing)
  - Evaluation experts (AIT and Carnegie Mellon)

3 Users of the Service

3a The users of the service

There are different kinds of users that will participate in the SEES #4 testbed trials and evaluation as outline in the previous section. Each kind of user will assist to explore different aspects with regard to the goals of SEES #4. In particular, the following user groups are envisaged:

- User group name: "*Formal AIT students*"
  - *Role*: This user group will participate in virtual classroom sessions, in collaborative learning sessions and in self-learning sessions using the project's Grid-enabled technologies and with the innovative pedagogical methods in place.
  - *Subject matter experience*: This user group is familiar with the use of E-Learning portals, with using a wide range of computer applications and with programming using advanced programming languages.
  - *Technological experience*: *Journeymen* in the above context.
  - *Other user characteristics*: This user group is typically of age 22-30. They are expected to dedicate a certain amount of time on E-Learning tools to respond to the class attendance and collaborative assignment requirements of their Master's course. All are fluent speakers of English with a positive attitude towards technology coming with a first degree in IT or Communications. As students of a professional Master's course they are pursuers of a serious career in the sectors of IT and Communications.
- User group name: "*AIT professors*"
  - *Role*: This user group will participate in virtual classroom sessions and in collaborative learning sessions using the project's Grid-enabled technologies and applying the innovative pedagogical methods in place.
  - *Subject matter experience*: This user group is familiar with the use of E-Learning portals, with using a wide range of computer applications and with programming using advanced programming languages.
  - *Technological experience*: *Journeymen* or *Masters* in the above context.
  - *Other user characteristics*: This user group is typically of age 25-70. They are expected to dedicate a certain amount of time on E-Learning tools to respond to the teaching requirements and collaborative assignment supervision and tutoring as part of their commitments for the Master's course. Naturally, they are fluent speakers of English with a positive attitude towards technology and they are oriented to an academic career.
- User group name: "*AIT researchers*"
  - *Role*: This user group will participate in collaborative learning sessions using the project's Grid-enabled technologies and applying the innovative pedagogical methods in place.
  - *Subject matter experience*: This user group is familiar with the use of E-

Learning portals, with using a wide range of computer applications and with programming using advanced programming languages.

- *Technological experience*: *Journeymen* or *Masters* in the above context.
- *Other user characteristics*: This user group is typically of age 23-65. They are expected to dedicate a certain amount of time on E-Learning tools to respond to the collaborative assignment supervision and tutoring as part of their commitments at AIT. Naturally, they are fluent speakers of English with a positive attitude towards technology and they are oriented to research or academic oriented career.

- User group name: "*AIT tutors*"
  - *Role*: This user group will participate in virtual classroom sessions (for recitation) and in collaborative learning sessions using the project's Grid-enabled technologies and applying the innovative pedagogical methods in place.
  - *Subject matter experience*: This user group is familiar with the use of E-Learning portals, with using a wide range of computer applications and with programming using advanced programming languages.
  - *Technological experience*: *Journeymen* or *Masters* in the above context.
  - *Other user characteristics*: This user group is typically of age 25-65. They are expected to dedicate a certain amount of time on E-Learning tools to respond to the recitation requirements and collaborative assignment supervision and tutoring as part of their commitments for the Master's course. Naturally, they are fluent speakers of English with a positive attitude towards technology and they are oriented to an academic or research career.
- User group name: "*AIT system administrators*"
  - *Role*: This user group will participate in the administration of the systems or applications for virtual classroom and collaborative learning sessions based on the project's Grid-enabled technologies.
  - *Subject matter experience*: This user group is familiar with the administration of E-Learning portals and a wide range of computer applications in Windows and Unix environments.
  - *Technological experience*: *Journeymen* or *Masters* in the above context.
  - *Other user characteristics*: This user group is typically of age 19-65. They are expected to dedicate a certain amount of time on the administration of E-Learning systems and applications. They are all fluent speakers of English with a positive attitude towards technology and they are oriented to system administration/IT management career.
- User group name: "*AIT educational programme administrators*"
  - *Role*: This user group will participate in the administration of distance learning educational programmes and they are in a position to evaluate the efficiency of E-Learning systems and pedagogical methodology in the context of virtual classroom and collaborative learning with regard to the goals of the formal Master's course.
  - *Subject matter experience*: This user group is familiar with the administration educational programmes in general and with E-Learning programmes in particular.

- *Technological experience*: *Masters* in the above context.
- *Other user characteristics*: This user group is typically of age 25-65. Their role is the administration of the distance learning programme. Naturally, they are fluent speakers of English with a positive attitude towards technology and they are oriented to educational programme administration and management career.

- User group name: "*AIT public relations staff*"
  - *Role*: This user group will participate in the evaluation of the exploitation potential of the formal distance learning programme (considering its innovative approach to pedagogical methods and Grid-enabled technology) from the viewpoint of public relations, promotion and marketing.
  - *Subject matter experience*: This user group is familiar with public relations in the context of distance learning programmes in particular.
  - *Technological experience*: *Masters* in the above context.
  - *Other user characteristics*: This user group is typically of age 25-65. They are expected to dedicate a certain amount of time on public relations and marketing for E-Learning programmes. Naturally, they are fluent speakers of English with a positive attitude towards technology and they are oriented to a public relations/marketing management career.
- User group name: "*AIT pedagogical methodology experts*"
  - *Role*: This user group will participate in the evaluation of the innovative pedagogical methods that the project will introduce in the context of formal distance learning based on virtual classroom and collaborative learning sessions.
  - *Subject matter experience*: This user group is familiar with the evaluation of pedagogical methodologies in general and in pedagogical methodologies for distance learning in particular.
  - *Technological experience*: *Masters* in the above context.
  - *Other user characteristics*: This user group is typically of age 25-65. Their role is to continuously monitor and improve the pedagogical methodology employed for formal distance learning based on virtual classroom an collaborative learning sessions. Naturally, they are fluent speakers of English with a positive attitude towards technology and also conscious of the importance of pedagogy as a necessary condition for effective distance learning. They are oriented to an advanced research or educational programme management in this area.

3b The priorities assigned to users

With regard to the importance and priority of each user group when it comes to conflict of opinion the following categorisation applies:

- Key users:
  - Formal AIT students
  - AIT professors
  - AIT tutors

  - AIT pedagogical methodology experts
  - AIT system administrators
- Secondary users:
  - AIT educational programme administrators
  - AIT researchers
  - AIT public relations staff
- Unimportant users:
  - None.

3c User participation

The “AIT researchers” group will participate in the design and implementation of the SEES #4 testbed in collaboration with “AIT professors” and “AIT systems administrators”. The other user groups will be involved in the trial and evaluation phase.

Specifically, user participation for each user group in the trial and evaluation for SEES #4 can be categorised as follows:

- Higher participation
  - Formal AIT students
  - AIT professors
  - AIT pedagogical methodology experts
  - AIT system administrators
  - AIT tutors
- Medium participation
  - AIT researchers
- Lower participation
  - AIT public relations staff
  - AIT educational programme administrators

Project Constraints

4 Mandated Constraints

4a Solution constraints

There are certain constraints with regard to the operation of the SEES #4 testbed which can be summarised as follows:

- Time of the operation of the testbed
    - During the testbed setup and operation, when PC/Workstation administrative support is required this can be done during the standard working hours of the system administration group, i.e.: 9am – 4.30pm local time.
    - Virtual classroom sessions that require collaboration with Carnegie Mellon can take place between 4pm and 9pm local time, due to the time zone difference with the US East Coast.
    - Collaborative learning sessions have to take place out of class hours. The schedule of class hours can vary and time slots for collaborative learning sessions will have to be defined at a stage close to the trials based on the class schedule of the participating students.
- Systems
    - It would be preferable to have the systems for the testbed deployed on Windows (Windows XP) environments. However, deployment on Sun workstations can also be supported.
    - With regard to collaborative learning sessions it would be desirable if certain tools could also be installed on student/faculty laptops (Windows) that will be connected to the AIT wireless LAN.
    - Concerning Windows platforms in particular, it should be noted that users <u>should not</u> need to have administrator's rights to be able to access installed software. Since the PCs/Workstations in the software lab are centrally administered, requiring administrator's password from the users would present a serious obstacle to the SEES #4 testbed operation.
- Networking
    - It should be noted that, currently, AIT is connected to the Internet over a 512Kbps line. AIT is anticipating connecting to GRNET/GEANT with a link of much higher capacity within the year.
    - Particularities of wireless LAN connectivity should be taken into account if software is to run on laptops.
    - In case students will have to participate in collaborative learning sessions from their homes, the constraints of PSTN connections to the Internet should be considered.
- Content
    - IPR/Licensing issues with regard to the use of educational content/software have to be observed during the trials (according to AIT and Carnegie Mellon policies).

4b Implementation environment of the current system

The current environment implementing E-Learning for the formal Master on ICT course makes use of the following facilities:

- Three large auditoriums (one larger, two smaller ones) with capacity for 100 to 200 participants, smartboards, videoconferencing facilities (big video screen-cameras-microphones accessible by all participants). Technical specs of the large auditorium:
    - 4 robotic head cameras
    - 2 VTRs DVCpro
    - 1 DVD player
    - 1 10-input vision mixer /switcher
    - 1 16-input audio mixer
    - 4 wireless microphones (2 miniature & 2 hand)
    - 4 mics with gooseneck
    - 120 inches back projection system with Barco projector
    - Controller for the lights with 4 presets (we can add lights from Magic TV studios, as well as to set up the required lighting conditions)
    - The 2 smaller auditoriums can be connected to the large one and increase the number of the spectators.
- High speed link with Carnegie Mellon 512 Kbps
- Software tools for videoconferencing and smartboards/whiteboards (Media player, etc)
- Large capacity blackboard server for digital storage of videoconferencing sessions, whiteboard, handouts and discussion lists
- Software for accessing all digitally stored material over the internet through a web-based interface
- Software labs with 35 Unix workstations and 35 PCs with access to the high-speed link with Carnegie Mellon.
- Lab facilities include:
    - State of the art instruments for characterisation of systems up to 40 Gbps, (Communication Analyser (Tektronix), Spectrum analysers, Error performance analysers, SONET/SDH testers).
    - Software simulators (OPNET, IE3D and Fidelity Zeland Software Package, ADS, Network planning)
    - Hardware kits for students' experimentation
    - A rich collection of software tools (Matlab, Rational software, Oracle, …)
- Wireless access to the Internet throughout the AIT premises

The above summarise the currently available infrastructure that can be at the disposal of SEES #4. In later stages, the equipment that will actually be employed in the context of SEES #4 will be determined.

4c Partner applications

In support of virtual classroom sessions, apart from NetMeeting, the MENTOR platform is also used. MENTOR was developed by Intracom to provide a framework for online sessions involving a teacher with full control of the session and a number of students. All participants can fully interact with each other and apart from voice and video they can share whiteboard facilities and internet browser facilities including plug-ins to support 3rd party applications accessible from internet browsers. In detail, MENTOR is an integrated training solution that enables in service training of high quality, anywhere, anytime providing the tools and mechanisms for conducting multimedia-rich training sessions in real time, with almost no restrictions on the number or participants and their geographical position.

The whole platform has already been tested and used over various environments, including, but not limited to, terrestrial connections (Ethernet LAN, leased lines, etc.), as well as radio links supporting point-to-multipoint transmissions.

The MENTOR platform offers numerous tools and utilities for instructor-trainees interaction, allowing all participants to easily exchange comments and ideas, feeling like they really collaborate with each other. Several means are provided for such communication: *text & voice messages, voice and video, coming from various sources*. At any point in time, the user can obtain control of the applications and system resources or the trainer may ask him/her to do so. It is worth noting that the instructor always has total control over the system, ensuring that all actions are performed in the expected manner. The platform also provides applications that enable the creation and review of teaching material, like application sharing, drawings and charts, text files and HTML content, located either locally or on the Internet. This ability to work on various sources of information facilitates the learning experience and makes it an easy and enjoyable one. Finally, the platform provides tools for distributing helpful training material, as well as means for integration with third-party systems, which provide quiz/tests generation and trainee progress monitoring. All the above-mentioned functionality is given through friendly user interfaces, hiding the complexities of network communication, synchronization and presentation.

In conclusion the MENTOR platform is a full-featured solution for conducting both *on-line, synchronous and asynchronous training sessions and presentations. The system is fully expandable, as far as the number of features supported is concerned, as well as the number of users/trainees.*

The *layered system architecture*, allows it to operated equally well over almost any infrastructure that supports IP and multicasting. This unique factor ensures that its users shall be in position to make use of MENTOR, either today, while operating over existing telecomm networks, or when they upgrade and adopt future networking infrastructures.

4d ELeGI related software

Tool	**Usage** (whether, how, why, by whom)
GRASP	This platform can be used by students/professors to demonstrate the power of the Grid but most important to deploy computationally demanding applications and perform experiments as part of the homework/project work of Master's students. This platform can also be used to wrap up existing AIT services currently offered to the students as Grid services.
IWT	This tool can be used by students and professors/tutors to gain access to educational material (lecture videos, lecture slides, additional resources, etc) as an activity in support of virtual classroom sessions. It can also be used for self-learning sessions when students wish to explore new areas.
Finesse	No, due to the fact that there is no matching course in the SEES #4 formal educational programmes.
Virtual Control Laboratory	No, due to the fact that there is no matching course in the SEES #4 formal educational programmes.

BuddySpace	This tool for enhanced presence is expected to be widely used to support collaboration among students and/or tutors.
KMi Stadium	This tool for enhanced presence can be used to support self-learning sessions provided that there is existing material relevant to the courses or that there are sufficient resources allocated to SEES #4 for the production of relevant material using the XO editor.
Magpie	Magpie could perhaps be used in conjunction with other tools such as the IWT or independently while browsing online learning material to support contextualised learning. However, it is not clear at the moment how its use and evaluation exactly matches the goals of SEES #4.
madkit	(Note: more information is needed before being able to determine the use of this tool in SEES #4)
Strobe	(Note: more information is needed before being able to determine the use of this tool in SEES #4)
Webra	(Note: more information is needed before being able to determine the use of this tool in SEES #4)
DYXWEB	This tool can be used as part of the “Web Technologies” course or the “E-Commerce Technologies” course, currently offered in the MSIN and MsITT programmes.
KTU/OU Assessment Tools	These tools can be used as part of the assessment activity to support the virtual classroom sessions at SEES #4.

4e Anticipated workplace environment

This is a formal education environment involving virtual classroom sessions, which, in turn, are supported by collaborative sessions and self-learning sessions.

All sessions take place at AIT premises and Carnegie Mellon premises. In certain circumstances, students/professors/tutors may access SEES #4 tools/services remotely over the Internet.

4f How long do the developers have to build the system?

The formal education environment is already running and it is part of the daily practice at AIT. Integration of the ELeGI systems/tools/processes and their evaluation will be in line with the ELeGI planning documents.

4g What is the financial budget for the SEES?

Total budget is approximately 310,000 Euro, indicatively allocated as follows:

- Formal education scenarios specification and SEES design (integrating necessary educational and administrative processes as well as the ELeGI pedagogical and didactical innovation): 40,000 Euro
- SEES #4 test-bed integration: 90,000 Euro
- Trial execution: 90,000 Euro
- Evaluation: 90,000 Euro

5 Test-Bed Design

5a Pedagogical / didactical approach

Approach	**Usage** (whether, how, why, by whom)
Collaborative learning, cooperative learning, social learning, project related learning	Collaborative learning sessions are inseparable from virtual classroom sessions in SEES #4. Tutors/professors can schedule collaborative learning sessions with students for recitation purposes. On the other hand, also students can schedule ad hoc collaborative learning sessions to work together on common assignments. Apart from this, researchers can avail themselves of collaborative facilities to exchange experience/knowledge in areas of common research interests. Parties in all of the above examples can be either from AIT or from Carnegie Mellon.
Constructivist learning	At AIT virtual classroom sessions are always accompanied by collaborative sessions (recitations) or self-learning sessions by individual students. During the collaborative and self-learning sessions a constructivist learning approach can provide for more efficient learning by enabling the student to become an active participant in the learning process. However, also during the virtual classroom sessions enhanced presence tools and the use of audiovisual facilities and teaching methodology aim to invite the students' active participation in a constructivist way.
Experiential learning, active learning, Problem based learning (PBL)	AIT is offering professional Master's degrees where students are expected to acquire real-world experience and develop real problem solving methodologies through their training. In this context, experiential learning (learning by doing) is a necessary instrument.
Personalised, individualised learning	In the context of a formal educational environment (like SEES #4) personalised learning is not widely applicable. However, pedagogical methodologies related to the individualisation of the learning experience during virtual classroom or collaborative learning sessions are applicable although pertinent to the discretion of the professor/tutor. Personalised learning is more relevant to self-learning sessions in the context of SEES #4 provided that it will be integrated in the respective systems/tools.
Ubiquity and accessibility (anytime/anywhere)	As part of SEES #4 students can participate in collaborative learning sessions anywhere/anytime while they can access educational material (lecture videos, handouts, course information) at all time through the Internet.
Contextualised, adaptive, situated learning	Not very relevant to a formal educational setting.
Distance learning	A key feature of SEES #4 is the aspect of distance learning in a formal educational environment based on the collaboration among educational institutions that unite their resources to create value.

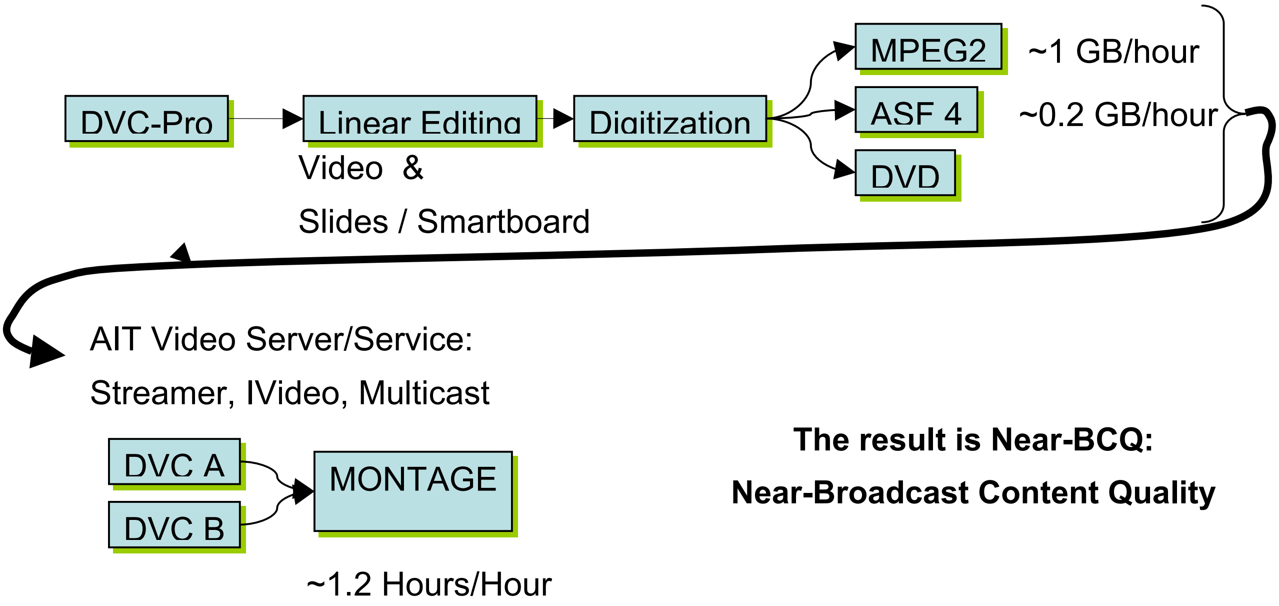
5b Learning contents

The MSIN Program is jointly provided by AIT and Carnegie Mellon, at the premises of AIT. The Master's Degree is granted by Carnegie Mellon. Students joining the Program must take five (5) mandatory core courses and six (6) electives out of a rich selection of elective courses. Choices of specific electives aim at several areas of specialisation including software engineering, telecommunications/networking, embedded systems, and electronics. The Program concludes with the successful completion and defence of a Master's Thesis.

More information regarding the courses offered as part of the MSIN programme is available through the following link: http://www.ait.gr/acadPrograms/acad_Msin.asp

From the MSIN courses, 4 are currently delivered via an interactive high-speed video link from either AIT or Carnegie Mellon and are attended simultaneously by students located at both campuses. Full interaction among students, tutors and professors is supported during these sessions.

Educational material for each of the offered courses including the videos of the lectures, handouts, additional material and course information are made available on a dedicated portal which can be accessed by students/faculty anywhere-anytime over the Internet. It should be noted, that handouts and additional material/readings are made available on the portal before the beginning of the lectures. The lecture videos are made available on the portal in less than two hours after the completion of the lecture. The audiovisual content generation procedure is illustrated in the following figure:



5c User support

As described in the previous sections of this document, three kinds of formal educational sessions are envisaged in SEES #4: virtual classroom sessions, collaborative sessions and self-learning sessions. The collaborative and self-learning sessions are considered a side-activity in support of the formal virtual classroom sessions. All these sessions will have to share the following types of learner support facilities.

- *Educational support*. This type of support is related to the educational activities and processes that should be in place to support learners and educators in the context of formal learning. For example, the role of an “academic advisor” is a type of learning support in a formal learning environment from professors/tutors to the students. Additionally, the role of the “academic programme administrator” is a type of learning support from the organisation to the professors/tutors and the students. In the context of SEES #4 educational support will be available between the following user groups:
  - “AIT Professors” to “Formal AIT students” (virtual classroom/collaborative sessions: teaching, tutoring)
  - “AIT Tutors” to “Formal AIT students” (virtual classroom/collaborative sessions: tutoring, recitations)
  - “AIT researchers” to “Formal AIT students” (collaborative sessions: project supervision)

- “AIT educational programme administrators” to “AIT Professors” (virtual classroom/collaborative sessions: policies, guidelines, scheduling of activities)
- “AIT educational programme administrators” to “AIT Tutors” (virtual classroom/collaborative sessions: policies, guidelines, scheduling of activities)
- “AIT educational programme administrators” to “Formal AIT students” (virtual classroom/collaborative sessions: policies, guidelines, scheduling of activities)

- *Technical support*. This type of support is provided from the “AIT system administrators” user group to all the other identified user groups. It involves the following kinds of technical support:
  - *System administration*: Administers/provides support for the operation and use of Servers, Workstations, Networking, Labs (virtual classroom/collaborative/self-learning sessions)
  - *Application/Tool administration*: Administers/provides support for the operation and use of both existing applications/tools and ELeGI application/tools that will be part of SEES #4 (virtual classroom/collaborative/self-learning sessions)
  - *Content management*: Administers/provides support for the content repository that is built to support self-learning sessions as a side-activity to virtual classroom sessions (self-learning sessions)
  - *On-line connectivity*: Administers/provides support for the efficient execution of virtual classroom sessions making sure that the synergy of networks, on-line applications and advanced auditorium facilities (mics, cameras, smartboards, etc) is fully operational (virtual classroom sessions)
- *Content generation support*: This type of support facilitates the generation of content following a unified presentation format/style. Content material can originate either from virtual classroom sessions, seminars, or special audiovisual recordings. All material is made available on content servers (self-learning sessions)

5d Training needs

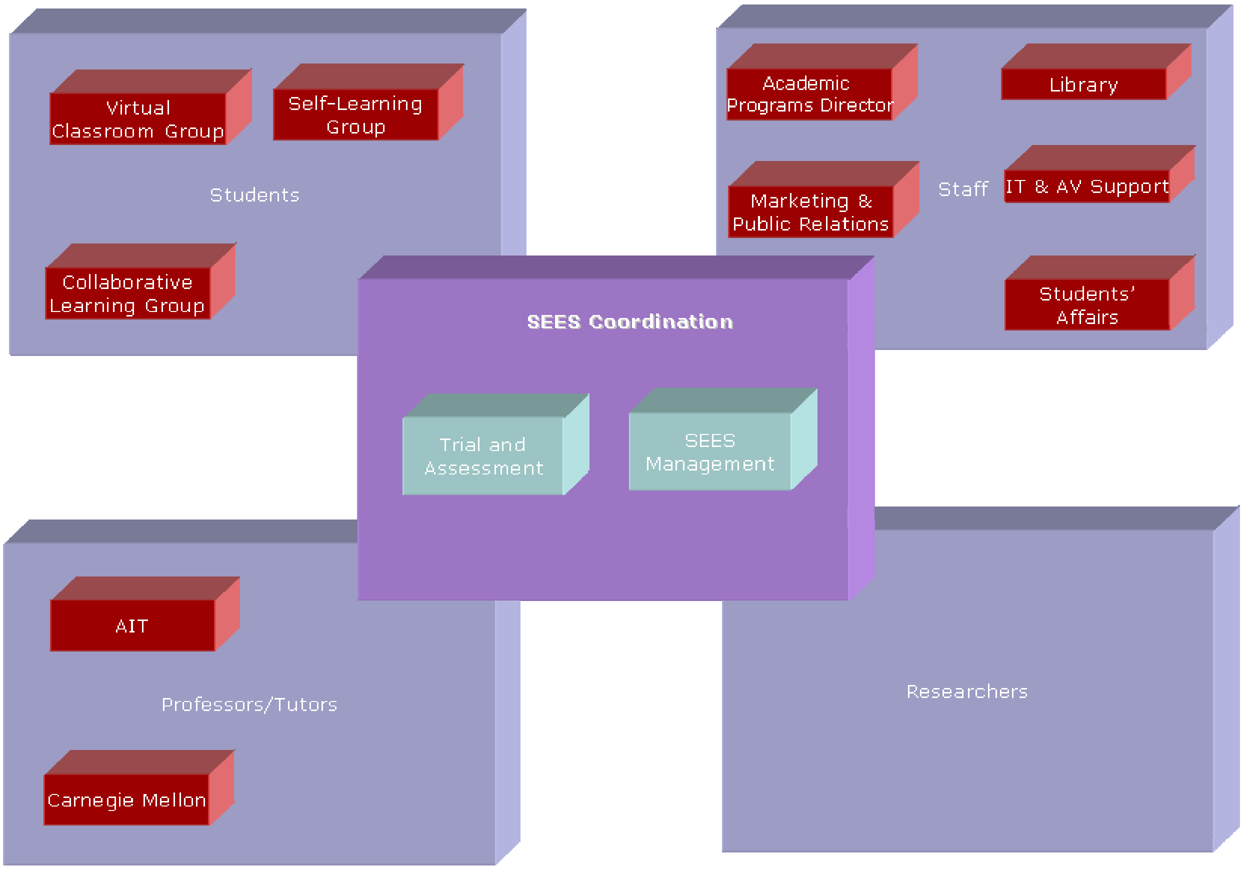
A number of formal learning scenarios are already deployed and they consist part of daily activity at AIT. Training is provided for all participants involved in these learning scenarios. As part of SEES #4 additional scenarios are envisaged which present additional training needs. The new ELeGI scenarios involve the introduction of novel pedagogical methods and innovative Grid-based tools. To cover training needs, apart form AIT/SEES #4 user groups, the following two user groups will be involved from the ELeGI project: “ELeGI Pedagogical methodology experts” and “ELeGI Technological innovation experts”. In particular, the following training needs can be identified:

- *Training on pedagogical and didactical methods*
  - “ELeGI/AIT Pedagogical methodology experts” to train “Formal AIT students” (virtual classroom/collaborative sessions)
  - “ELeGI/AIT Pedagogical methodology experts” to train “AIT Professors” (virtual classroom/collaborative sessions)
  - “ELeGI/AIT Pedagogical methodology experts” to train “AIT Tutors” (virtual classroom/collaborative sessions)
  - “ELeGI/AIT Pedagogical methodology experts” to train “AIT Researchers” (collaborative sessions)
- *Training on the installation, administration and use of ELeGI applications/tools*

- “ELeGI Technological innovation experts” to train “AIT researchers” (virtual classroom/collaborative/self-learning sessions)
- “ELeGI Technological innovation experts” to train “AIT System Administrators” (virtual classroom/collaborative/self-learning sessions)
- “AIT Researchers” & “AIT System Administrators” to train *All Other AIT User Groups* (virtual classroom/collaborative/self-learning sessions)

5e Organisational aspects

The educational activity is organised and structured as follows:



5f Economic aspects

The economic aspects of the formal educational scenario in distance learning can be examined from four different viewpoints:

- *Live virtual classroom sessions*

  Live virtual classroom sessions as implemented in the environment of SEES #4 provide the opportunity to both educational institutions to commonly take advantage of world-class expertise that can be available on either side of the Atlantic for a fraction of the cost that would be needed to have those experts physically present at different physical classroom sessions.

- *Offline virtual classroom sessions*

  Since virtual classroom sessions are always recorded and edited for off-line access, there is also the potential, which SEES #4 is already exploiting, of reselling such sessions as custom professional courses subject to IPR agreements between the two educational institutions. Such courses can either take place in a classroom with the support of a teaching assistant or over the web.

- *Collaborative learning sessions*

  The possibility to exploit the latent computational power of under-utilised computing resources for the performance of demanding computations or in support of virtual scientific experiments over a Grid-enabled infrastructure presents a significant saving for academic institutions.

- *Lifelong learning*

  Content generation based on the raw material available from live virtual classroom sessions provides a cost-efficient solution for the production of Learning Objects (LOs) that can be efficiently utilised for lifelong learning solutions. However, this aspect is not expected to be explored in the context of SEES #4.

It is not possible at this point to give an estimation regarding the break-even point or to give more concrete estimation regarding the economic aspects.

5g Quality Aspects

As part of the contractual agreement between RESIT/AIT and Carnegie Mellon an independent evaluation group has been established, which continuously monitors and evaluates the educational processes. Properly defined questionnaires are employed and feedback is analysed and relevant reports are communicated to all parties involved in the educational processes.

5h Technology

Functional requirements to Grid technology	
Functionality	**Usage** (whether, how, why, by whom)
Mass calculation	GRASP
Distributed resources	GRASP
Peer-to-peer	No
Discovery and brokering	No
Metering and accounting	No
Service Level Agreement Negotiation	No
Monitoring	GRASP, IWT
Data, information and knowledge management	IWT
Virtual organizations and groups	Buddyspace, KMi Stadium
Load Balancing	No
Fault tolerance	No
Advance Resource Reservation	Yes (performance of virtual scientific experiments)
Notification/Messaging	Buddyspace
Workflow management	No
Certification	No

Authentication, Authorization and Accounting (AAA)	Yes
Trust Management	No
Digital and intellectual rights	No
...	

Communication and collaboration activities to be supported by Grid services	
Functionality	**Usage** (whether, how, why, by whom)
eMail	Yes
Discussion fora	Yes
Instant Messaging	Buddyspace
Chat	Buddyspace
Audio conferences	Yes
Video conferences	Yes
Application sharing	No
Shared editing of documents	No
Shared collection of structured information (databases)	IWT
Shared structuring of knowledge (ontologies)	Magpie, IWT
Shared maintenance of knowledge (resource centres, repositories)	IWT
Shared projects (planning of tasks, timelines resources)	No
Collaborative simulations, games	No
...	

6 Relevant Facts and Assumptions

6a External factors that have an effect on the product or service, but are not mandated requirements constraints.

None we can think of at this stage.

6b Assumptions that the team are making about the project

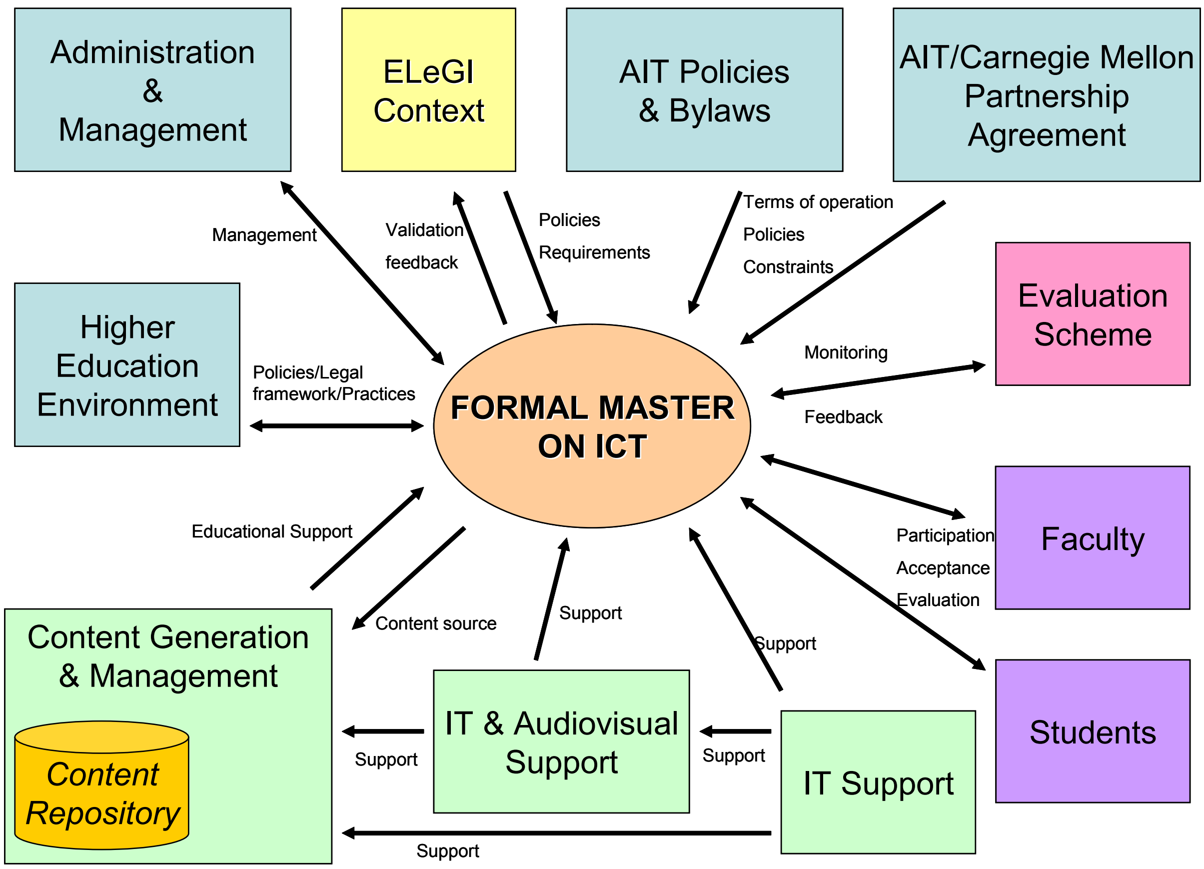
A core infrastructure for SEES #4 is fully deployed and operational at the moment. Our basic assumption is that the additional technological innovation and pedagogical methodologies from other project partners are at an implementation stage that allows them to be integrated with the current SEES #4 infrastructure and that their implemented features comply with their intended purpose.

Functional Requirements

7 The Scope of the Work

7a The context of the work

The following context diagram illustrates the relationships between different SEES #4 entities and constraints where applicable. All these entities are all illustrated dependencies/interaction mechanisms are already in place.



7b Work partitioning

In the following we outline a super-ordinate use case that illustrates how the entities of the previous section interact with each other in the SEES #4 context.

1. Administration & Management decide to offer a new course
2. Compliance with AIT/Carnegie Mellon partnership agreement is verified
3. Compliance with Higher Education Environment is verified
4. AIT Policies and bylaws are enforced to provide a concrete course implementation procedure
5. Based on the concrete course implementation procedure appropriate faculty is invited
6. Based on the concrete course implementation procedure appropriate infrastructural, IT & Audiovisual Support is enacted

7. Based on the concrete course implementation procedure an evaluation scheme and monitoring mechanism is instantiated
8. Based on the concrete course implementation procedure a detailed course description is advertised to the student community
9. Based on the concrete course implementation procedure interested students register for the course
10. Based on the concrete course implementation procedure the course content is created
11. The course offering is initiated in the given context
12. On the side of the course offering content generation and management mechanisms are enacted
13. Content repository is populated/updated

The above use case describes the operation of the SEES #4 environment as it currently stands. However, in the context of the ELeGI project, Grid enabled technological innovation will be added to the IT and audiovisual infrastructure and properly supported, additional content will be made available at the content repository and will be used by students and faculty. At the same time, new pedagogical and didactical models will be applied by the faculty. Above all, the evaluation scheme will be appropriately adapted and enhanced. Finally, the emerging exploitation potential will be assessed and reported by the administration and management. Carnegie Mellon will be exposed to several of the above steps.

8 The Scope of the Service

8a Service Boundary

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

8b Use case list

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9 Functional and Data Requirements

9a Functional Requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9b Data requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

Non-Functional Requirements

10 Look and Feel Requirements

10a The interface

Specific templates apply to the design of the educational content (presentation slides, web pages, lecture video credits, etc). No further look and feel constraints are imposed.

10b The style of the product

It should be serious and consistent. At the same time it should be attractive and it should enhance the motivation of learners and educators to use it.

11 Usability Requirements

11a Ease of use

It should be rather intuitive to use without very strong requirements on suitability for non-expert users.

11b Personalization and internationalization requirements

As part of a formal educational scenario, SEES #4 does not impose strong personalisation requirements. No strong requirements on internationalisation apply since English is the only language used.

11c Ease of learning

No further requirements than the ones stated in 11a and 11b apply.

11d Accessibility requirements

Accessibility requirements are highly desirable and in certain cases are required under equal opportunities policies that are in place.

12 Performance Requirements

12a Speed and latency requirements

Very strong requirements on speed and performance for real time virtual classroom sessions. Strong performance requirements (since user motivation highly depends on it) for collaborative learning sessions and off-line access to educational content.

12b Safety critical requirements

None identified.

12c Precision requirements

No particular requirements identified at this stage.

12d Reliability and Availability requirements

Very strong requirements on reliability and availability for real time virtual classroom sessions. Strong availability requirements (since user motivation highly depends on it) for collaborative learning sessions and off-line access to educational content.

12e Robustness requirements

Very strong requirements on robustness for real time virtual classroom sessions. Educational content repository should also be robust.

12f Capacity requirements

Since SEES #4 is part of a formal educational scenario capacity requirements are straightforward based on the number of students of AIT and Carnegie Mellon. Regarding real-time virtual classroom sessions one session at a time is envisaged. Regarding collaborative learning sessions it is envisaged to have up to three collaborative learning sessions with up to 10 members each at any time. However, this requirement will be finalised after concrete scenarios for SEES #4 are specified. Finally, up to 5-6 students should be able to access video content simultaneously at any time.

12g Scalability or extensibility requirements

Being a formal educational testbed in an area of technological education, up to 50 students are envisaged per educational programme. Based on this, it is not foreseen to face strong scalability or extensibility requirements in the medium term.

13 Operational Requirements

13a Expected physical environment

Almost all sessions take place at AIT premises as described in the previous sections making use of the following infrastructure:

- Three large auditoriums with capacity for 100 to 200 participants, smartboards, videoconferencing facilities (big video screen-cameras-microphones accessible by all participants)
- High speed link with Carnegie Mellon 512 Kbps
- Software tools for videoconferencing and smartboards/whiteboards (Media player, etc)

It is desirable that some of the collaborative learning sessions can have participants based at a location out of AIT premises (e.g.: home, etc) via the Internet. Also students should be able to take part in collaborative learning sessions through the wireless LAN that is operational at AIT premises.

It is highly desirable that access to off-line educational content is provided to users out of AIT premises over the Internet.

13b Expected technological environment

The technological environment to support lecture recording and the creation of video educational content consists of the following, which are part of the auditoriums and the audiovisual control rooms:

- 4 robotic head cameras
- 2 VTRs DVCpro
- 1 DVD player
- 1 10-input vision mixer /switcher
- 1 16-input audio mixer
- 4 wireless microphones (2 miniature & 2 hand)
- 4 mics with gooseneck
- 120 inches back projection system with Barco projector

- Controller for the lights with 4 presets (we can add lights from Magic TV studios, as well as to set up the required lighting conditions)

Video content is stored on a video server access to which is supported by a number of PCs or workstations.

Specific devices and hardware to be involved in virtual scientific experiments will be identified together with the concrete SEES #4 scenarios.

13c Partner Applications

Compatibility with the major web browsers.

13d Productization Requirements

Support for specific registration processes, accounting and billing is desirable in order to explore the exploitation potential of SEES #4 in the context of lifelong learning.

Similarly, packaging the educational content in modules that can be efficiently downloaded from common capacity Internet connections will help significantly for the productization of content in a lifelong learning exploitation scenario. In such a case, mechanisms for digital rights management are essential.

14 Maintainability and Support Requirements

14a How easy must it be to maintain this product?

As easy as possible.

14b Are there special conditions that apply to the maintenance of this product?

No special conditions.

14c Supportability

The following support functions are expected:

- On-line help desk
- On-line documentation/manuals
- Discussion fora

14d Portability requirements

Generally, services should run on Windows XP or Sun Solaris operating systems. Services supporting collaborative learning sessions or access to off-line educational material should run at least on Windows XP operating system. Access to educational content over the web using the major web browsers should be supported.

15 Security Requirements

15a Access requirements

Role-based access control should be supported as far as access to the educational content repository is concerned. Web access using username-password should always make use of a security protocol such as SSL. Public key infrastructure for authentication may be applicable in the medium term in the context of lifelong learning.

15b Integrity requirements

Public key infrastructure for educational content integrity may be applicable in the medium term in the context of lifelong learning.

15c Privacy requirements

Student records should always be kept confidential. According to AIT/Carnegie Mellon policies, faculty are not allowed to exchange views on the progress of individual students and the content of sessions between students and tutors should be kept strictly private.

15d Audit requirements

No particular requirements are envisaged at this stage.

15e Immunity requirements

It is a mandate for the AIT IT support department to make sure that all material exchanged through the AIT network is virus free and safe. No further requirements apply.

16 Cultural and Political Requirements

16a Are there any special factors about the product that would make it unacceptable for some political reason?

SEES #4 is a formal educational environment that adheres to Greek, EU and US laws and educational policies that clearly specify all cultural and political requirements to be fulfilled.

17 Legal Requirements

17a Does the system fall under the jurisdiction of any law ?

SEES #4 operates in Greece and Greek law applies. However, due to the partnership between AIT and Carnegie Mellon, for the provision of the specific educational service the law of the state of Pennsylvania also applies.

17b Are there any standards with which we must comply ?

N/A.

Project Issues

18 Open Issues

18a Issues that have been raised and do not yet have a conclusion.

None identified at the moment.

19 Off-the-Shelf Solutions

19a Is there a ready-made system that could be bought?

No available system can provide all functionality required.

19b Can ready-made components be used for this product?

Certain commercial components can support specific functionality but integration is an issue.

19c Is there something that we could copy?

No.

20 New Problems

20a What problems could the new system cause in the current environment?

The following potential problems due to the integration of the project results with the current E-Learning environment at SEES #4 have been identified at this initial stage:

- Acceptance of the new services, pedagogical methods and tools by:
    - Teaching staff
    - Research staff
    - Students
    - Technical support staff for distance learning and laboratories

    Acceptance problems by the above could appear due to reluctance to adopt to change even if the value of the results is evident. This is a common problem that may occur in many environments when new tools or processes are introduced.
- In the formal educational environment at SEES #4 strict evaluation criteria and quality thresholds are in place. These have been established in collaboration between AIT and Carnegie Mellon. The new services to be introduced have to meet these criteria and thresholds before they become an integral part of the current E-Learning framework. Such criteria are not only educational but also technological. I.e.: the performance, security and robustness of introduced services has to be verified.
- Meeting increased networking requirements due to the introduction of new services (connectivity, bandwidth, QoS) could present a challenge.

20b Will the new development affect any of the installed system?

Based on the information provided in section 1a the areas that might be affected by the integration of new systems are:

- The systems for supporting virtual classroom sessions
- The systems for supporting collaborative learning sessions
- The systems for supporting self-learning

No conflicts are foreseen with the integration of new systems in the above cases.

20c Will any of our existing users be adversely affected by the new development?

Given that any proposed service has to fulfil the strict evaluation criteria detailed in section 20a before being integrated into the current environment we do not expect that users will be adversely affected.

Still however, resistance to change and innovation as part of the human nature cannot be completely ruled out.

20d What limitations exist in the anticipated implementation environment that may inhibit the new system?

None.

20e Will the new system create other problems?

No.

21 Tasks

21a What steps have to be taken to deliver the system?

When functional requirements are finalised via the definition of detailed scenarios, further steps towards delivering the system will be clearly identified.

21b Development phases

Following the definition of the steps towards delivering the system, development phases will be specified. An iterative approach with development phases and cycles will be followed. As opposed to a clear top-down or bottom-up approach it is proposed to follow a hybrid top-down and bottom-up approach to development since certain components are already available and certain processes in the formal educational environment of SEES #4 are already established.

22 Cutover

22a What special requirements do we have to get the existing data, and procedures to work for the new system?

Data and content are already available and the procedures for their generation are in place. Also, procedures concerning the operation of the formal educational environment of SEES #4 and the delivery of envisaged educational services are available and followed as part of daily practice. No special requirements are currently foreseen.

During the course of the ELeGI project it is expected that the presentation of data/content may change and that the educational processes may be adjusted. However no changes on the actual data/content and no significant changes in the educational processes are anticipated.

22b What data has to be modified/translated for the new system?

Data/Content will need to be packaged in the form of Learning Objects for administration, management and delivery over the Web. Existing and new educational services will need to be wrapped up as Grid/Web Services.

23 Risks

The following potential risks can be identified in the context of SEES #4:

- Being users of technology provided by other partners, presents dependencies which also include some risk (timely delivery, quality of delivered material, etc)
- Some of the test scenarios involve system interaction and coordination with technical and academic staff at Carnegie Mellon. This presents a potential risk in terms of lack of adequate technical support or reluctance to participate in test distance learning sessions and evaluation processes.
- Exploitability risks should the acceptance level or technical support of introduced services be inadequate.
- Force Majeure… :-)

24 Costs

Following the definition of the deployment/development phases a cost estimate can be produced. Although it is not possible at the moment to provide figures based on the existing data, it is estimated that SEES #4 will not exceed its allocated budget.

25 User Documentation

25a The plan for building the user documentation

The introduction of new pedagogical and didactical methods that will be integrated in SEES #4 will be supported by appropriate documentation.

Additionally, based on documentation of the innovative tools that will be integrated in SEES #4, a consolidated documentation for the deployed systems will be provided.

B) SEES #4
Feasibility Analysis

1 Specification Status

1.1 Summary of the goals

1.1.1 Goals

The goals of the SEES #4 are the following :

Goal 1: Establish a specialised evaluation framework on the basis of formal distance learning scenarios. More specifically, three main scenarios are currently envisaged:

a. Formal distance learning in a virtual classroom

b. Collaborative learning activity as a complement to formal distance learning

c. Self-learning activity as a complement to formal distance learning

Goal 2: Trial and evaluation of novel pedagogical methods for distance learning in a formal educational environment.

Goal 3: Trial and evaluation of Grid-enabled and other technological means for distance learning in a formal educational environment. The following kinds of tools will be evaluated:

d. Grid-enabled tools for the performance of ***virtual scientific experiments*** and computations

e. Grid-enabled tools for the establishment of ***virtual laboratories*** the facilities of which can be shared among students based at different locations.

f. Tools and software architectures for ***enhanced presence*** in the context of distance learning.

Goal 4: Perform service elicitation through the scenario specification, trial and evaluation process in order to identify services applicable to formal distance learning as well as their potential and opportunity for formal education providers and learners.

Goal 5: Quantify the exploitation potential of the elicited services for different stakeholder profiles based on the established evaluation framework.

1.1.2 Comments

The approach of this SEES is not to demand for highly specific eLearning services but to provide an organisational and technical framework of formal learning in which a selection of generic Grid based eLearning services can be evaluated. The description of the framework and the expertise at AIT shows confidence that the local conditions are given to successfully include new services.

1.2 Relevance of the initial specifications

These initial specifications are very detailed concerning the current operation and sufficiently describe the technological context for the embedding of new tools and services. The next phase will have to specify in detail the new kind of applications proposed by AIT, i.e. the virtual scientific experiments and virtual laboratories.

2 Organisational and pedagogical feasibility

Overall summary:

The present specification of SEES #4 outlines an effective and well-developed formal learning scenario, which is supposed be very suitable to test and evaluate the integration of Grid-based tools and systems to enhance the quality of open and distance learning, with special focus on collaborative learning sessions, enhanced presence and virtual experiments.

The integration of new pedagogical methodologies and technical innovations into a deployed eLearning environment gives the opportunity to thoroughly evaluate the advantages and disadvantages of Grid-based learning.

The users (students and staff) in the context of SEES #4 are suitable to explore different aspects of Grid-based learning, since they are familiar with 'conventional' eLearning for learning and/or teaching. The user group will be able to experience the advantages or disadvantages of Grid-based learning.

2.1 Motivation

The main interests from the organisational point of view:

In this SEES the main educational objective is to improve the quality of an eLearning course through innovative didactic concepts and the use of Grid-based tools and services. The need for improvement is an outcome of the ongoing evaluation process, which has revealed the need to increase student participations in virtual classrooms. The main goal is to employ enhanced presence during the distance learning sessions and to increase the efficiency of collaborative learning. In order to achieve this goal- a two-way strategy will (and needs to) be followed: enhanced presence through new didactic elements and the tuning of the implemented ones, and implementation of Grid-based services and tools.

SEES #4 focuses on the integration of new pedagogical methodologies and technological innovations, which will be developed and implemented in the ELeGI project.

Recognition of added value:

The improvement of synchronous and asynchronous virtual collaborative learning, the performance of individual or collaborative virtual scientific experiences and the use of virtual laboratories are clearly advantages for the AIT learning community as well as for other learning communities which will benefit from the acquired experiences. These improvements can be well supported through the integration of Grid-based services.

SEES #4 has taken into account that the integration of Grid-based tools, systems and the provision of services is rather a requirement emerging from the evaluation outcomes, the educational goals, the adaptation of the didactic models and improvements in the pedagogical concept rather than the other way round, which means that the change will not be driven by technology possibilities.

Pedagogical effectiveness:

The effectiveness of the learning process can be significantly increased if goal 2 and 3 in particular will be achieved.

2.2 Organisational and pedagogical analyse

2.2.1 Learner/user-centred aspects

Summary of the analysis of the main motivational aspects:

Motivational factors can be subdivided into 3 different aspects:

Didactic approach: the focus on collaborative learning and experiential learning is probably well adapted to the learner needs. The realistic attitude of refusing the intensive use of technology-based 'individualised/personalised' learning shows a deep understanding and experience of the learners' and staff's reality as well as of organisational and economical issues in a formal learning environment. Personalised learning is always an aspect inherent to eLearning environments, but a balance between individualised and social learning has to be achieved.

Support activities: the detailed description of roles and interactions of the different actors foreseen for educational, technical and content development support shows that the importance of support for learner motivation and success has been recognised and well integrated into the learning scenario.

The learning environment has been developed according to the learner profile, taking into account the special needs of the target group and the necessity to integrate all learners and staff into the learning community.

2.2.2 Learning environment

Summary of the analysis of the main content aspects:

This aspect has not been analysed, since the content changes will not be significant if compared with the deployed MSIN curriculum.

Summary of the analysis of the main organisational aspects:

Organisational questions are specified according to learner and staff requirements. The learning targets are clearly defined. The characteristics of the target group are well taken into account and well integrated into the learning environment. Learning needs like support, guidance and construction of individual learning paths have been taken into account. The roles of the different users are clearly defined and are appropriate for the learning scenario. The interaction process among the different users is partially defined. The required technical resources are identified and their integration is partial described.

Summary of the analysis of the main support aspects:

The predominant role of support for successful eLearning has been identified and taken into account. Effective and appropriate tutoring and support systems will be used. Technical and pedagogical support for all other parties is planned. Mechanisms to promote group cohesiveness are planned as well as a system to support communication and collaboration among learners/users and staff/other users. Training activities for all users/learners in order to use the new pedagogical methodologies and new Grid-based technology are foreseen.

No special training for eLearning will be needed.

Summary of the analysis of the main evaluation aspects:

The implementation of an evaluation process is foreseen, where all aspects of the educational process will be continuously evaluated. Questionnaire-based user feedback will be analysed and all relevant aspects will be communicated to the parties involved in the educational process.

2.3 Peer comments

The main purpose of SEES #4 is to elicit services applicable to formal distance learning from pedagogical and technological point of view, establishing the potential of such services in terms of exploitation for different stakeholder profiles. In this work it will evaluate novel pedagogical methods and Grid-enabled tools for the establishment of virtual laboratories and for the performance of VSE and computations.

Experiential learning is the essential part of SEES #4, though there are no discussion about the ways to incorparate this feature into the system. The proposal of experiential learning tools to use, their technical requirements and interaction possibilities with other system parts is desirable.

Contextualised, adaptive, situated learning is mentioned as not relevant, but it could be appropriate to self-learning sessions. The self-learning sessions are typical to IWT which is supposed to be a part of the SEES #4 software. The self-learning session approach also is tightly coupled with personalised learning, so contextualised, adaptive and situated learning could be considered as one of the features of the SEES #4 software system.

3 Technical feasibility

Some innovative tools to enable collaborative and experiential learning seems to be needed, but it has to be further described, what a virtual scientific experiment and what a virtual laboratory is in the context of an IT learning system.

The answer to that question and more detailed specifications of the SEES, in a Grid functionalities oriented way, are mandatory in order to make a verdict about the technical feasibility.

3.1 Summary of Grid functionalities required and Tools

Concerning the required Grid functionalities we found:

- Use of Grid facilities and tools to execute ***virtual scientific experiments***;
- Establishment of ***Virtual laboratories*** through Grid-enabled tools
- Realise, try and evaluate a ***Grid Service oriented framework***.

That can be translated by the use of:

- VO and groups
- AAA
- Computational power

3.2 Peer comments

The technical feasibility depends on the feasibility of ELeGI services in general, as stated in the specification (6b):

"Our assumption is that the additional technological innovation and pedagogical methodologies from other project partners are at an implementation stage that allows them to be integrated with the current SEES #4 infrastructure and that their implemented features comply with their intended purpose."

The evaluation within this SEES will give a proof on the universality and applicability of the generic Learning Grid services developed in ELeGI.

In the next phase it will be strongly necessary to further identify the selected services and to define the detailed requirements on their operation and integration with the existing systems (e.g. MENTOR and Blackboard). Especially for the virtual scientific experiments it has to be cleared if and how a Grid enabled VCLab can be used as a development framework for the experiments foreseen in this SEES.

Several systems are enumerated in the functional requirements to Grid technology (GRASP, IWT, Kmi Stadium, …). They have potential to implement the necessary functionality, but this enumeration would benefit from wider comments about the context of the usage of these tools. Answers to the questions like “why” and “how” are important from the technological position and would facilitate the comprehension the architecture of the SEES #4 software and the feasibility of this architecture.

Specific hardware can significantly influence some technical aspects of SEES #4 software. The resolution of these hardware issues as soon as possible is advantageous and would make the further system design more robust, because there would be no new requirements which could demand considerable changes in system architecture later.

Part VII: SEES #5 (Physics Course)

A) SEES #5
Analysis and Requirements Specification

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Version History

Version	Comments, Changes, Status	People
0.9	First step iteration draft.	Dr. B. Vassiliadis
1	Comments, additions	Dr. M. Xenos
1.9	Second step draft (sections 3, 4, 5a,b,c,d,g,h)	Dr. B. Vassiliadis
2	Second step completed. Updated 1a,1b, 5e,5f.	Dr. B. Vassiliadis
2.9	Third Step draft. Sections 7-14.	Dr. B. Vassiliadis
3	Updated 1a,1b, 5h.	
3.1	Updated all sections based on comments received by FIM	Dr. B. Vassiliadis
3.2	Updated 4d, 5e, 7b. Finalised 3rd step (sections 15 – 27).	Dr. B. Vassiliadis
3.3	Checked all sections for typos.	Dr. B. Vassiliadis
3.4	Updated 1b, 10a, 12a, 12c, 13b, 13d, 14d.	Dr. B. Vassiliadis
3.5	Comments, additions	Dr. M. Xenos Dr. B. Vassiliadis
3.6	Added sections 1b1, 1b2, 1b3. Updated 1a, 5e, 5g	Dr. B. Vassiliadis

Project Definitions

0 SEES Glossary

Term	Definition
LO	Learning Object

Project Drivers

1 The Purpose of SEES no 5

1a The user problem or background to the project effort

The Hellenic Open University (HOU) supports a diverse population of students which undertake undergraduate or postgraduate studies. Moreover, it provides postgraduate curricula to graduates who wish to extend or upgrade their studies to subjects related to their profession.

HOU curricula correspond to various certificates, Bachelor or Master's degrees. A Bachelor degree may be comprised of several research directions. Courses are designed according to the distance learning methodology. According to this methodology, students study using text books, participate in 5 tutorials for each module taking place in 8 towns, communicate with the corresponding tutor by telephone, fax, email and letters, prepare 4 – 6 assignments for each module and finally take a final examination 10 months later, that is at the end of each module. A student belongs to one student – group, called class. A class is based on a major Greek city in which class sessions take place. A tutor is allocated for each class of a maximum capacity of 32 students who inhabit in a specific geographical region.

The academic personnel of HOU involves a small number of permanent personnel (Professors, Associated Professors and Assistant Professors) as well as a large number of tutors. The permanent personnel undertakes, besides tutoring, the coordination of all classes and the overall academic responsibility for a specific course. Tutors cooperate with HOU on an annual basis. They, in many cases, belong to the permanent staff of other Greek Universities.

HOU allows admission of students without an entry examination. Although it is a public University students pay fees for the cost of their studies. However, a considerable number of students is supported by scholarships, which discharge them from fees. It should be noted that fees cover the cost of the instructive material and all the expenses related with the studies.

Physics is a research direction of the Natural Sciences Programme of the School of Science and Technology. The programme itself has a 4-year duration and leads to a Bachelor Degree. The programme requires from each student the successful completion of 12 modules and 3 laboratory modules. Among these modules, three are related to the Physics research direction. The Physics research direction, which in this SEES is referred to as the 'Physics Course', uses 7 text books.

The total number of registered students in the course of Physics in the Academic year 2000-2001 was 510. In 2001-2003 another 1200 were added (600 each year). Currently over 1800 students are registered for various stages of the course. For the programme of Natural Sciences, HOU plans to increase the number of new students to 1500 per year. This change will be probably take place in the academic year 2005-2006.

The material used for delivering the course includes print material (text books), electronic material, video lectures, electronic fora and e-mail. Frequent meetings between Tutors and students take place for presentations, discussing problems or for providing additional information. Laboratory experimentation is also available at HOU premises in Patras. Since HOU covers the whole country, a small number of centres are used in major cities providing support such as lecture rooms, and, in the near future, video-conferencing facilities. It must be noted that the tutor/ student ratio is kept steadily at 1:30. This allows the continuing monitoring of student's performance and the establishment of tight relations between the learners and the academic staff.

HOU, as an Open University, serves a diverse population of students. A typical HOU student is rather of a mature age, part time student. Many students are also professionals and have different cultural backgrounds and career goals. They are also geographically dispersed all around Greece.

HOU uses the Centra communication and collaboration tool for on-line delivery of content and lectures in real time. Asynchronous services are provided through HOU web sites and email services.

HOU has repeatedly evaluated the procedure of delivering e-learning to its students. Recent assessments reports mention the following drawbacks of the existing learning methodology:

Low participation to e-learning sessions:	the participation of students to e-learning sessions and the use of collaboration tools is low. Two reasons have been identified for this drawback. The first is the low connection speed between users and the central server located at HOU. This largely depends on the communication system infrastructure in Greece which is upgraded slowly but steadily. The second reason concerns the lack of interest shown by the users for the e-learning system itself. Although basic functionality such as videoconferencing and collaborative support are provided, the system seems to lack the interactivity and the efficiency needed for broad acceptance.
Interactivity:	visualisations or simulations are not supported. Such interactive sessions attract the interest of the user and greatly increase the efficiency of the learning process. For the Physics course in particular, simulations or on-line experiments are deemed important in the learning process but it is difficult to support them with the existing tools since many of them require significant CPU recourses. There is no integration of technologies that support the various aspects of the learning process.
Efficiency:	students at HOU have significant time constraints as far as the learning process is concerned. Most of them are professionals and as such are part time students. The parameter of time is critical. Learning content should be highly specified and not too general. The e-learning system should provide the means to cut down the costs of learning through adaptation, effective task assignment, execution duration control and monitoring.
Flexibility:	there is a need for a more flexible e-learning system. The target group of learners is highly heterogeneous. Students have different goals. The pace of learning may differ significantly even among students of the same class. Students also differ in the amount of time they spend for attending e-classes or studying.
Progress Monitoring and Assessment:	although HOU has an good ratio of teaching staff per student, assessment is often difficult. There is also limited coordination between the study material and time management of the students. There is also a great difficulty to assess the learning procedure as a whole without the use of the proper tools. Furthermore, links between the learning process, student behaviour and categorisation, content, time schedules are hard to mine. This kind of metadata could significantly improve the way that e-learning is delivered by HOU.
Task oriented system:	the current methodology is task oriented rather than process oriented. This means that only individual learning tasks are supported rather than

system:	the whole learning process. This fact may lead to poor student performance through the partitioning of the learning process (acquisition of fragmented/ tightly coupled knowledge).
New roles for students are not supported:	new learning models encourage new roles for the students including that of the researcher, creator or even some times the designer of content or services. The current system is somewhat monolithic and lacks the flexibility for supporting new roles.
Costs:	inclusion of new tools or services to the existing system is a too costly process. It is also difficult to manage the integration of internal and external resources since aspects such as security, heterogeneity and copyright are not dealt with.
Number of students is large:	the number of students that need to be supported by distance learning applications at HOU is quite large. It is already mentioned that 1800 students are already registered for the Physics course. Their number is estimated to reach 4000 in the year 2006. Normally, this is not a problem if static, web applications are used for delivering content. A simple web server is adequate. Nevertheless, in the case of more complex services such as virtual laboratory experiments, there is a problem on how to cope with tens or even hundreds of experiments running at the same time by remote users. Furthermore, according to HOU rules, there can be no strict rules on when students may access a service or not. Access to services is quite random in terms of number of users, time of access and time of use. HOU's policy to improve the quality and capacity of the e-learning services (number of user supported), requires a solution that can handle possibly thousands of users at the same time in the future.

Experimentation has a central role when teaching the science of Physics. Albert Einstein quotes:

"In the matter of physics, the first lessons should contain nothing but what is experimental and interesting to see. A pretty experiment is in itself often more valuable than twenty formulae extracted from our minds."

This statement underlines the importance of experimentation in Physics. Furthermore, there is a need to use visual content in order to enhance the learning experience of the students and supplement the methods that are already used (text books, on-line content, synchronous/ asynchronous collaboration).

The user problem in HOU can be summarised as follows:

Users need a service that improves efficiency in the cognitive and social domains: improve learning capacity and academic performance and increase group and individual self-confidence.

There is a need to adopt experience – based e-learning services as an additional medium for engaging the students into actively taking part in distance learning.

Furthermore, there is an important consideration that affects the design of any future service:

The user population (students) can be measured in thousands.

This means that any new service should be able to meet peak processing loads that may vary greatly over time.

Although HOU is a state University, about 80% of its funding comes from students' fees. This means that the University has to adopt a flexible and sustainable business model in order to minimise costs. This business model is closely linked to the quality of the educational services that are provided to the students. Apart from classic problems of distance education which are common for all European Institutions, HOU has to take into account the fact that e-learning has not gained such a wide acceptance in Greece as in other countries. Although very important steps have been made in this field in the past few years, this fact remains a serious concern for HOU policy makers. The University's business policy is greatly influencing the design of any new service.

Thus, the business problem in HOU can be summarised as follows:

There is a need to provide new services while keeping costs to a minimum and maximising return on investment.

1b Goals of the project

Overall Goals

The main goal of the SEES is:

Main Goal: Improve efficiency of current HOU e-learning practises by promoting an experience –based e-learning model. To use the new services as reinforcements to the foundations laid by the linear structured text books and the on-line and off-line lectures.

The goal of the SEES is not to solve all the problems mentioned in section 1a but rather to integrate a new learning methodology that will work as a supplement to existing practises. The aim is to increase:

- student motivation to participate in on-line sessions,
- student confidence and satisfaction ,
- efficiency of the learning process.

In order to reach the main goal, the following sub-goals have to be accomplished:

Sub- Goal1: Provide added value services.

- provide advanced, media rich services in the form of multi-step, cooperative experiments/ simulations for the Physics course,
- facilitate collaboration and knowledge sharing and reuse between groups and individuals.

Sub- Goal2: Support thousands of users while preserving adequate Quality of Service.

- provide the services to a diverse and very large student population,
- provide a single access point with a homogeneous interface,
- preserve quality of service (fault tolerance, response time) at any time.

Sub- Goal3: Evaluate the didactical approach and the technology infrastructure by contacting a real, large scale experiment in the Physics course at HOU.

- provide / configure metrics for measuring performance in terms of scalability, quality of service and security,
- test the infrastructure in a real situation,
- assess the results and provide feedback.

SEES no5 will focus on advanced collaborative experience – based learning services. In this context, collaboration will take place through the exchange of data and knowledge. The SEES will support virtual laboratory services where *n* students perform *n* experiments (simulations of complex Physics phenomena).

Other secondary services include:

- authoring of educational material for supporting the experiments,
- association with relevant course modules, organized in Learning Objects (LOs) and external sources.

SEES organisation

Figure 1 presents a general overview of the SEES organisation. The Simulation/ Experimentation services are the core of the SEES, providing visualisation interfaces for contacting individual and/or cooperative experiments. Resources (tools and data) are used for supporting these services. A portal is used for integrating new and existing tools and for providing transparent access.

Existing tools and services include:

- Centra, a synchronous collaboration tool, which will be used for advanced collaboration/ sharing of knowledge and resources related to the experiments, and virtual class management,
- HOU Web sites, used for asynchronous delivery of educational material and for off-line collaboration.
- Tools and Web browsers are used to access and manipulate information objects:
    - Internet Explorer/ Mozilla forWeb browsing,
    - Word for creating documents,
    - Excel for creating spreadsheets, analysing data and finding solutions,
    - PowerPoint for creating, organising, and illustrating presentations,
    - WordPad for plain text editing.

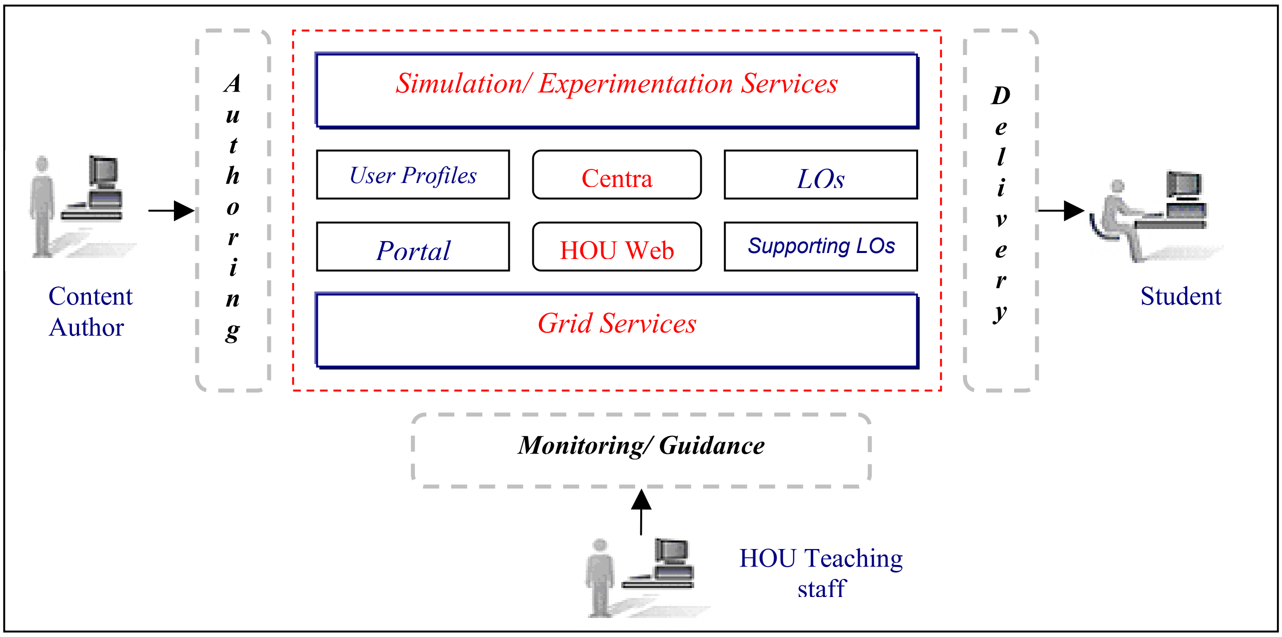

Figure 1. Overview of the SEESno5 oganisation

In addition to the above mentioned tools, integration methods should allow the use of most kinds of applications or tools that associated with specific file types defined in the Windows environment.

Data include:

- Educational material organised in LOs. This material shall be derived from HOU text books. For this SEES, only a small part of this material will be transformed in LOs.

- User profiles. This information is derived from existing student information and other monitoring tools (e.g. log analysers, Centra report generators).
- Supporting material especially designed for assisting students in performing the experiments. Authoring of supporting material shall be limited and shall take the form of Web pages with few lines of text and graphics. Links to internal and external sources shall be provided by Content Authors or the HOU teaching staff.
- Other metadata.

Grid services shall be used for resource allocation and service delivery.

In this SEES, simulation shall be designed based on concrete educational objectives that need to be achieved by the student. Feedback is used to make the learning experience more efficient. A simulation has three levels of complexity: easy, medium and hard. Complexity is closely linked to the learning objectives. If the learning objectives include the need for collaboration between students, the complexity increases significantly. The following table presents the relation between the number of students collaborating and the complexity of the experiments. Five experiments/simulations shall be developed for SEESno5.

Complexity	Number of students participating	Number of experiments
Easy	1	1
Medium	2	3
Hard	3 or more	1

The simulations will be comprised of several steps, thus letting students choose different paths using multiple choice questions. Additional supporting material will be presented when needed including supporting LOs, references to the HOU web site or the text books. After each step, the intermediate results are presented and feedback is provided.

Feedback shall be provided in the following ways:

- on-line and during the experiment, with the collaboration of a Tutor who oversees its completion. Using synchronous tools (Centra), the Tutor assess the choices that the student makes and provides feedback when necessary.
- debriefing after the end of the simulation. This can take place through asynchronous communication methods (e.g. email) or during the regular face to face meeting of the classes.
- automatic feedback. Assessment methods that are build-in in the service. Feedback loops in the simulation/experiment narrative offer hints or additional information on how to improve results.

Simulations will have a finite number of outcomes in order to control their complexity. The challenge in creating the SEES simulations/experiments is to reach a consensus between the stimulation for student participation and the need to reach the learning objectives.

Services should be accessible using standard PCs. The software should include Web browsers with the least possible number of plug-ins. There should not be a need to install expensive software (e.g. MatLab) in the user machine in order to access or use the services. In this SEES, the computational resources of the users are not considered resources of the Grid (i.e. the CPU power of the computer of a user is not used in the Grid).

The introduction of advanced services such as the ones described for SEESno5 in HOU's infrastructure must enable a leverage of the University's course administrative operations, providing new ways for communicating and introduce the use of improved teaching methodologies using Grid technology. However, this is not an easy task since it has to overcome the traditional ways of administration, information sharing, and teaching. Moreover, it needs an effective student-centered implementation and support mechanism in order to assure its widest acceptance and use by the academic community. It shall also integrate existing tools and databases that are already in use and possibly extend their capabilities.

Another goal of the SEES is to improve collaboration between students. This will be accomplished through cooperative experiments. In a cooperative experiment, students share resources (data sets, results, opinions etc.) to perform a complex, multi step process.

Students may access the SEES service from anyplace in Greece through a portal. There are 8 points supporting the portal, called nodes which are used for sharing resources and servicing users. Nodes are geographically dispersed and they are based in major Greek cities where HOU classes are making their regular sessions (figure 2). Each node is covering a specific region and supports mainly the students that are living in the vicinity. The backbone that is used by the nodes for transferring data is the GUNet (Greek Universities Network), a high speed network infrastructure that links all Greek higher education organisations. The speed of GUNet is currently at 155Mbps. The goal of the SEES is to transform and extend the actual city-class model to a Grid model. Each node plays the role of an electronic regional support center, offering basic services such as direct and personalized attention towards students: virtual meetings with teachers and other students, seminars and round tables. There are two super nodes that are coordinating the smaller ones. Super nodes are used to handle large CPU loads, store intermediate results from simulation runs and backup data.

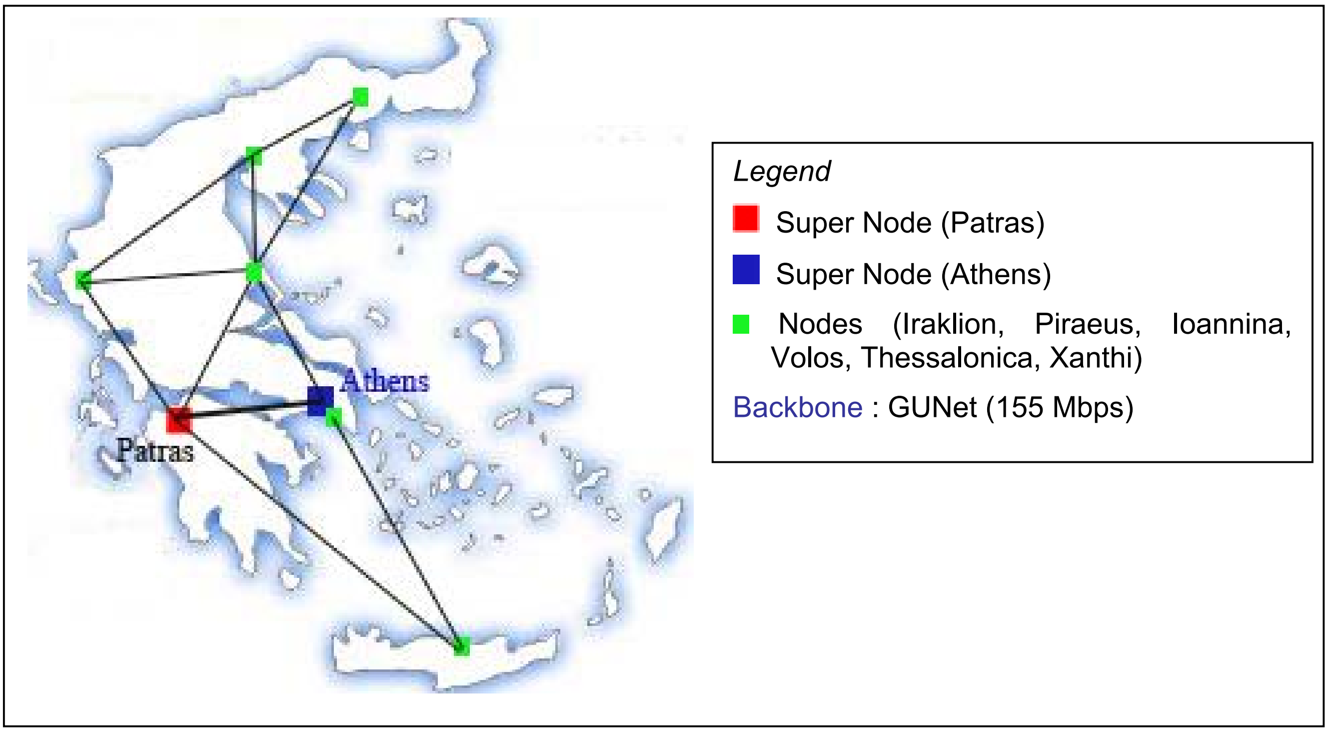

Figure 2. A possible node distribution of the SEESno5 Grid

Since this SEES widespread deployment of computational resources involves the Internet as a communication backbone, the E-Legi infrastructure must seamlessly deal with the heterogeneous nature of the network. Some of the challenges that such infrastructure must deal with are:

- the user population is large and dynamic. Nevertheless, participants include members of the same institution,
- the resource pool is large and dynamic, the quantity and location of available resources can change rapidly,
- a computation (or process created by a computation) may acquire, start processes on, and release resources dynamically during its execution,
- resources have, in general, the same authentication and authorization mechanisms and policies. Nevertheless, differences across different domains inside HOU do exist (e.g. different laboratories).

The necessity for using Grid Technology for SEES no5

As stated in section 1a, HOU's policy is to adopt new technologies in order to minimise costs and maximise return on investment (ROI) in all levels: from administration to the delivery of education. In the latter case, new e-learning services should be designed in way that:

- fully utilise existing resources,
- can be expanded in order to support a large number of users while minimising costs,
- it is flexible and able to respond to the rapidly evolving Greek market,
- increases the power of core resources without creating the need for investing in additional hardware or hosting infrastructures,
- support the University's dynamic policy for expansion.

In this context, E-Legi's Grid technology is a significant step towards the direction of a compact, scalable and cost-efficient infrastructure for e-learning services. The use of Grid technology is imposed in order to fulfil real business needs:

- to combine resources on demand for service provision,
- to intelligently allocate finite resources to the appropriate applications,
- to free expensive supercomputing resources for only the most high-end processing needs while still supporting the wide range of compute-intensive applications run by research groups throughout HOU,
- to increase ROI on existing resources,
- to be able to support the ever-increasing number of users,
- to provide cross-domain functionality.

A Grid infrastructure would permit transparent access to services and resources wherever they are located. Furthermore, special functions valuable for the SEES such as:

- resource reservation,
- storage of large volumes of data,
- minimisation of data transferred by using a super-node structure,

are made possible.

In conclusion, the business value of using Grid technology for the SEES, stems from:

- leveraging existing h/w and s/w investments and resources,
- reducing operational costs,
- creating a scalable and flexible infrastructure.

In this SEES, there is a clear need to support a large number of users and cope with peak processing loads. It can be argued that acquiring CPU power and increasing storage capacity by using clusters of computers is both a cheap and efficient solution for supporting large numbers of users. This is partially true, but the real problem is not purely technological (e.g. about CPU power) but business as well. If contemporary technology is used then cost will be increased since:

- management and monitoring of different resources, is difficult and expensive,
- expanding usually means buying and dedicating new hardware and software to new services,
- resources are still fragmented,
- ROI is not maximised,
- overload peaks are not always efficiently dealt with.

It is our opinion that without Grid technology, it would be possible but not efficient to build this SEES for HOU. The use of Grid technologies serves quite well the business and expansion policy of the University: support a large numbers of students, provide new services by minimising support and management costs and maximising ROI on existing and new equipment.

1c Opportunities and “return of value”

SEES opportunities include:

- Creation of virtual communities to augment in-class communities.
- Possibility of providing interactive education.
- Possibility of attracting more distant and home-bound students.
- Possibility of expanding educational programmes.

Return of value stems from the following educational, organisational and external benefits:

Educational:

- Use more efficient learning models.
- Overcome limitations problems of current computing infrastructure.
- Reduced training costs.
- New assessment mechanisms for monitoring student progress.
- Support for computationally expensive services.
- Provision of ubiquitous e-learning services.
- Provision of consulting services to other academic institutions in Greece concerning new e-learning models, and Grid-enabled learning.
- Innovation

Organisational:

- Improvements in organisational efficiency (better information flow, savings in staff time, improvements in service provision).
- Enhanced public profile of the institution.
- High return on investment: support more students, with less effort and reduced costs.

Other:

- Strategic partnering with external organisations (e.g. other higher education institutions, commercial or community organisations),

- New markets: provision of new services through the collaboration with other academic organisations in Greece or Europe.

2 Client, Customer and other Stakeholders

2a The client is the person/s paying for the development, and owner of the delivered system.

The client of SEES no5 is HOU, as the organisation hosting and managing the service.

2b The customer is the person/s who will pay for the SEES' service.

The customers are HOU students who pay for attending a course. Other potential customers include other Greek Universities and eLearning organisations.

2c Other stakeholders

SEES no5 stakeholders include:

- Students: students of the Physics course at HOU. Users shall indirectly provide the requirements for designing a new learning model. This means that their requirements shall be assessed though their behaviour throughout the learning process. Students will also be involved in the assessment phase of the SEES and provide valuable feedback concerning the efficiency of the proposed solutions.
- HOU Teaching Staff: academic personnel including Professors and Tutors. They will provide input on the design and adoption of new learning models and evaluate the SEES efficiency.
- HOU Technical and support staff: including network and server administrators, special technical staff for supporting e-learning service provision.
- Laboratories: HOU laboratories include laboratory staff, equipment, e-learning modules, services, knowledge.
- Academic Institutions collaborating with HOU: academic institutions, such as the University of Patras, are possible collaborators in the development and provision of MSc. Curricula.
- Greek Ministry of Education: a potential successful deployment of a Grid service architecture in HOU, may boost the adoption of new learning models and Grid services in other higher education institutions. This will be made possible through the cooperation of the Greek Ministry of Education. Experts of the Ministry will evaluate the new methods and decide if the return of investment for its adoption in a wider scale is feasible.

3 Users of the Service

3a The users of the service

The users of the service are categorised as follows:

- Student

Characteristics	*Description*
Description:	the “Student” user is an individual who attends the Physics course. Students pay an admission for attending the course. They are located in different geographic areas all around Greece and they have different backgrounds.

User role:	a student uses print and on-line material in order to complete the course. Regular meeting with the teaching staff are also held. Regular examinations and projects also take place for evaluation purposes. The student will be the main user of the E-Legi services.
Experience:	User's knowledge concerning the E-Legi services is medium. Apart from the user interface functions and basic service functionality, this user group is not experienced with the E-Legi system.
Technical experience:	Minimal
Aspiration & Objectives:	• Educational needs: Students often have different needs in order to achieve the same learning objectives. The general objective is to achieve flexibility, interactivity and efficiency in the learning process as described in section 1a. • increased collaboration with other students: exchange of knowledge and sharing of experiment results. • technical support for using the E-Legi services. The advanced nature of the services shall require initial training of the students on how to use them and how to exploit their full potential. On-line support is also required.
Other:	Usually students do not have physical or intellectual disabilities. Their attitude towards technology is positive although they do not share the same experience in using information technologies. Gender and social groups vary significantly. A typical student has an age between 23 – 45 years. Most students are in their mid 20's. A student holds a high school diploma and, occasionally, another University degree. Time constraints are pressing for this type of user. A typical student of the Physics course is not a full time student and is often a professional. It has been observed that inefficient time management is one of the most significant parameters that lead to failures in the projects and the final examinations.

- Tutor

Characteristics	*Description*
Description:	A Tutor is a member of the teaching staff of HOU. Each tutor is responsible for guiding one class through the educational process.
User role:	The tutor uses on-line tools for teaching and communicating with the students of his class. Face to face meetings or class sessions are also taking place in regular intervals. Classes are sets of students. A class is based on one major Greek city and covers specific geographic vicinity. For example, the class at Ioannina, covers the northwest area of the country. Students living in this specific area are obligated to attend this class only. Class sessions are of two types: real and virtual. Regular meetings take place between students and teaching staff. Virtual meetings are

	supported by existing synchronous and asynchronous communication tools. Class strength may range between 5 to 30 students. A class which corresponds to a specific region may be void if there are no students to attend it. Classes are regarded as entities that have different level of attainment and may use slightly different on-line materials. All classes share the same, general educational goals. Nevertheless, individual sub-goals may differ since each class has different needs and learning paces. The Tutor is responsible for guiding each student, for assessing his performance and for providing additional educational material when necessary.
Experience:	The user is an expert in using E-Legi services. He is capable of exploiting their full potential and passes his knowledge to students.
Technical experience:	Medium. The user has technical experience in elearning and information technology but does not poses expertise in Grid technologies.
Aspiration & Objectives:	Efficiency in supporting students in the learning process.
Other:	Tutors do not have physical or intellectual disabilities. Their attitude to technology is positive although they have significant experience in using information technologies. Gender and social group vary significantly. A typical Tutor is between 30 -45 year old. A Tutor holds a Phd diploma and has experience in teaching and elearning methods. Tutors are part time employees of HOU. This means that they are occupied with other professions, usually teaching in secondary or higher education organisations all over Greece.

- Course coordinator

Characteristics	*Description*
Description:	This user is responsible for coordinating the learning process for all classes by cooperating closely with each tutor.
User role:	He has frequent communication with the tutors about the progress of each class. He is using administrative services in order to assess the performance of all classes and may intervene when difficulties arise.
Experience:	The user is an expert in using E-Legi services. He is capable of exploiting their full potential and passes his knowledge to Tutors and students.
Technical experience:	Medium. The user has technical experience in elearning and information technology but he is not an expert in Grid technologies.
Aspiration & Objectives:	• Efficiency in supporting Tutors in managing classes.

	• Efficiency in supporting students in the learning process.
Other:	The course coordinator is a permanent staff member of HOU. This user holds a Phd diploma and has significant experience in teaching and elearning methods.

- Technical staff

Characteristics	*Description*
Description:	The technical staff of HOU ensures that the E-Legi services maintain their operational capabilities. Technical staff may also include content creators.
User role:	Provide technical support to other users, upgrading, maintenance, security. They are responsible for producing and managing on-line material
Experience:	The user is an expert in using E-Legi services.
Technical experience:	The user has significant technical experience in eLearning Grid technologies.
Aspiration & Objectives:	Efficiency in supporting E-Legi services
Other:	This user group is comprised of permanent staff of HOU, usually engineers and e-services experts.

3b The priorities assigned to users

The following table summarises the priorities for each user group identified in section 3a.

Type of User	*Priority*
Student	Key user
Tutor	Key user
Course coordinator	Secondary user
Technical staff	Secondary user

3c User participation

The following table summarises the participation level required for developing the requirements for each user group identified in section 3a.

Type of User	*User Participation*
Student	These users are significant for providing user requirements since they are the main user group. They are fairly motivated and they generally have a positive attitude during experiments for the assessment or testing of new services and tools. It is anticipated that two or three groups comprised of 5-10 students will take part in the development of the user requirements. These

	user groups will originate from geographically dispersed areas: Northern Greece, South Western Greece and central Greece.
Tutor	Six tutors will take part in the requirements definition. They will provide requirements concerning services such as: • interface of visual experimentation services, • design of experiments, • knowledge sharing services, • integration with class collaboration services.
Course coordinator	The course coordinator will provide requirements including: • design of experiments, • integration of experiments into the existing learning process.
Technical staff	Two engineers of the Support Group at HOU will provide requirements including: • security, • equipment for services enactment and support, • network capacity, • integration with existing systems, • e-learning content development and integration requirements, • other technical requirements.

Project Constraints

4 Mandated Constraints

4a Solution constraints

The E-Legi solution has the following constraints:

- Conceptual constraints and boundaries have been imposed by the service design (e.g. user-centric approach and control and universal access).
- There are a number of legislative and policy issues, as well as ethical and legal considerations.
- Constraints related to the stakeholders, agents, and entities that are part of the e-learning value chain.
- Technological limitations and constraints are inherent in the types of current and future technologies that might be part of the final system.
  - Students will access E-Legi services using computers operating the Windows/Linux platform and standard browsers.
  - Bandwidth capacity. E-Legi services should not require extreme amounts of electronic communication between students and instructors. Customisation of amount and type of data communicated should be available.

4b Implementation environment of the current system

The current system is a server using the Centra software (http://www.centra.com), a virtual classes elearning support system.

This configuration does not affect the development or deployment of E-Legi services.

4c Partner applications

Currently HOU uses a Centra server for delivering real time communication services to students. This also includes on-line content.

E-content in the form of HTML pages is also used. This content includes text, images, video and streaming media.

E-Legi services should be able to use material and interface with the Centra server.

4d ELeGI related software

Tool	**Usage** (whether, how, why, by whom)
GRASP	GRASP may be used as the basic infrastructure for supporting the different nodes of the SEESno5 HOU network. Although GRASP is focused on application service provision it could be modified to support coordination of resources and CPU load balancing. This solution's ability to overcome performance and quantity limitations by combining resources is considered valuable. Coordination of resources is also critical. The GRASP infrastructure could be used as the basis for supporting high level e-learning services for SEESno 5. The technical staff of HOU will use it directly for managing the Grid infrastructure and E-Legi low level services.
IWT	No
Finesse	No

Virtual Control Laboratory	VCLAB is a good solution for supporting active learning and simple experimentation. Experiments supported in VClab are visual simulations of simple complexity. A major drawback of this tool is the requirement to install MatLab in the user machine in order to perform calculations. MatLab is an expensive and quite demanding, in terms of CPU load, tool. VClab will not be used in the SEES, nevertheless, it is a good paradigm on how a virtual laboratory should work.
BuddySpace	No
Kmi Stadium	No
Magpie	No
madkit	No
Strobe	No
Webra	No
DYXWEB	No
Centra	Centra is currently used in HOU as the main platform for supporting on-line collaboration. It is used by students and Tutors mainly for on-line lectures.

4e Anticipated workplace environment

SEES no5 users are working either at home or at the University. All users are static so there is no need for mobile support.

The following table summarises the workplace environment for every user group.

Type of User	*Workplace environment*
Student	Home office / Work office
Tutor	University office
Course coordinator	University office
Technical staff	University office

4f How long do the developers have to build the system?

The deadlines of the SEES are in line with the deadlines described in the E-Legi technical annex.

The design of the SEES will take 18 months and the implementation about 2½ years.\

4g What is the financial budget for the SEES?

The budget for SEES no5 and for the full duration of the project is split as follows:

Task	Budget (€)
Feasibility and Initial Requirements analysis	45000
Design	20000
Implementation / Installation	100000
Support	15000

Testing	10000
Total:	**190.000**

The budget is within the limits. It is realistic to build the service although its support after the completion of the project needs additional funding. This will be provided by internal budget of HOU.

5 Test-Bed Design

5a Pedagogical / didactical approach

Approach	**Usage** (whether, how, why, by whom)
Collaborative learning, cooperative learning, social learning, project related learning	Communication through the learning environment is already a key feature in the HOU learning methodology. This feature needs to be strengthened in the SEESno5 use case. Students are geographically isolated and it is through dialogue in chat rooms, discussion spaces, email and videoconferencing that they will be able to form learning communities, to share knowledge, to challenge and to question key issues. The use of experiments and simulations should provide the stimulation needed to form more active virtual communities.
Constructivist learning	Constructivist learning will be used as a method for designing the SEESno5 learning scenarios and for the support of the learning process by the tutors. Knowledge construction will be assisted by exploring experiments in a simulation of real world. This situation shall encourage students to test ideas against alternative views and contexts.
Experiential learning, active learning, Problem based learning (PBL)	In order to overcome low participation and increase efficiency, SEES no5 learning environment should support and challenge the student's thinking. Collaboration will also take place both between students and between student – tutor. The tutor will actually become a mentor rather than the holder of knowledge. This means that the tutor should be able to employ and encourage social negotiation. Although educational goals for each module that comprises the Physics course are predetermined, the E-Legi learning model should partially support negotiation rather than imposition, of goals and objectives.
Personalised, individualised learning	
Ubiquity and accessibility (anytime/anywhere)	Learning anytime, anywhere, without geographical and scheduling barriers is essential. HOU students are responsible for their own time management. This means that many of the E-Legi services must be available anytime.
Contextualised, adaptive, situated learning	

5b Learning contents

The Physics course at HOU is part of a programme that leads to the Natural Sciences degree. This degree aims at covering all basic cognitive fields of Physics, Chemistry and Biology while projecting the cohesion of these sciences and highlighting their important inter-scientific fields. It also aims at understanding the principles, notions, theories as well as the main applications thereof as well as developing problem solving ability.

SEESno5 will only make use of part of the existing content for the Physics course which is comprised of seven text books, namely:

- Classical Mechanics (256 pages)
- Mechanics (260 pages)
- Thermodynamics (168 pages)
- Statistical Thermodynamics (232 pages)
- Electromagnetism (234 pages)
- Phasmatoscopy (346 pages)
- Theory of Relativity (140 pages)

There are also two texts book for laboratory experimentation:

- Physics Laboratory Experiments I (146 pages)
- Physics Laboratory Experiments II (under preparation)

All texts books are delivered to students. They are also available in electronic format although they are not available on-line. Each book is written in a way that is suitable for distance learning. It is comprised of special sections, each one having its own educational objectives and goals. Most sections have their own assessment mechanisms in the form of exercises, quizzes, experiments and educational activities. Several sections construct a chapter entity.

A text section can be easily turned into a learning object (LO), if metadata is attached to it. Metadata information would allow efficient reuse, searching and sharing of LOs. This means that such an LO would be:

- reusable – a single LO may be used in multiple contexts for multiple purposes,
- self-contained – each LO can be studied independently,
- can be aggregated – LOs can be grouped into larger collections of content, including traditional course structure,
- regarded as e-tagged with metadata.

Only a small number of LOs will be produced. They will be directly relevant to the experiments that will be developed. It is expected that an experiment will be associated to 2-3 LOs.

Besides text books, there are other forms of learning content that are used in the Physics course:

- on-line presentations: multimedia rich web seminars,
- on-line material: HTML pages with images and links to external information,
- visual simulations: a few Java based visualisations of experiments with minimal interaction,
- streaming video lectures: streaming audio and video.

In SEESno5, a number of interactive simulations of experiments need to be developed. It is anticipated that five experiments of different complexity will be finally produced. The subjects of the experiments are not available at this point.

5c User support

User support depends on the user group. For the different user groups of SEES no5, the following requirements have been identified:

- Student

Student support services in SEESno5 should provide ‘learner support’ and ‘learning support’.

- *Learner support* describes all the assistance provided by the E-Legi services and matches the facilities which a face-to-face system provides for the success of its students.
- *Learning support* describes the assistance provided by existing HOU tools in the actual process of learning to ensure that the learning tasks are performed successfully. These tools will also be integrated to E-Legi services.

Student learning support

	Support Description
Content	• Dispatch of printed and other physical learning materials • Instruction on the online learning technique • Bulletin Boards. Online discussion rooms for all students to post comments, questions and learning support documents • Email for contacting Tutors • Online tutorials. Online tutorials to support students in meeting their learning objectives • Face to face tutorials. The facility to arrange online, face to face tutorials that support the students in meeting their learning objectives • Resources / Library. Online access to additional material to support student learning • Student – Self Assessment. The online facility to check learning progress during the course • Assessment Feedback – electronic • Assessment Feedback – manual • Advice on further study (links to educational material outside HOU) • FAQ section • Glossary
Motivation	The provision of feedback is an important dimension of the education process and feedback on student work is a characteristic part of student support services.
Technology	Email, video-conferencing, bulleting board, web based forum.

Student learner support

	Support Description
Content	During experimentation, students will be supported by Tutors, technical staff and on-line help services. Each tutor is assigned a class of 5 – 30 students. Each student may be supported by the tutor technically on how to use the services. Support is available both on line and off line. Email and guidance in real time should be available. Student personal web page. A personal home- page per student to allow them to introduce themselves to online colleagues, showcase their work, provide alternative sources of course information to colleagues. Face to face meetings are possible 3-4 times per year. Weekly telephone and email communication is already a standard support procedure at HOU.

Motivation	The communication between students and between students and Tutors will ensure that the users' motivation level is kept in high levels. It is anticipated, that students with low motivation shall get additional help by the Tutor. This includes face to face meetings and frequent communication via telephone or email.
Technology	Technical support should be available both by electronic communication with the technical staff (email), by a special forum for technical and educational support and by an on-line help guide. A guide for installing and using the E-Legi services on the user computer should be available both on-line and in print.

- Tutor

	Support Description
Content	A text book that includes advanced technical and educational guidelines on using the new services must be available. A personal page at the portal with links to tools and services.
Motivation	Tutors have frequent face to face meetings and phone conferences with the course coordinator. In these meetings all problems are discussed and solutions are improvised.
Technology	On – line tutorial and email communication with the technical staff and the course coordinator should be available. A special forum for tutors that deals with the use of E-Legi services should also be available.

- Course coordinator

	Support Description
Content	A text book that includes advanced technical and educational guidelines on using the new services should be available. A personal page at the portal with links to tools and services.
Technology	On – line tutorial and email communication with the technical staff and the course coordinator should be available.

- Technical staff

	Support Description
Content	Detailed guides for authoring/ upgrading the educational material should be available. Detailed installation and maintenance guides for the services are required. Communication with the developers of the E-Legi services should be available. An E-Legi technical forum for all European users of this service should be available for sharing experience and solving problems.
Technology	On-line and print manuals and guides. Web-based forum, email lsits.

5d Training needs

It must be noted that although students of the Physics course are familiar with information technology, they are not experts and they possibly will have little time for getting familiar with the services. Thus, services should be transparent and require as little interaction as possible for non-technical matters. This would greatly reduce the training needs. The training needs for each user category are summarised in the following table:

Type of User	*Training needs*
Student	It is expected that students must follow a short course of about 4 hours on how to use the E-Legi services. This course can take place during the frequent meetings with their tutors or alternatively in the beginning of the academic year. Meetings should also take place for discussing problems or questions.
Tutor	Tutors will have to follow a short course (about 10 hours) on E-Legi services before the start of the academic year. Furthermore, training has to include experimentation with the services and extensive testing. This will require at least one month for the Tutors to familiarise with the new services.
Course coordinator	The course coordinator has to follow the same training as the tutors. The coordinator should also be an expert on how E-Legi can be used to maximise the effect of the learning process.
Technical staff	The technical staff needs to be trained on how to install, maintain and upgrade the E-Legi services. This requires special training courses. Content authors should additionally be able to exploit the full potential of the E-Legi Grid services when they develop new experiments and supporting content.

5e Organisational aspects

The objectives of SEES no5, as far as the organisational aspects are concerned, includes (figure 3):

- Problem statement, initial analysis
- feasibility analysis,
- the detailed requirements specification for the Physics course use case,
- SEES design and development,
- SEES enactment,
- testing and evaluation of the E-Legi infrastructure in a distance learning experiment.

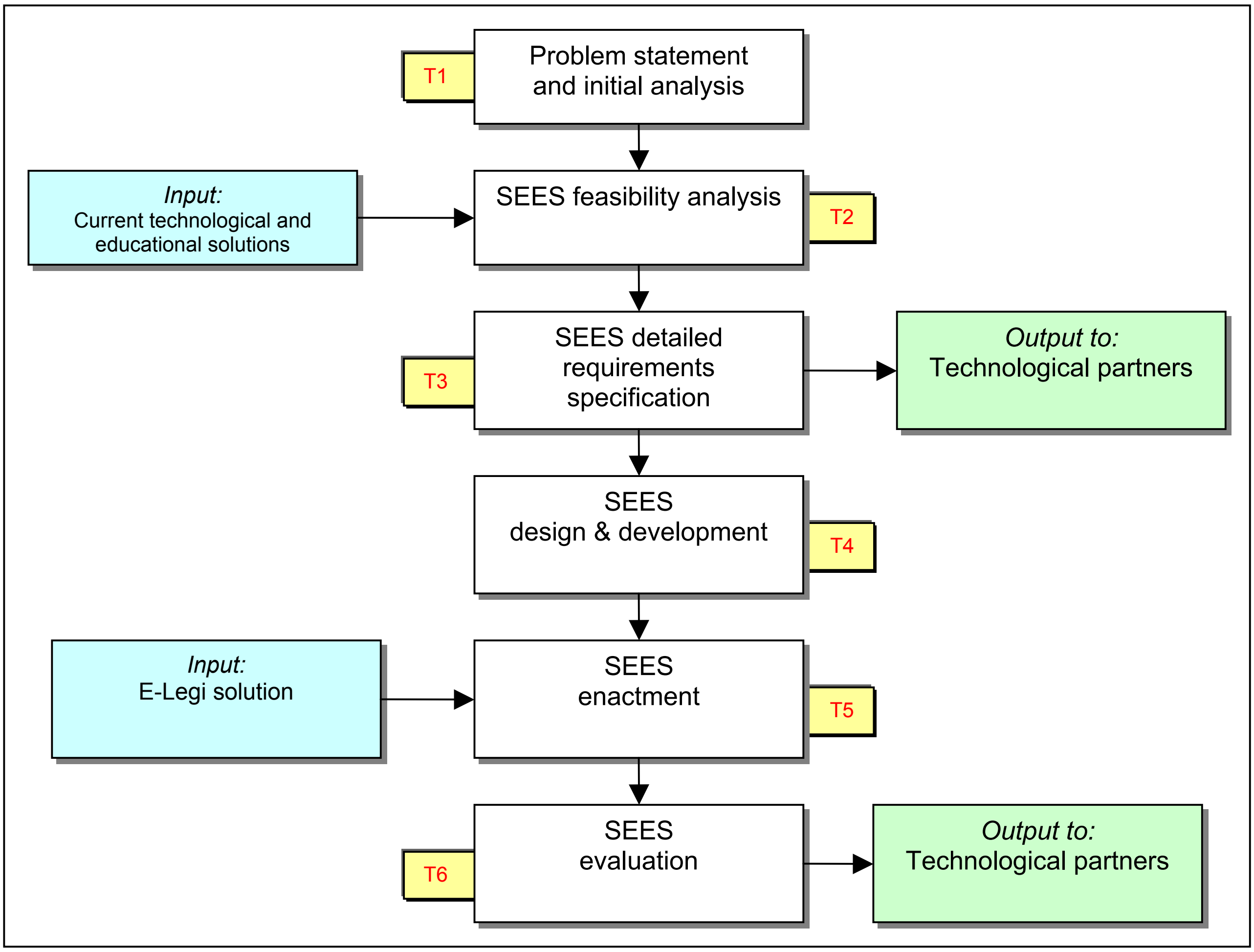

Figure 3 SEESno5 Task Plan

In order to run the SEES, a course environment will be set up consisting of four members:

1. Three classes (with a total number of 15 – 30 students),
2. six tutors
3. a course coordinator,
4. technical/support staff

The work is divided in several tasks:

- *Task 1 Problem statement and initial analysis*.
- *Task 2 SEES feasibility analysis*.
- *Task 3 SEES detailed requirements specification*. Define use case and user requirements. With a starting point in the E-Legi educational and technological methodology, define the user requirements for this specific SEES.
- *Task 4 SEES design & development.* Design and develop experiments. Data preparation. Integration with Centra. Development of Portal. Installation to nodes. Do the necessary introduction, motivation and training of people to make them able to participate in the SEES. Carry out other necessary preparations at the different sites, including preparing new educational material where necessary.

- *Task 5 SEES enactment.* The SEES will be run by HOU. Experience shall be gathered of how educational models and E-Legi services can be managed. This will be documented and serve as input to the evaluation task.
- *Task 6 SEES evaluation.* Technical, educational and business evaluation. Using the evaluation planning process described in 5g, characteristics will be categorised, evaluated and analysed.

The preliminary time plan for SEES no5 is as follows:

Time Period	***Tasks***	***Staff***
First 18 months	• Feasibility analysis • Detailed user requirements	• 1 project manager • 1 e-learning expert • 1 e-services expert
Years 2 & 3	• SEES design & development	• 1 project manager • 1 e-learning expert • 1 services expert
End of year 3	• SEES enactment	• 1 project manager • 1 e-learning expert • 1 e-services expert • 2 technicians • 3 tutors • 3 classes (5-30 students)
Year 4	• SEES evaluation	• 1 course coordinator • 3 tutors

SEES no5 will involve a number of people for its completion. As depicted in the organisation chart (figure 4), there are many different roles that cover managerial, assessment, technological and educational criteria. Many of the actors involved, will be working in E-Legi for a specific, short period of time engaged in special duties (e.g. assessment).

The Project Manager of the SEES will be responsible for the overall management of the use case. He will coordinate the staff working in the project and will be responsible for the completion of individual tasks within the appropriate timeline. The project manager is also responsible for the final quality check of the work produced by HOU in E-Legi. The project manager is Prof. A.N. Skodras, Head of the Department of Informatics.

The services leader is responsible for the technical development of the SEES. He will provide the technical requirements for the Physics Course use case and will guide two experts during the installation, enactment and evaluation of the E-Legi service. The services leader is Dr. B. Vassiliadis. The positions of the two experts will be covered after the first 18 month period.

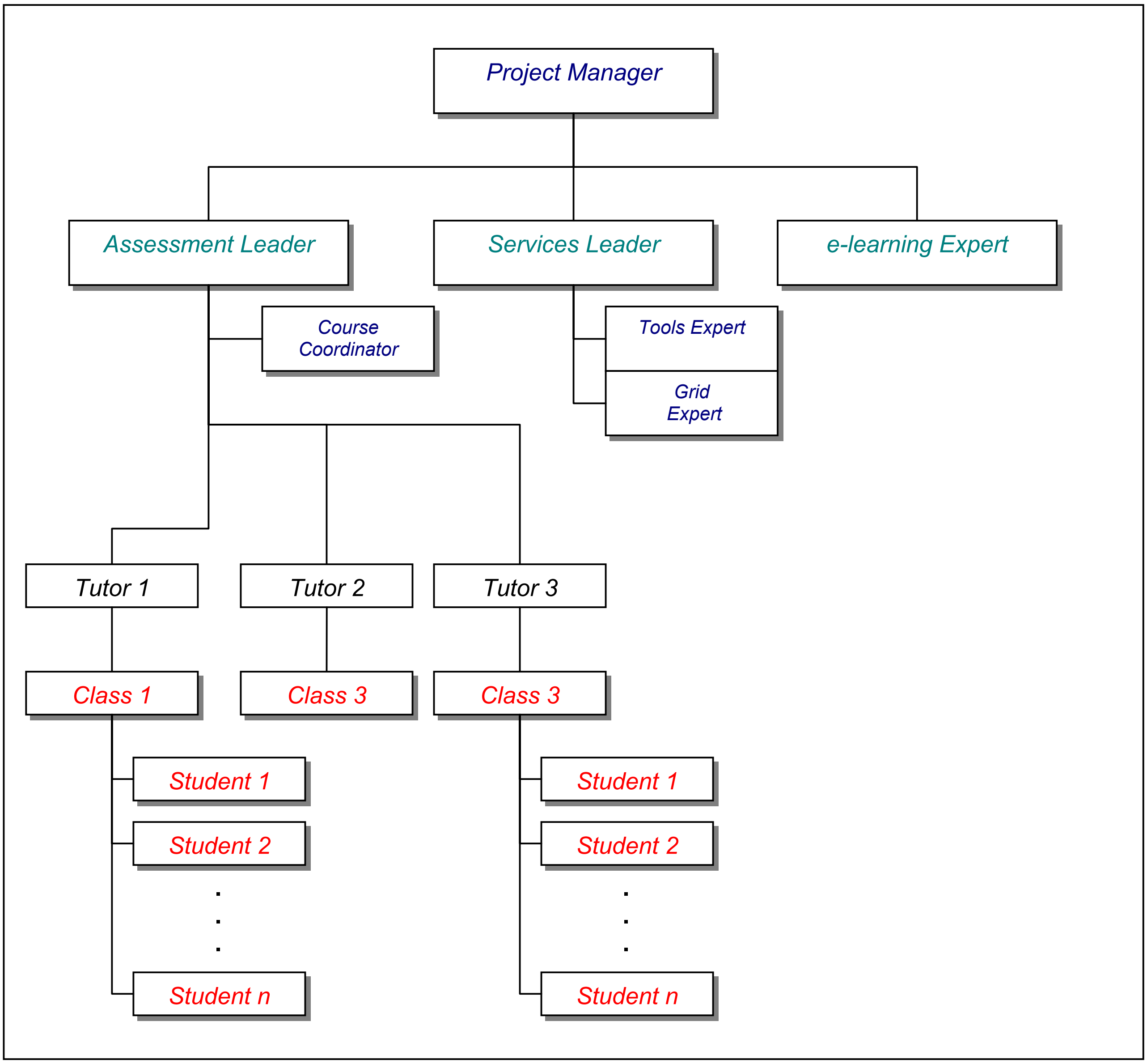

Figure 4 SEES no5 Organisation chart

The e-learning expert is responsible for the requirements analysis, design, and integration of new e-learning models. He will design and support a concrete e-learning use case that has actual educational value for HOU. The e-learning leader will be appointed among the tutors of the Physics Course.

The Assessment Leader is responsible for assessing SEES no5 during the installation and enactment phase. He will cooperate with 1 course coordinator and three tutors that will make use of the E-Legi services. The three Tutors will be responsible for using the services to guide three classes of students during the learning process. The classes are comprised of a set of students that are geographically dispersed. Each class may have a strength of 5-10 students. Since assessment is going to take place at the final stages of the project, the names of the above mentioned actors are not yet available. The Assessment Leader will be Dr. M. Xenos, Lecturer at HOU.

The added value of using E-Legi to support new educational models at HOU, stems from two directions:

- the use of visualisation services for interactive experiments,
- the additional support for cooperation.

The value chain diagram (figure 5) presents how the E-Legi capabilities bring benefits and advantages to HOU.

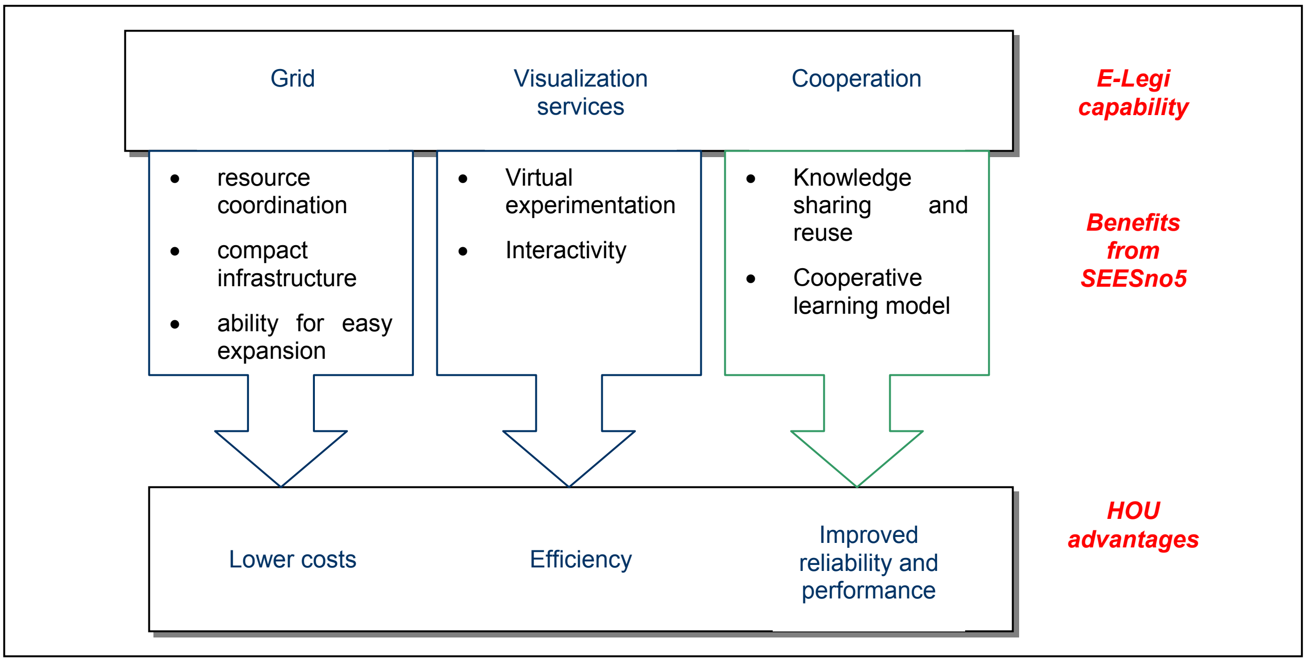

Figure 5 SEESno5 Value chain diagram

5f Economic aspects

Besides the technological and pedagogical objectives of SEES no 5, there are also economical goals that affect the business model that is going to be adopted by HOU for the exploitation of E-Legi results during and after its completion.

It is essential to note that the E-Legi services for SEESno5 are primarily directed for internal exploitation. This means that HOU is the prime consumer of E-Legi benefits. As described in 1c, added value and opportunities arise mainly from the increase of the effectiveness of the learning process in HOU. The marketing of the knowledge gained and services developed during the project lifetime are considered secondary.

The reason for the focus on internal exploitation of E-Legi results stems mainly from the situation that governs distance education in Greece. Major clients are rare, and they mainly belong to the public sector. This includes Universities, secondary education schools etc. The market for exploiting a large system such as the one developed from E-Legi will be probably restricted to Universities which are all controlled by the Greek state. Furthermore, large changes in the market are not anticipated for the years to come. HOU will remain the larger consumer and provider of distance education services in Greece.

HOU plans to rely on E-Legi results in the long term. The project will be tested in a small number of students, and if successful, it will be soon adopted as the main platform for educational delivery for the School of Science and Technology. This means that the platform should be able to support a very large number of approximately 5.000 students. In the future these numbers are expected to increase since demand is very high: in 2004 there were 65.979 candidates for 5160 new student positions at HOU. Therefore, the sustainability of the E-Legi solution is not only connected to the improvement of the educational process but to the ability to support a large number of students as well.

5g Quality Aspects

The evaluation plan should give an indication on the procedures to be implemented to assess the E-Legi methodology and services and insure that quality is maintained at high levels. Priorities for evaluation can be generally divided in three main categories:

- Viability (technical, educational viability)
- Cost effectiveness (economic viability)
- Functionality and impact on existing educational practices (provision of services).

Several indicators must be identified that can supply a measure of the success of the SEES in achieving the targets set in each of the above mentioned categories.

A set of assessment criteria must be clearly identified for several categories of e-learning provision that E-Legi deployment will affect. These criteria should then be de-composed, where possible, into smaller metrics that can be quantifiable – that is, a number can be assigned to them. All this “atomic” measurements, combined together using mathematical equations, will finally provide some kind of performance indicator.

SEESno5 evaluation criteria for the E-Legi methodology and services should try to establish whether the services:

- create new possibilities compared to present tools and methodology,
- supports the transition from classic educational models to advanced, student centric methods,
- are cost-effective.

Evaluation criteria must be closely linked to objectives and expected results, as depicted in the example in figure 6.

The evaluation methodology for the Physics course should be able to manage complexity at several levels:

- Organizational complexity – there are several levels of management.
- Technical complexity – some metrics are quite mathematically sophisticated and change over time as the University’s structure evolves.
- Distributed complexity – some components of the SEES are geographically afar.
- Measurement complexity – a single metric may combine tenths of lower level metrics (atomic metrics).

Collection of most metrics will be performed manually. Automatic measurement tools should also be deployed to evaluate the efficiency of E-Legi solution (e.g. log file analysers). The quality assessment procedure will be supported by the Software Quality Laboratory of HOU. Therefore, HOU shall adopt a clearly defined procedure that describes the collection process. When the collection process is performed manually, training must also take place.

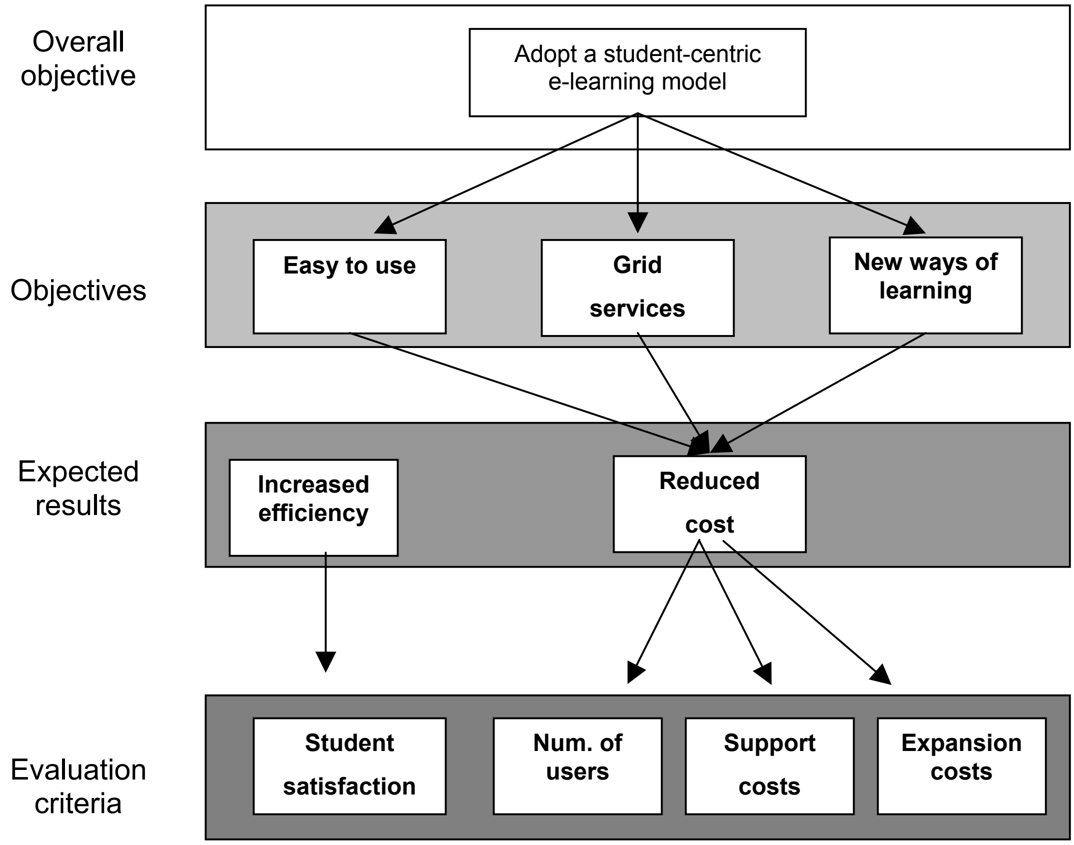

Figure 6 Example of how objectives can be related to evaluation criteria

5h Technology

Functional requirements to Grid technology	
Functionality	**Usage** (whether, how, why, by whom)
Mass calculation	Mass calculation is needed for running complex experiments and for visualizing the results. Computer resources that need to be utilized in such a situation include clusters of computers running Linux or Windows located at HOU premises all around Greece. The main clusters will be located in the two super-nodes connected in a high speed intranet.
Distributed resources	Students and class profiles are distributed. Other information including metadata, experiment's information, additional educational material are also distributed. Resources are cashed in order to overcome bandwidth problems.
Peer-to-peer	No
Discovery and brokering	No
Metering and accounting	No
Service Level Agreement Negotiation	No
Monitoring	No

Data, information and knowledge management	No
Virtual organizations and groups	Classes of students and loosely formed groups of learners are considered as virtual groups. Virtual groups are already supported by Centra.
Load Balancing	Yes
Fault tolerance	No
Advance Resource Reservation	Reservation is needed for contacting heavy load experiments.
Notification/Messaging	No
Workflow management	No
Certification	No
Authentication, Authorization and Accounting (AAA)	Authentication and authorisation is needed only for users. Users need to authenticate once and gain access to the services. User resources are also private and other users need authorisation to use them.
Trust Management	No
Digital and intellectual rights	No

Communication and collaboration activities to be supported by Grid services	
Functionality	**Usage** (whether, how, why, by whom)
eMail	Email is used by all user types for intra-communication. It is already supported by HOU mail services.
Discussion for a	Discussion fora are already used by all user types for intra-communication and exchange of information. It is already supported by HOU web services.
Instant Messaging	is used by all user types for intra-communication. It is already supported by Centra.
Chat	is used by all user types for intra-communication. It is already supported by Centra.
Audio conferences	It is used during an on-line lecture. It is already supported by Centra.
Video conferences	It is used during an on-line lecture. It is already supported by Centra.
Application sharing	No
Shared editing of documents	No
Shared collection of structured information (databases)	It is used for sharing information between users.
Shared structuring of knowledge (ontologies)	It is used for sharing knowledge between users and for assessment of the learning process.
Shared maintenance of knowledge (resource centres, repositories)	No
Shared projects (planning of tasks, timelines resources)	No

Collaborative simulations, games	It is used for the Physics experiments.

6 Relevant Facts and Assumptions

6a External factors that have an effect on the product or service, but are not mandated requirements constraints.

E-learning issues in an Open University such as HOU are complex and interrelated. Some of the significant forces and drivers include:

- Social and cultural drivers influencing the behaviour and the expectations of users are among the most powerful set of forces.
- Educational, business, and market environment in Greece is rapidly changing.
- Information and telecommunications technology and the rapid convergence, diffusion, advancements, and the impact and dynamic nature the technology sectors across multiple domains.
- Critical mass of users of technology-related products and services.
- Student population with more skills are expecting and demanding improvements and new advancements in technology.

Among the motivating factors is the drive for cost savings and for improved performance of the e-learning methodology, productivity, reduced errors and enhanced student satisfaction.

6b Assumptions that the team are making about the project

- that the design could be developed and it will work within the context of the mission and goals that were set for the service,
- that the characteristics of the envisioned system (i.e. cooperative experimentation etc.) should be among the high priorities for the E-Legi services,
- that HOU educational policy and legislative requirements will not prevent or circumvent key aspects of the system,
- that technical staff will continue to maintain, enhance, review, and adjust the service over time,
- that current tools and technologies can be integrated in the E-Legi infrastructure,
- that HOU is willing to support the infrastructure after project end. This means to devote sufficient resources to maintain and extend the services for the long term.

Functional Requirements

7 The Scope of the Work

7a The context of the work

The Work Context Diagram (figure 7) illustrates the system boundaries and the relationships among the key entities of the SEESno5 services.

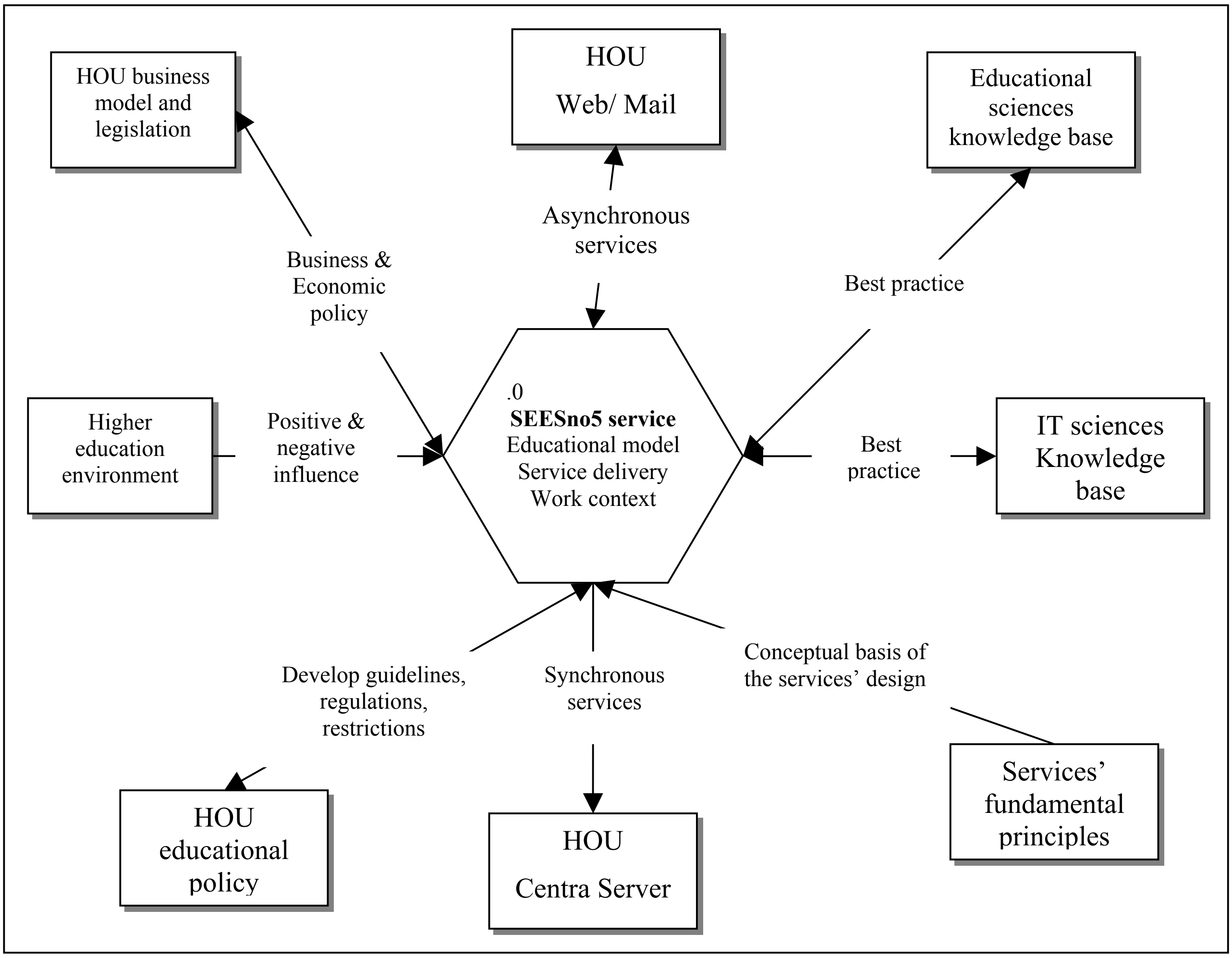

Figure 7 Work context diagram

The work context diagram has two main parts:
1. The SEES service - .0 - educational model, service delivery, work context.
2. The affiliated systems:
   - Services fundamental principles - basis of the system design.
   - HOU Web/Mail services – tools and information repositories currently in use for the support of the educational process or for administrative purposes.
   - Student Population – provide input for the formation of educational policy and services and it is affected by them.
   - HOU educational policy - provides resources and develop guidelines, regulations,

and restrictions.
- HOU business model and legislation – provide business and economy guidelines, rules, policies, restrictions.
- HOU Centra Server – synchronous collaboration services to be used with E-Legi.
- Higher education environment - positive and negative influences from the environment in higher education and e-learning in Greece.
- Information Technologies Sciences knowledge bases- best practices of the domain.
- Educational Sciences knowledge base - best practices of the domain.

It should be noted that the placement of the educational model, service delivery and HOU work context at the center of the diagram indicates that influencing those dimensions is the primary goal of the SEES. Other entities that are connected to the SEES services indicate that value is added to the system by involving and integrating these important entities of the educational process into the service. The bi-directional arrows illustrate that all of the components and entities in the SEES interoperate. Each of the major components of the service make a contribution to the goals of the SEES.

7b Work partitioning

Based on the work context diagram and the definitions of the users, the following list of high-level events is generated.

Event ID	Event Description	Input	Output	Internal	Affected/ Involved Actors
1	Provide support content by developing LOs	☐	☐	☑	Students Tutor Course Coordinator
2	Perform experiment (visualisation of data sets and output)				Students Tutors
3	Search for resources	☑	☐	☑	Student IT sciences Knowledge base
4	Access supporting educational material	☐	☐	☑	Students
5	Perform on-line test/ essay	☐	☐	☑	Students Tutors
6	Collaborate using asynchronous sharing (email, newsgroups, workspace)	☐	☐	☑	Students Tutors
7	Collaborate using synchronous sharing (audio/video chat, virtual space, video conferencing) during an experiment	☐	☐	☑	Students Tutors
8	HOU's educational policy guidelines	☑	☐	☐	All users
9	HOU business and economy model guidelines	☑	☐	☐	All users
10	Higher education guidelines and support (e.g. from the Ministry of Education)	☑	☐	☐	All users
11	Provide interfaces for managing and supporting the services	☐	☐	☑	Technical staff

12	Provide interfaces for linking to other applications (tools and databases). This includes import/export data.	☑	☑	☐	Technical staff
13	Experiment notification service (notify users about new events, changes, experiment/simulation status etc.)	☐	☐	☑	Students
14	Archive/ backup simulation data/results	☐	☐	☑	Students Tutors
15	Provide feedback after simulation end	☐	☐	☑	Students Tutors

8 The Scope of the Service

8a Service Boundary

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

8b Use case list

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9 Functional and Data Requirements

9a Functional Requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

9b Data requirements

This information will be gathered with a requirements definition tool in task 4.3 after the production of D8.

Non-Functional Requirements

10 Look and Feel Requirements

10a The interface

The SEES portal covers a multitude of applications, and it is a single, consistent window through which SEES information can be found and applications be presented to the users. It is a personalized, web-based working environment.

The SEES portal will act as a universal access point in which users will share explicit information, and exploit online collaboration tools with appropriate functionality (through the use of portal components) for the specific role of each user.

The portal supports four different types of services (figure 8):

- collaboration and communication: using synchronous and asynchronous tools,
- delivery: delivery of learning content,
- operation: special tools used to generate material/ communicate (e.g. MS Office tools),
- experimentation: services for contacting experiments.

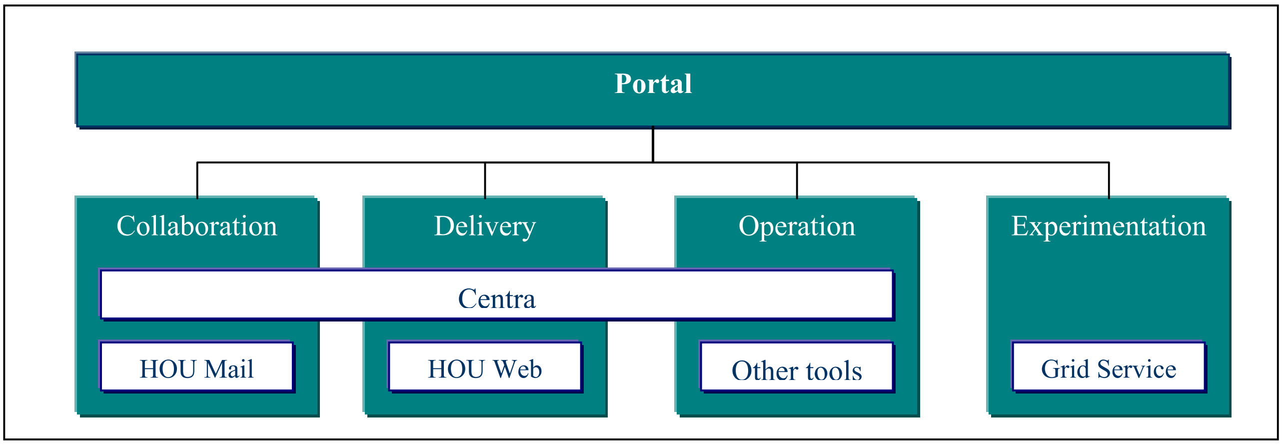

Figure 8 The SEES portal: integration of tools and services into a common access point

In the building of the SEES portal, the following goals have to be reached:

- to generate a user interface presenting the right information at the right time where role and configurable access rights determine the user context,
- to build a secure and stable infrastructure that easily deploys complex web applications and services,
- to easily integrate future services and tools.

Integration of third-party tools in the SEES infrastructure will almost always represent a challenge in making the user interface appear as part of one system rather than get the feeling of working in a lot of different tools. Ideally this should be done by having all tools use the same metaphor for user interfaces, and use the same vocabulary when talking about the same things.

In this SEES, the approach followed should try to integrate all existing tools as services in a web portal. All the services (tools) should be invoked using http requests, either to start the entire tool or to execute smaller services implemented by the tool. The user interaction will partly be in a frame in the portal and partly in a separate window invoked by the tool.

Users should have a set of basic options and styles for the interface since E-Legi is basically human centered. Access to the services are provided through the portal interface should try to anticipate student expectations.

The interface should have the following characteristics:

- It should be highly attractive to all users,
- it should be lightweight and download quickly,
- intuitive,
- consistent in its design and organisation,
- consistent in the terminology used,
- limited but useful use of colors (e.g. naming of buttons, links, menus etc.),
- on-line help and documentation should be available,
- the language of the interface should be in Greek.

10b The style of the product

As any product, SEESno5 E-Legi services should be designed to meet or exceed the expectations of the involved user groups. The appearance of the user interface should be highly attractive, entertaining, functionally efficient, and able to accommodate the variety of personal tastes and skill levels of HOU students.

The functionality of the services for the ‘Course Coordinator’, ‘Tutor’ and ‘Technical Staff’ should be a more authoritative and assertive, while other interactions should be more effective with a supportive approach. Sessions such as collaboration or information sharing should promote a high degree of interactivity, while others should be more appropriate with a structured pattern (e.g. access to LOs).

11 Usability Requirements

11a Ease of use

The requirements for ease of use should be consistent with the characteristics discussed in sections 10a and 10b. HOU student population is extremely diverse in preferences, taste, and training. Nevertheless, students will not put too much time on their one to learn how to use the services. It is important that a consensus should be reached on how much the interface/services can be changed. The interface should not be so dynamic that it becomes a distraction. Large scale, automatic changes to the user interface should be avoided since the user should be able to determine how much the system changes over time. System complexity should also be hidden from the user. This includes the way that the services access different resources and exchange information.

The interface should also be informative and transparent with carefully designed error and status messages.

11b Personalization and internationalization requirements

As stated in previous sections, the interface should support basic personalisation.

SEESno5 is focused on Greek students only so there are no requirements for internationalisation.

11c Ease of learning

Web interfaces are already familiar to most HOU users. Assistive services such as wizards, and tutorials will help users during the learning phases. Embedded help and other forms of support such as training classes, and support groups should be available, especially for students.

Students should be comfortable interacting with the system within two 20-minute sessions. Analysis of use patterns should be used to improve the ease and performance of the learning process over time.

11d Accessibility requirements

Services should be accessible using the most popular Web browsers. The content should be available in simple web pages. Java applets or Flash components should be used wherever interactivity is required.

Services should be accessible from anywhere in Greece.

12 Performance Requirements

12a Speed and latency requirements

Each of the SEESno5 task should have acceptable limits of performance in terms of speed. Most of these tasks are accomplished in near real-time, although many other tasks that are part of a chain of subtasks may continue on.

The following table gives the latency limits for visualising the results of an experiment. The time is measured from the moment the user submits the input data set to the time the results are presented in his/her screen.

Experiment complexity	Performance time (in sec)
Simple	3 -10
medium	<20
hard	<30

A major factor for high-bandwidth tasks in determining the speed of the transactions is the speed of the Greek telecommunications network and infrastructure. The intelligence of the E-Legi solution such as load balancing and pre scheduling will help to alleviate "congestion" and work to optimization of services' performance.

User connections should have a minimum bandwidth of 128kbs.

12b Safety critical requirements

Safety issues include mainly the sharing of information that is misleading, misrepresented, or does not comply with HOU standards. This information may originate from sources outside HOU (e.g. the Internet) or from human errors (e.g. a Tutor provides false information about a subject).

12c Precision requirements

The services should have minimum fault tolerance, meaning that node failures will not affect significantly the delivery of the services.

12d Reliability and Availability requirements

All users should have constant access to the SEESno5 services. Build-in redundancy, and backup procedures should be available.

12e Robustness requirements

N/A.

12f Capacity requirements

SEESno5 has the following capacity requirements:

- total number of users: 1800
- total number of simultaneous users: 100

It must be noted that in the next five years the number of the total number of users of the SEESno5 service could rise up to 5000.

If the E-Legi infrastructure is expended to be used by the School of Science and Technology, then the total number of users could be around 10.000 in the next three years.

Thus, in order for the E-Legi infrastructure to be usable in the long term, it should be able to support a total number of 10.000 users.

12g Scalability or extensibility requirements

The E-Legi infrastructure should be scalable in order to fit the ever changing needs of HOU.

13 Operational Requirements

13a Expected physical environment

All hardware that supports the E-Legi infrastructure will be installed in HOU premises.

13b Expected technological environment

The hardware used to run the service should involve powerful servers but not supercomputers. User hardware should range from laptops to normal PCs.

The user hardware should have the following minimum requirements:

- CPU: Pentium IV 2,6GHZ
- RAM: 256 MB
- HDD: 40GB
- Graphics Card: On board with 64 MB RAM

13c Partner applications

The interfaces with other HOU application are presented in the following table:

Application	Data Content	Interface medium	Volume
Centra	Streaming media	Internet, HOU LAN	10GB/day
HOU Web	HTML, Java	Internet	200MB/day
HOU Mail Server	Mail	HOU LAN	150MB/day

13d Productization Requirements

Students should be able to install the software needed to access the services using printed instructions. This software should be available both on-line and on CD.

Student computers are not active resources in the SEES #5 Grid and thus there is no need to install Grid middleware on them.

14 Maintainability and Support Requirements

14a How easy must it be to maintain this product?

The service should be able to be maintained by the technical staff of HOU. Users should be able to install components (if needed) to access the services by their one.

New content should require a maximum of two weeks for integration in the services.

External tools should require minimum effort to be linked with the service. Input/output functions from/to the services should require a maximum of two weeks to be developed.

14b Are there special conditions that apply to the maintenance of this product?

There are no special conditions.

14c Supportability

There should be complete documentation (both on-line and in print) on how the services are installed, supported and maintained. Manuals for all user groups should also be available.

Support should be provided by a special support group comprised of a technical staff. Electronic communications with this group should be available. An electronic fora should also be established using Centra for discussing problems and providing tips.

Build-in online help should be available.

Additional support to students on how to use the services will be also provided by the Tutors.

14d Portability requirements

Users should be able to run the services under Windows2000, Windows XP, Linux platforms and MacOS.

15 Security Requirements

15a Access requirements

The general access requirements of the SEES include:

- the service shall identify all of its users before allowing them to use its capabilities.
- the service shall identify all of its client applications (e.g. Centra sessions) before allowing them to use its capabilities,
- the service shall not require an individual user to identify himself multiple times during a single session (single sign-on).

The following table specifies who has authorised access to what services/ data and how access can be granted:

Component:	Authorised Access by:	May grant access to:
Data sets	▪ Students that perform the experiment ▪ Tutor	-

	▪ Course coordinator	- Tutors
Student assessment results	▪ Student ▪ Tutor of the class that the student belongs to, ▪ Course coordinator	- - Tutors
Class assessment results	▪ Tutor of the class that the student belongs to, ▪ Course coordinator	
Course assessment results (all classes)	Course coordinator	Tutors
Student Profile	▪ Tutor of the class, ▪ Course coordinator	Other Tutors
Email messages	▪ Sender ▪ Receiver	All users
Class Fora messages	▪ Students of the class ▪ Tutor of the class ▪ Course coordinator	All users
Supporting LOs	▪ Tutors ▪ Course coordinator	Students
LOs	▪ Tutors ▪ Course coordinator	Students
Student history	▪ Tutor of the class, ▪ Course coordinator	
Upload file into class workspace	▪ Students of the class ▪ Tutor of the class ▪ Course coordinator	- - Students of other classes
Download file from class workspace	▪ Students of the class ▪ Tutor of the class ▪ Course coordinator	- - Students of other classes
Change user account	Technical staff	
Change user Privileges	Technical staff	
Update LO	Technical staff / Content author	
Update supporting LO	Technical staff / Content Author	
Give access to supporting LO	▪ Tutor ▪ Course coordinator	

15b Integrity requirements

Attacks against data being transferred are relatively rare. Data integrity requirements are focused in the host and client computers:

- incorrect data cannot be introduced in the service databases,
- distributed resource repositories should be protected from intentional abuse (unauthorized creation, modification, or deletion),
- the service shall determine if communicated data it receives has been modified, if additional data has been added to it or if some protected data has been deleted,
- the service shall generate automatic alarm messages to the technical staff within 5 minutes if communicated data are abused,
- the service shall be able to determine if the following stored data has been modified without authorization, if additional data has been added without authorization, or if some or all data has been deleted without authorization:
  - account information (students, Tutors, course coordinator, technical staff),
  - feedback information to students,
  - transaction information (log files of students' activities),
  - user profiles,
  - data sets.

15c Privacy requirements

Description	Type	Sensitivity	Comment
User profile	Stored data	High	the service shall not allow unauthorised users to capture or store any personal information about other users
Student assessment	Stored Data	High	
Student Data sets	Stored data	Medium	
Email notifications	Communications	High	The service shall not allow unauthorized individuals or programs access to any communication between users

15d Audit requirements

Security Audit Control:

The service shall perform automatic security audit control after it starts or restarts.

The service shall enable an audit control of all users.

The service shall record all security related events:

- Start, end of audit control,
- access control events (including successful and unsuccessful identification, authentication and authorization events),
- changes in access control,
- intrusion detection (including attempts to modify the security logs, user profiles, data sets, user privileges).

The service shall include the detailed information within each security audit record:

- date and time of the security event.
- type of the security event,
- actors involved in the security event (internal/ external users, applications, process),
- outcome of security event (e.g., success, failure),

The service shall enable the technical staff to read/search/sort the security audit records.

15e Immunity requirements

The service shall scan any files uploaded / posted or mailed for known computer viruses, worms, and Trojan horses.

The service shall disinfect (and delete) any data found to contain such a harmful program.

The service shall update daily its virus definition files.

The service shall notify the user (e.g. sender, receiver) and the technical staff if it detects a harmful program during a scan.

16 Cultural and Political Requirements

16a Are there any special factors about the product that would make it unacceptable for some political reason?

No.

17 Legal Requirements

17a Does the system fall under the jurisdiction of any law ?

The system must comply with all Greek laws. Special care should be given to the sharing of personal data (e.g. student profiles). All services should comply with international standards and ethics. This means that:

- the service will not maintain secret records about individuals,
- no use can be made for the records for other than the original educational purposes without the individual's concern,
- HOU is legally responsible for the integrity of the service.

17b Are there any standards with which we must comply?

N/A.

Project Issues

18 Open Issues

18a Issues that have been raised and do not yet have a conclusion.

N/A.

19 Off-the-Shelf Solutions

19a Is there a ready-made system that could be bought?

No.

19b Can ready-made components be used for this product?

No.

19c Is there something that we could copy?

No.

20 New Problems

20a What problems could the new system cause in the current environment?

The most important problem that could be caused by the introduction of new services into HOU e-learning methodology is its approval by the teaching staff and the students. As already mentioned in section 1a, there is a great concern at HOU about the low participation of users to the on-line collaborations sessions. This problem may come up in the new services as well.

20b Will the new development affect any of the installed system?

HOU currently operates Centra, as a collaboration tool and several web sites using standard web technology. The new development will greatly affect the second category of tools.

20c Will any of our existing users be adversely affected by the new development?

All user categories will be greatly affected by the new services. If successful, these services may change the focus of e-learning from print material to on-line.

It is also expected that different categories of users will experience significant improvements in their task performance. This applies particularly for students.

20d What limitations exist in the anticipated implementation environment that may inhibit the new system?

As far as technical part is concerned, Centra will not be used as a core service but rather as an additional support tool. The on-line material is already categorised in modules which are ready to use in the new services.

20e Will the new system create other problems?

No other problems are anticipated.

21 Tasks

21a What steps have to be taken to deliver the system?

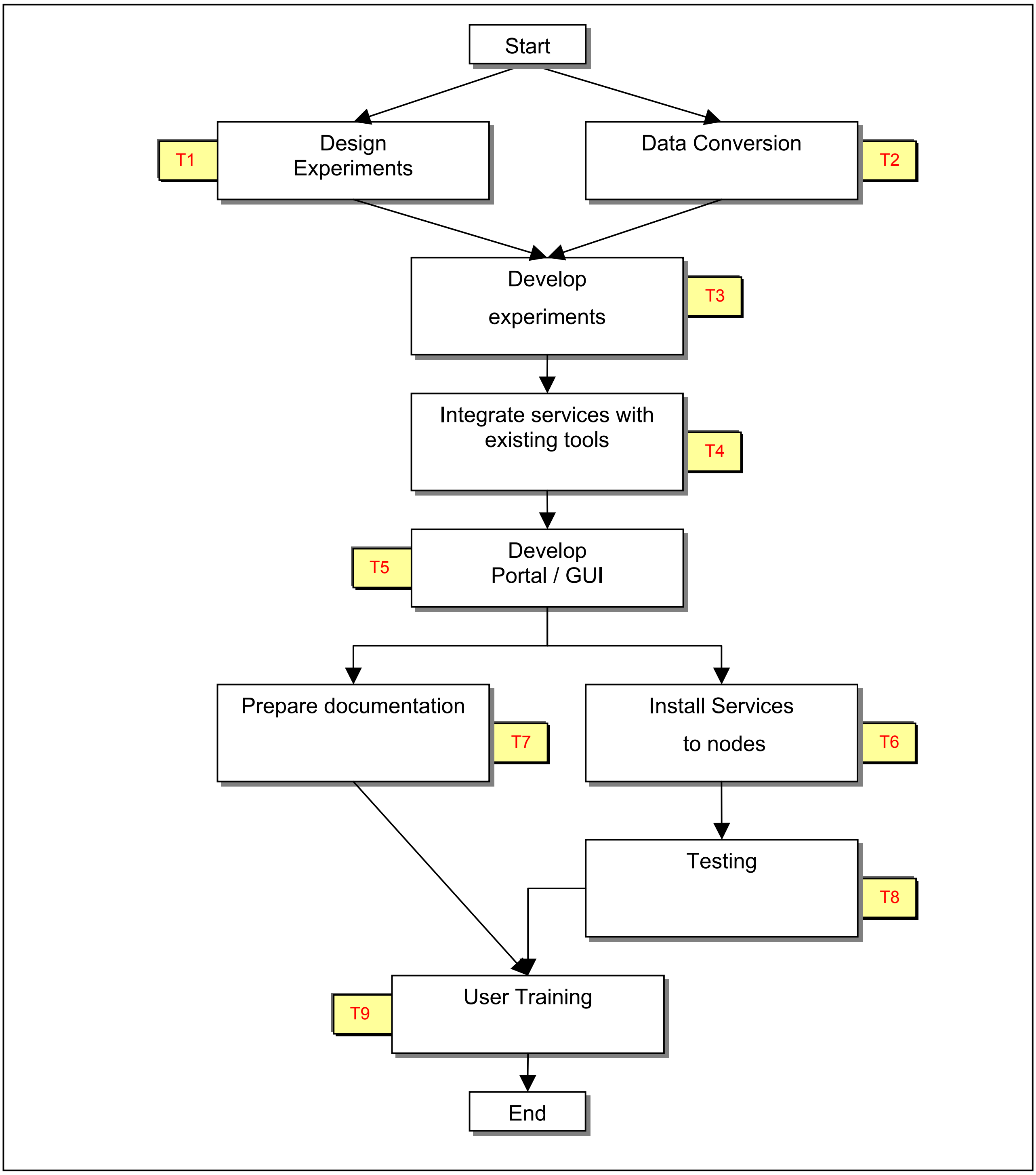

Figure 9. Development process diagram for SEESno5

21b Development phases

The development phases are:

- Phase 1. Development of experiments

- Phase 2. Development of the interfaces and integration with existing tools
- Phase 3. Development of the portal
- Phase 4. Installing, and testing of the service.

22 Cutover

22a What special requirements do we have to get the existing data, and procedures to work for the new system?

22b What data has to be modified/translated for the new system?

Existing data that need to be converted include:

- learning material in electronic form that need to be converted to LOs. This material is specially written for e-learning and as such it has learning objectives, exercises and links attached to it. Metadata have to be attached to the material during the conversion process.
- Web pages developed in HTML which include supporting material in text and images. They can be easily integrated into the service.
- Email messages from the HOU mail server follow the MIME format and can also be easily integrated in the service.
- Accounts for user groups need to be created.

23 Risks

There are many risks stemming from the introduction of such innovative services. The table below describes the main risk factors.

Risk	Description	Risk Level
Low Acceptance	Services not accepted (used) by the user group.	High
Capacity	Support thousands of users	High
Increased management complexity	Services difficult to manage from an educational point of view.	High
Usability	Users are unable to effectively use the services (incomplete training, lack of IT skills, lack of transparency). Services are difficult to administer.	High
Flexibility	Inability to adapt to diverse learning styles of HOU students.	Medium
Sustainability	Under funding after end of project. HOU's e-learning strategy excludes E-Legi services.	Medium
Scalability	Services are not scalable.	Medium
Low Quality of Service	Low quality/ availability of provided services due to low bandwidth.	Medium
Integration	Integration with existing technological infrastructure difficult/ costly.	Low
Support	Increased costs for technical support.	Low
Security	Security and copyright concerns.	Low
Coordination	Difficulties in coordination with other e-learning efforts inside HOU.	Low

Lack of support	Lack of efficient support to users creates difficulties in using the services.	Low

24 Costs

The following table presents the amount of money required for building the requirements into a service. Costs are rough estimations.

Task / Deliverable	Analysis	Cost (€)
Design of experiments	5 experiments	20000
Development of experiments	5 experiments	35000
Development of portal	2 technical staff 1 services expert	12000
Development of GUI	2 technical staff 1 services expert	8000
Data conversion	3 LOs per experiment = 15 LOs	3000
New data development	3 supporting LOs per experiment = 15 supporting LOs	8000
Integration with other tools	2 technical staff 1 services expert	30000
Installation	2 technical staff	4000
User Training	15 students 5 Tutors 1 Course coordinator 2 Technical staff	9000
Documentation	4 print guides 3 on-line guides	6000
Testing	3 student classes 5 Tutors 1 Course coordinator 2 Technical staff	10000
Total:		**145.000**

25 User Documentation

25a The plan for building the user documentation

User documentation includes:

Description	Type	Authors
Installation Manual for Users	Print	Technical staff
User Guide	Print	Tutors

Educational Guide	Print	Course Coordinator
Service Installation and support Manual	Print	E-Legi developers
User Guide for Authoring	Print	Technical staff
On-line help	On-line	Technical staff / Tutors
Glossary	On-line	Technical staff / Tutors
FAQ	On-line	Technical staff / Tutors

The update frequency of user documentation varies. Installation manuals are rarely updated (e.g. only when new versions of the services are developed). The same holds for User Guides, although new versions with minor updates shall appear every year.

Electronic documentation may be updated more frequently since it involves on-line feedback from the users which are relevant with the direct use of the service.

It is expected that in the first year the most of the user documentation will be updated and many new versions will appear. This is due to the fact that the service is new and the coverage of many subjects will need to be improved. User feedback will be the main source of information for updating the documents.

B) SEES #5
Feasibility Analysis

1 Specification Status

1.1 Summary of the goals

1.1.1 Goals

The main goal is to improve efficiency of current HOU e-learning practises by promoting an ***experience –based e-learning model***.

In order to reach the main goal, the following sub-goals have to be accomplished:

Sub-Goal1: Provide added value services.

- provide advanced, media rich services in the form of multi-step, cooperative experiments/ simulations for the Physics course,
- facilitate collaboration and knowledge sharing and reuse between groups and individuals.

Sub-Goal2: Support thousands of users while preserving adequate Quality of Service.

- provide the services to a diverse and very large student population,
- provide a single access point with a homogeneous interface,
- preserve quality of service (fault tolerance, response time) at any time.

Sub-Goal3: Evaluate the didactical approach and the technology infrastructure by contacting a real, large scale experiment in the Physics course at HOU.

- provide / configure metrics for measuring performance in terms of scalability, quality of service and security,
- test the infrastructure in a real situation,
- assess the results and provide feedback.

1.1.2 Comments

Given the density of the document, it is rather difficult to differentiate the current features and the new wanted features to be taken into account as requirement of specification

Nevertheless, the goal of this SEES is very interesting :

- ***"Transform and extend the actual city-class model to a Grid model";***
- Need for a more flexible e-Learning system;
- Production of five experiments of different complexity.

1.2 Relevance of the initial specifications

Very good relevance of these initial specifications. The vision of what the SEES #5 partner wants to realise seems to be very clear in its mind. HOU has also a good vision of the task to be carried out during the different phases of the development.

2 Organisational and pedagogical feasibility

Overall summary:

In SEES #5, the quality, flexibility and effectiveness of an eLearning physics course will be improved through the introduction of the “ELeGI methodology” and EleGI-services. Therefore ambitious goals have been set. Special focus has been given to virtual scientific experiments, simulations and visualisations, which are very CPU-consuming and will profit from Grid-based tools and systems as well as from the development and adaptation of suitable didactic models. The high number of learners and staff of the eLearning community provides a great opportunity to test the effects and benefits of Grid-based services for learning in a large and highly heterogeneous community of part-time students. From a pedagogical point of view, the main aspects of a suitable learning environment have been taken into consideration and suitable solutions were found. The authoring process, which is crucial for the implementation of service-based learning, needs further specification. This might have some consequences for the planned budget.

2.1 Motivation

The main interests from the organisational point of view:

In SEES #5, the main educational goal is to enhance the pedagogical effectiveness of an established eLearning course through the use of Grid-based tools and systems as well as new didactic models. The need for improvement is an outcome of recent assessments, which have shown the need for increasing student participation in eLearning sessions. Furthermore, due to the specific requirements of the teaching subject, the necessity to introduce visualisations and simulations for teaching has been identified. Another important issue to take into account is the profile of the target group: since the target group is highly heterogeneous and has little time for learning and practising, these two characteristics call for a more efficient and flexible learning system, with a high degree of independence for each learner's individual learning path.

For students and course staff, the added value of the introduction of Grid-based applications as well as the use of new didactic and pedagogical elements is significant, since the improvement of collaborative work, the use of complex and collaborative virtual scientific experiments and simulations as well as the monitoring process, could be achieved with great difficulty or not at all through web-based technology support.

2.2 Organisational and pedagogical analysis

2.2.1 Learner/user interest

Summary of the analysis of the main motivational aspects:

Motivational factors can be subdivided into 3 different aspects:

The didactic approach: the focus on experiential learning through the integration of virtual scientific experiments with different levels of complexity and the enhancement of collaborative learning experiences is well adapted to learner and subject needs and consequently could motivate the course participants.

Upgrading the effectiveness and flexibility of the course by promoting individualised learning can, under certain circumstances, be a demotivating fact since the sense of peer group and its interaction, which are always an important source of motivation, could be disturbed or even brought to a complete standstill. The course administration should consider making some provisions for overcoming this possible problem.

The detailed description of roles and interactions of the different actors foreseen for educational, technical and content development support show that the importance of support for learner motivation and success has been recognised and well integrated into the learning scenario.

2.2.2 Learning environment

Summary of the analysis of the main content aspects:

This aspect has not been thoroughly analysed.

The effort needed to transform the existing linear content structure based on textbooks into a non-linear learning object-based approach for content reusability is underestimated. The metadata description of learning objects is very resource-consuming. The structural didactic approach of learning materials developed for printing differs completely from a learning object-based approach.

Summary of the analysis of the main organisational aspects:

The learning targets are well defined. The characteristics of the target group are well taken into account and integrated into the learning environment. Learning needs like support, guidance and assessment have been taken into account. The roles of the different users are clearly defined and are appropriate for the learning scenario. The definition of the learning material/course author should be considered. The interaction process among the different users is partially defined. The required technical resources are identified and their integration is described.

Summary of the analysis of the main support aspects:

The leading role of support for successful eLearning has been identified and taken into account. The learner support approach, which is mainly tutor-based with focus on individual motivational and emotional aspects (personalised), and the learning support based on tools and systems for effective learning performance, are both suitable for the envisaged target group. The required technical and pedagogical support for all parties is planned. Mechanisms to promote group cohesiveness are planned as well as a system to support communication and collaboration among students and staff.

Training for the students and other relevant parties to become familiar with the Grid-based systems and tools and the new pedagogical methodologies are planned and partially defined.

Summary of the analysis of the main evaluation aspects:

The implementation of an evaluation process is foreseen. The “ELeGI methodology” introduction process will be monitored and evaluated at different levels. The main focus will be given to the pedagogical effectiveness of the ELeGI methodology and services. The mathematical approach planned for the evaluation process needs to be accompanied by a more qualitative evaluation approach.

2.3 Peer comments

The purpose of HOU is very ambitious and interesting. We believe that it coincides with the main objectives of ELeGI Project, in fact it foresees a collaborative, contextualised and experiential learning during a Physics distance course.

We believe that the Grid infrastructure is suitable to solve the problems related to the virtual laboratory experiments. We think that our work in WP5, regarding the definition of pedagogical learning model for VSE, will be very useful for the creation of virtual learning environments that will support a collaborative and contextualised learning based on the experimentation.

So we suppose pedagogically feasible the achievement of learning environments, that facilitate the collaborative learning through interactions with other students, tutors and applications. In this case we think that the learning approach developed in the WP5, should be used, since it is specific for VSE.

A Grid infrastructure and suitable didactical learning model for virtual experiments are able to solve some current constraints for the Physic course organized by HOU, regarding low participation to e-learning session, interactivity, efficiency, flexibility, costs, number and roles of students.

3 Technical feasibility

The technical feasibility is strongly linked to the Centra Tool.

The requirements about speed and latency depends strongly on the Greek telecommunication network and also on the availability of the dedicated resources (computers). If the resources are completely dedicated to e-LeGI, the system could manage them in order to foreseen the workload.

The fault tolerant feature will be addressed as well as the Grid services can do it.

The other performance requirements are also very strict :

- Reliability
- Availability
- Capacity
- Scalability & extensibility

Some of them could be analysed in detail in order to proof their feasibility.

To summarize, this SEES seems to be feasible technically on the condition of decreasing a little the requirements.

3.1 Summary of Grid functionalities required and Tools

- Mass calculation
- Distributed resources / Advance reservation
- VO and groups
- AAA

Other kind of requirements :

- CPU load balancing
- Hundreds of experiments running at the same time by remote users
- to combine resources on demand for service provision,
- to intelligently allocate finite resources to the appropriate applications,
- to be able to support the ever-increasing number of users.
- E-LeGI Services should be transparent for the student user
- Very large number of users : 10 000.

A question to keep in mind for the next step of the specifications is the possibility to integrate CENTRA tool in the e-LeGI infrastructure. For that, the interfaces between E-LeGI and CENTRA must be defined precisely.

3.2 Peer comments

The SEES #5 approach is to hide the Grid infrastructure behind a web portal as a single access point with all services invoked by HTTP requests. IWT may be used to realise the portal functionality, integrating existing HOU services and the new services under a common web based interface.

The specification gives a good reasoning for Grid technology as a compact, scalable and cost-efficient infrastructure to combine and intelligently allocate resources in the eight HOU nodes, ensuring quality of service (fault tolerance, response time) and leveraging existing h/w and s/w investments. However, the integrity, privacy, audit and immunity requirements are putting high demands on the Grid infrastructure, especially for AAA and Trust Management.

Grid services are regarded as the mechanism for resource allocation and service delivery, so it would be nice to have the review of the tools (Centra, Simulation services, LO, …) that are scheduled to be (re)implemented as Grid-aware. Most likely all major part of the new infrastructure will be adapted to Grid usage and even self contained systems will be required to have Grid service interfaces. IWT, as the tool for asynchrony learning, could be viewed as the supplement for Centra which is targeted to synchronic learning activities.

The number of planned experiments and simulations is feasible and guarantees that they can be produced with a good quality. As simulation services will be designed as complex entities (in terms of functionality and composition of several steps), they are apt to be aggregated by collecting some distinct services. The other possibility is to aggregate only LO data. Either way, the choice should be made clear.

On the learners' side all interactions will be available in simple web pages, Java applets or Flash components. Student computers are not intended to be active resources in the Grid and no Grid middleware is intended to be installed on them. The reason for that can be seen in the large number and the variety of users to be supported and the low expectations that are made on the bandwidth and duration of their network connection.

For the virtual scientific experiments the speed and latency requirements (3-10 sec. for simple complexity) implies that the network will be sufficient for submitting input data and receiving results. A combination of client-side virtual reality and remote computation like done in VCLab could increase the realism of the experiments.

Even if Matlab (or some other expensive package) is necessary for VCLab, this can be avoided in distributed Grid environment, leaving these heavy weight parts of the system on the dedicated servers. Of course this wouldn’t remove the expenses of acquiring the needed software for the servers, but client side software could be implemented as simple as possible (mostly for data input at result visualization). Another merit of Grid based architecture is the potential to distribute the computation intensive tasks (e.g. Matlab calculations) to less loaded server nodes.

Another goal of this SEES is to facilitate "collaboration and knowledge sharing and reuse between groups and individuals", but this is not further specified in the SEES description. In other contexts this is seen together with the P2P functionalities of the Grid and its full potential would be exploited if the learners' computers were active resources on the Grid. Nevertheless a Grid combining the HOU nodes will simplify the information sharing for students accessing different nodes.

Part VIII: Results and Conclusions

1 Overview of SEES' focus and complementary aspects

The tables in this chapter give a synoptic comparison of the SEES specification. It wouldn't be feasible to evaluate all aspects of a Learning Grid width equal intensity in every test-bed. Therefore the SEESs are chosen and developed as *complementary* to have a wide range of application scenarios that in total cover nearly all Grid functionalities:

- SEES #1 (VIAD) to make informal learning by Grid based tools available for the empowerment of actors in a local development project
- SEES #2 (EnCOrE) is dedicated to informal learning by scientific collaboration and language harmonisation
- SEES #3 (e-Qualification and e-Assessment) will develop special services with a potentially wide application in formal and informal learning scenarios
- SEES #4 (Master in ICT) is a formal learning test bed for the application of Grid services in the context of "blended learning"
- SEES #5 (Physics Course) is a formal learning test bed for the application of Grid services in the context of "open and distance learning"

Nevertheless, some core Grid functionalities (e.g. Authentication, Authorization and Accounting) will play a role in every test-bed, allowing to compare the requirements coming from different perspectives.

1.1 SEES Specification Status

This table tries to compare the focus and elaboration of the SEES specifications. It is a current snapshot of the ongoing specification process.

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master in ICT)	5 (Physics Course)
Focus	• Community building • Knowledge exchange • Distributed, cross-organisational resources • Regional development	• Collaborative Editing • Ontology construction • Use of written dialogues	• User portfolios • Matching of users and communities • Adaptive assessments • Software agents • P2P Models	• Mass calculation for LSA • Distributed data for LSA • e-Assessment as a Learning Grid service	• Enhanced Presence • Virtual Scientific Experiments • Virtual Laboratories	• Virtual Laboratory services (experiments) • Collaboration / Knowledge sharing related to the experiments • Quality of Service
Conceptual Strengths	• Social impact • Analysis of actors and relationships	• Clear final aim (Dictionary) • Progressed requirements	• Universal approach for both formal and informal learning • Grid relation	• Clear focus (grading service) • Clear benefit (if working)	• Technical Infrastructure • Organisational framework	• Clear need for Grid • Organisation and time plan
Current Weaknesses	• Status of planning • Concept in tool usage	• Assumptions on external stakeholders • Variety of tools to be integrated	• Variety of concepts and technologies to integrate • Application scenario (test-bed) description	• Feasibility of LSA for grading purposes • Conception of LSA algorithm for Grid based calculation	• Relation to primary needs • Unclear selection of tools and methods	• Conceptual integration with existing environment • Experiments not specified

1.2 Selected Pedagogical approaches

This table is a synopsis of the pedagogical approaches selected by the SEES partners. An explanation of theses approaches, as given to the partners, can be found in the guidelines for the SEES Analysis and Requirements Specification (see Appendix).

We see a focus on collaborative and constructive learning and (for the formal learning test beds) experiential and problem based learning. Ubiquity and accessibility can be seen as a natural property of nearly every scenario.

Remarks in italics indicate additional suggestions coming up from the feasibility analysis.

	1 (VIAD)	**2 (EnCOrE)**	**3a (E-Qualification)**	**3b (E-Assessment)**	**4 (Master ICT)**	**5 (Physics Course)**
Collaborative learning, cooperative learning, social learning, project related learning	It is the major goal of this SEES... We will measure the elaboration (and elicitation) of services through telepresence tools for collaborative learning. ...Each actor is a teacher as well as a learner	...Encore is the teacher as well as the pupil... ...New subjects will be continuously introduced at two levels (Junior and senior)... ...Collaborative work between scientists through discussions, controversies and consensus phases...	*Grid services supporting discovery and building of learning and collaborating communities*		Collaborative learning sessions are inseparable from virtual classroom sessions... Tutors/professors can schedule collaborative learning sessions... ... also students can schedule ad hoc collaborative learning sessions...	...already a key feature in the HOU learning methodology... ...needs to be strengthened... ...The use of experiments and simulations should provide the stimulation needed to form more active virtual communities...
Constructivist learning	Usable in a second time.	..."Learners" will construct the answer by formulating his/her query. The answer is unique for each learner.... *Contributors will learn through construction of the dictionary*		Frequent practice and feedback on quality of written essays allows learners to construct their own knowledge of the subject.	...During the collaborative and self-learning sessions a constructivist learning approach can provide for more efficient learning by enabling the student to become an active participant in the learning process...	...will be assisted by exploring experiments in a simulation of real world environments... ...shall encourage the students to test ideas against alternative views and alternate contexts....
Experiential learning, active learning, problem based learning	Only if actors require it.		*Especially in ASIMIL test-bed*		... students are expected to acquire real-world experience and develop real problem solving methodologies...	...the tutor will actually become a mentor rather than the holder of knowledge... ...the ELeGI learning model should partially support negotiation rather than imposition, of goals and objectives...

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master ICT)	5 (Physics Course)
Personalised, individualized learning	Only if end users require it.		*Adaptation and group selection based on learner's portfolio*		In the context of a formal educational environment (like SEES #4) personalised learning is not widely applicable... Personalised learning is more relevant to self-learning sessions...	
Ubiquity and accessibility (anytime/anywhere)	System must be the most accessible. Tools of telepresence will have to be used everywhere.			The service needs to be available at any time the learners or teachers wish to use it.	... students can participate in collaborative learning sessions anywhere/anytime while they can access educational material...	Learning anytime, anywhere, without geographical and scheduling barriers is essential
Contextualised, adaptive, situated learning	No.				Not very relevant to a formal educational setting	
...		...Experimental learning through access to dialogues related to the construction of the dictionary...			..distance learning in a formal educational environment based on the collaboration among educational institutions that unite their resources to create value...	

1.3 Selected Tools

This table is a synopsis of the Grid compliant prototypes and ELeGI related tools selected by the SEES partners. An explanation of these tools, as given to the partners, can be found in the guidelines for the SEES Analysis and Requirements Specification (see Appendix).

The selection may change due to the outcomes of the detailed functional requirements analysis as well as to the outcomes of the WPs 8 (Grid compliant prototypes) and 9 (VSE and enhanced presence demonstrator). GRASP may probably be used as the core Grid middleware for all other Grid based tools. A further analysis hat to be made on the applicability of VCLab for the virtual scientific experiments in SEES #4 and 5.

Remarks in italics indicate additional suggestions coming up from the feasibility analysis.

	1 (VIAD)	**2 (EnCOrE)**	**3a (E-Qualification)**	**3b (E-Assessment)**	**4 (Master ICT)**	**5 (Physics Course)**
GRASP	To be studied for each tool		*...some aspects like the acceptance of a user in Virtual and Dynamic Organisations have been explored in the GRASP project...*	..to overcome performance and quantity limitations ... ...high computational needs and need to store extremely large corpora. ...security management across different administrative domains... ... accounting services to the institution using LSA.	...by students/professors to demonstrate the power of the Grid... ... to deploy computationally demanding applications and perform experiments as part of the homework/project work... ... to wrap up existing AIT services...	... basic infrastructure for supporting the different nodes of the SEESno5 HOU network... ... could be modified to support coordination of resources and CPU load balancing... ... for supporting high level e-learning services... ... for managing the Grid infrastructure and ELeGI low level services...
IWT	Probably, e.g. for teaching knowledge to the tourist		*May include the generic e-Qualification services*	SEES #3 does not need IWT to function but perhaps IWT might want to incorporate LSA assessment into its automatic student evaluation.	... to gain access to educational material (lecture videos, lecture slides, additional resources, etc)... ... for self-learning sessions when students wish to explore new areas....	No
Finesse	No				No	No

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master ICT)	5 (Physics Course)
VCLab	No				No, due to the fact that there is no matching course in the SEES #4 formal educational programmes. *To be cleared if a Grid enabled VCLab can be used as a development framework*	...will not be used in the SEES, nevertheless, it is a good paradigm on how a virtual laboratory should work... *To be cleared if a Grid enabled VCLab can be used as a development framework*
BuddySpace	...most important role during the first time...	...will play a significant role... ...will allow memorizing written dialogues...			... expected to be widely used to support collaboration among students and/or tutors....	No
KMI Stadium	Probably not	Maybe useful to present the dictionary to incoming users...			... to support self-learning sessions provided that there is existing material relevant...	No
FlashMeeting	...most important role during the first time...				*Probably not (using MENTOR instead)*	No
Magpie	..-should be proposed to the local actors during the first time...	...would allow anyone surfing on the web to access easily to the senses defined for word present in the dictionary...		...has potential use as a tool for locating and sharing appropriate corpus documents.	... could perhaps be used in conjunction with other tools such as the IWT or independently while browsing online learning material to support contextualised learning...	No
madkit	No				More Info needed	No
Strobe	No				More Info needed	No
Webra	Not yet, at this time				More Info needed	No
DYXWEB	On demand, to write a document together	...potential starting point to set-up the dictionary prototype collaborative site...			...can be used as part of the “Web Technologies” course or the “E-Commerce Technologies” course...	No

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master ICT)	5 (Physics Course)
Others			ASIMIL and TESTOOL as test-beds		KTU/OU Assessment Tools can be used as part of the assessment activity to support the virtual classroom sessions	Centra is currently used in HOU as the main platform for supporting on-line collaboration. It is used by students and lecturers mainly for on-line lectures.

1.4 Selected Grid Functionalities

This table is a synopsis of the Grid functionalities selected by the SEES partners. An explanation of these tools, as given to the partners, can be found in the guidelines for the SEES Analysis and Requirements Specification (see Appendix).

The selection will evolve during the detailed functional requirements analysis, when dependencies are exposed. For example Trust Management will be raised as an issue depending on detailed privacy and access requirements.

Italics indicate additional suggestions coming from the technical feasibility analysis.

	1 (VIAD)	**2 (EnCOrE)**	**3a (E-Qualification)**	**3b (E-Assessment)**	**4 (Master ICT)**	**5 (Physics Course)**
Mass calculation	Probably yes	*Molecular Modelling Computation will use the Grid functionalities...*		GRASP	GRASP	... for running some complex experiments and for visualizing the results....
Distributed resources	for each VLO the resource (local, people knowledge) is not centered	*For access to external systems and databases*		GRASP	GRASP	Students and class profiles... ...metadata, experiment's information, additional educational material...
Peer-to-peer	Yes, see above	To set-up a private network for work on the dictionary excluding the reader and involving author, partner, reviewer, and editor...	Grid Learning Services based on $(P2P)^n$ dialogue *One of the main Grid functionality required*	No	No	No
Discovery and brokering	For end users to find services offered by VLOs			No	No	No
Metering and accounting	Probably, but: to be refine			No *Not within OU usage, but probably for future ASP*	No	No

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master ICT)	5 (Physics Course)
Service Level Agreement Negotiation	Not at this time *Probably in case of reliability of the system.*	A level value would allow reader to adapt number and nature of displayed elements *...could be useful for the determination of the level of functionalities or/and the nature of authorised researches...*	*...a system which should employ flexible negotiation techniques...*	.. at the system training time... the lowest quality of service (QoS) in terms of speed .. during summative assessment, a slightly higher (faster) QoS ...The highest (i.e. fastest response time) QoS is required for formative assessment	No	No
Monitoring	Probably not				GRASP, IWT	No
Data, information and knowledge management	In second time of the Experiment			Helpful to enlarge and increase the size and quality of the corpora documents	IWT	No
Virtual organizations and groups	Will be the starting point for the Experiment	Two important levels of virtual organisation are 1) Editorial community, 2) Reader community	... composite Grid interface as a ubiquitous map that allows a user to flow in the Grid virtual organisations... ...agents that work as e-Qualification actors to dynamically construct a virtual community...	*Yes*	BuddySpace, KMi Stadium	Classes of students and loosely formed groups of learners are considered as virtual groups. Virtual groups are already supported by Centra.
Load Balancing	Probably to overcome weakness of the communication network			No	No	Yes
Fault tolerance	Probably yes			No	No	
Advance Resource Reservation	Probably yes				Yes (performance of virtual scientific experiments)	Reservation is needed for contacting heavy load experiments.

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master ICT)	5 (Physics Course)
Notification/Messaging	Will have to be available for each VLO	Notification of article submitted to publication, invitation to write an article, invitation to a conversation, to schedule a video conference, etc..	... an alarm indicating that someone has entered the community, a broadcast of his knowledge level is sent to the other member's agent... ...In ASIMIL we have moreover needed to control several methods of parallel dialogue and exchanges...	No	BuddySpace	No
Workflow management	*In case of composite services*	For the editor to monitor the publication process. For the author to follow the article publication protocol	*Yes*	No	No	No
Certification				No	No	No
Authentication, Authorization and Accounting (AAA)	To identify the super users from the other users *To support different levels of information integrity (strong need)*	...access to the dictionary requires the author to be identified... *Further special rights for partners, reviewers, editors on access to an article*	Anyone is connected to the Grid through his Grid-e-Card...	*Yes*	Yes	Users need to authenticate once and gain access to the services. User resources are also private and other users need authorisation to use them.
Trust Management				No	No	No
Digital and intellectual rights	As soon as confidential data or document are produced	...A license like the one proposed by Creative Commons for open content... ..Sharing of resources protected by copyright in the private peer-to-peer network...		Yes	No	No
Others	*Dynamic creation of services*		*Service Composition*			

1.5 Selected communication and collaboration activities

This table is a synopsis of communication and collaboration activities selected by the SEES partners. An explanation of these, as given to the partners, can be found in the guidelines for the SEES Analysis and Requirements Specification (see Appendix).

Conventional communication tools (eMail, forums, chat, conferences etc.) are included here although they have no demands for Grid technologies. But if a Grid infrastructure is built for virtual organisations to support advanced collaboration tools, the conventional ones may be included to reach a homogenous and seamless way of working. At least the user and group maintenance and the authentication should be integrated (single sign-on).

	1 (VIAD)	**2 (EnCOrE)**	**3a (E-Qualification)**	**3b (E-Assessment)**	**4 (Master ICT)**	**5 (Physics Course)**
eMail	All actors have already eMail	As a complement to other communication tools	*In ASIMIL*	No	Yes	Already supported by HOU mail services
Discussion forum	Already in the pays Website	Forums will be attached to each article and to the dictionary...	*In ASIMIL*	No	Yes	Already supported by HOU web services
Instant Messaging	BuddySpace	For instance an Author request for help from a Partner via instant messaging...	*In ASIMIL*	No	BuddySpace	Already supported by Centra
Chat	BuddySpace / FlashMeeting		*In ASIMIL*	No	BuddySpace	Already supported by Centra
Audio conferences	FlashMeeting	May be used when videoconferences are unavailable	*In ASIMIL*	No	Yes	Already supported by Centra
Video conferences	FlashMeeting	Will be used in the virtual laboratory for editorial activities pertaining to the dictionary construction and evolution...	*In ASIMIL*	No	Yes	Already supported by Centra
Application sharing	For the CRN	..should allow sharing of communication and collaboration activities, in particular to solve the difficulties in discussion about hardly printable information...	*In ASIMIL*	No	No	No
Shared editing of documents	Depending on the VLO demand	...Typically in the Author-Partner interaction about the dictionary article content...	*In ASIMIL*	No	No	No

	1 (VIAD)	2 (EnCOrE)	3a (E-Qualification)	3b (E-Assessment)	4 (Master ICT)	5 (Physics Course)
Shared collection of structured information (databases)	Depending on the VLO demand	...a corpus of texts from the scientific literature... ...figures ... and schemes ...		Yes	IWT	Used for sharing information between users
Shared structuring of knowledge (ontologies)	Depending on the VLO demand	Not yet, only anticipated. The dictionary will be a first step towards ontologies...		No	Magpie, IWT	Used for sharing knowledge between users and for assessment of the learning process
Shared maintenance of knowledge (resource centres, repositories)	Depending on the VLO demand	The dictionary is a repository for meanings of words in the community		Yes	IWT	No
Shared projects (planning of tasks, timelines resources)	Depending on the VLO demand	Interaction by instant messaging needs to be scheduled. The submitting protocol for article needs some timeline.		No	No	No
Collaborative simulations, games	Not yet		*Main purpose of ASIMIL test-bed*	No	No	Used for the Physics experiments

2 Requirements for further development (methodologies and technologies)

In this chapter we sum up issues coming from the SEES analysis that will have an influence on the further development within the ELeGI project.

ELeGI Tools

All SEES will use a combination of generic and specific services and tools. It has to be cleared which of them will be taken from existing and common ELeGI developments and which will have to be specially developed for each SEES. The specific services may be a composition of generic ones, putting additional requirements on them.

The recent WP8 outcome (D5 - "Grid compliant prototypes") makes the following combination most plausible:

- GRASP to be used as core Grid middleware (but without end-user oriented administrative interfaces)
- IWT to be used for basic eLearning services, administrative services as well as portal functionality
- other (e.g. VCLab or SEES specific) services to use the basic services from GRASP and IWT.

It should be cleared if this could be a common basic platform for most of the SEES, which would give a reliable framework for the integration of other services.

VCLab is interesting for the two formal SEES. However it has to be cleared whether VCLab can easily be used as a development framework to create new experiments needed by the Masters in ICT course and the Physics course. Also the collaborative aspects of VClab need to be further explained and compared with the SEESs educational needs. Another question is whether VCLab will need the embedding in IWT to be used in an educational context.

BuddySpace is intended to be widely used in 2 or 3 SEES. But currently it is a separate application and the homogeneity with other communication tools (from a user's perspective) will be an issue (see below).

User Interfaces

Grid technology gives a solution for the technical interoperability of systems and services, but not for the integration and harmonisation of their front-ends.

At the beginning the user interface of the Grid compliant prototypes and related ELeGI software will be very heterogeneous. This has to be considered when they are used together and will lead to higher training needs. In the long run it will be a crucial point for the development of a Learning Grid Architecture to enable the integration of different advanced services in a homogenous user interface. As stated in SEES #5:

"Integration of third-party tools in the SEES infrastructure will almost always represent a challenge in making the user interface appear as part of one system rather than get the feeling of working in a lot of different tools. Ideally this should be done by having all tools use the same metaphor for user interfaces, and use the same vocabulary when talking about the same things."

User device

One question, to be decided for each SEES is, how far the learners' devices will be in touch with the Grid. Three main usage models can be distinguished:

  - The Grid is hidden behind a portal which is accessed by common web browser with user/password authentication (as in IWT)

- o Client applications use the Grid transparently through web services or legacy servers accessing the Grid via API ("Grid user" model of GRASP)
- o The user's computer is an active Grid resource (and therefore the core Grid middleware has to be installed on user's side)

The third usage model is the most advanced one and would exploit the full potential of the Grid. However, it will put the highest demands on the maturity and availability of the Grid infrastructure for different system platforms, and the end users will rely on simple software installation without a complex configuration. As described for the FINESSE demonstrator in D5, the generation and distribution of keys and certificates needed for Grid access will be an issue to be solved in this case.

Relations to other ELeGI workpackages

According to the present development and specification of the SEESs some recommendations and indications for further work in the context of the ELeGI project can be given:

Workpackage 5:

- o One of the main focus of the D10 (M9) is the development of a didactical model for virtual scientific experiences. A VSE model in **D10** will be of interest for the SEES #4 and SEES #5, who intend to use virtual scientific experiments.
- o Furthermore didactical concepts for collaborative work would be interesting for SEES #1, SEES #2, SEES #4 and SEES #5. It could be interesting to add and explore the collaborative aspect in the scope of VSEs model or to shift the focus from virtual scientific experiments didactical models to didactical concepts to enhance collaborative learning.
- o The concepts of the knowledge space theory should be compared with the concepts of e-Portfolio and matchmaking processes proposed for e-Qualification (SEES #2).

Workpackage 6:

- o Further development of web services architecture for conversational and collaboration aspects should consider the requirements specified by the SEES for **D20** (M14). Collaborative aspects are required for SEES #1,SEES #2, SEES #4 and SEES #5.

Workpackage 8:

- o The analysis of existing systems (GRASP, Finesse, IWT, VCLab) in **D5** (M4) and the impact of the foreseen requirements on the further reengineering of these tools. The Functional requirements to Grid technology in the "SEES specification (5h) should be taken into account for further software development. Not all Grid functionalities or tools are currently required by the SEESs.

Workpackage 9:

- o The requirements for VSE in the scope of SEES #4 and SEES #5 may have an impact on the developed of the VSE demonstrator (VCLab+IWT) in **D24** (M17).

3 Gender Issues

In the present SEES development no particular barriers either for men or for women can be identified. The learning scenarios, as far as it can be evaluated at the present development stage provide equal opportunities for women and men.

The selected pedagogical models for the SEESs favour both men and women. In a later development stadium a monitoring process should be established identifying gender related questions and special needs and as far as possible solutions for the recognized issues shall be provided. All SEES will be repeated evaluated with respect to gender issues.

4 Further Proceeding

Due to the complexity of the SEESs and to the fact that the basic technical concepts are developed in parallel, it was decided to keep the SEESs specifications at this stage on a level above the fine grained functional and data requirements and to provide an initial, high-level feasibility analysis. Two further tasks are planned in this workpackage: the detailed software requirements specifications and the analysis and requirements specifications update.

SEESs detailed software requirements specifications

The results of the feasibility analysis and the first results of the technical and conceptual workpackages will help to produce realistic and detailed software requirements.

The objectives of this task will be:

- To identify and agree on common representations and modelling techniques for requirements engineering in the ELeGI SEES context. The textual Volere template and a Wiki based glossary were used for the first steps, but for the next steps (use cases and detailed functional requirements) we need formal tools and techniques which should be compatible to those used by the developers in other workpackages.
- To transform the specifications of the SEESs done in D8 into detailed software requirements based on the definition of use cases and to deliver these requirements to the software and Grid architecture developers in the workpackages WP 7,8, and 9.
- To address the identified relationships with other workpackages, leading to a harmonisation of pedagogical and technical terms and concepts.

A basis for this task will be the following documents:

- The current SEES specifications and feasibility analysis (D8)
- Preliminary version of didactical and knowledge representation models for VSE (D10)
- Preliminary version of web service architecture for conversational and collaboration processes (D12)
- Preliminary specification of Virtual Learning Communities (D13)
- Other internal results of the workpackages WP7, 8 and 9.

The output of this step (the detailed requirements specifications) will be given as internal results to the other workpackages.

SEESs analysis and requirements specifications update

This task is planned to update and refine the SEESs' requirements and related scenarios after the realisation of the Grid compliant prototypes of existing applications, the demonstrators (WP8,9) and the technologies and standard choices (WP3).

A basis for this task will be the following documents:

- SEES specifications and feasibility analysis (D8)
- Detailed SEESs software requirements (IRs)
- Prototype versions of the Grid compliant software systems (D14)
- 2nd prototype, technologies and standards evolution monitoring report (D17)
- Updated version of didactical and knowledge representation models (D18)
- Updated version of web services architecture (D20)

- VSE and enhanced presence demonstrators (D24)

The outputs of this task will be:

- Updated **analysis of each SEES.**
- Updated **concepts and terminology**. This includes the mapping of the current concepts and terminologies from other workpackages with the initial concepts and terminologies of WP4 and the provision of information on changes to the SEESs
- Updated **feasibility analysis**. Functionality of the developed prototypes and the available technologies with the initial SEESs specifications will be mapped. Suggestion on the needed adjustments for the SEESs specifications will be provided.
- Updated **SEESs' requirements specification.** Updated analysis and requirements specification for each SEEEs will be produced. An update version of SEES requirements specifications (**D27**) will be provided in **M18**. This deliverable depends on the realisation of the Grid compliant prototypes of existing applications and the demonstrators (WP8, WP9), the technologies and standards choices (WP3).

Part IX: Appendix

A) Guideline for the SEES Analysis and Requirements Specification

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Version History

Version	Comments, Changes, Status	People
1	First version	Fred Neumann
2	Second version	Paul Held, Sonia Hetzner, Fred Neumann

About this Document

This document is a guideline on how the SEESs Analysis and Requirements Specification Template (**SEES_ReqTemp_V2.doc**) will be filled out.

The document is a version, to the needs of ELeGI amended, of:

Volere Requirements Specification Template (Edition 9)
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http://www.volere.co.uk

The Volere Template is exhaustive but designed for the development of a product used in an environment that has to be identified and described but is seen as given. In the scope of WP4 and especially for the informal SEESs the organisational environment (i.e. the test-bed) has also to be developed and proofed for feasability. **Therefore some extensions and specifications are applied to the original volere document**. The largest is the introduction of *Section 5. Test Beds Design* that reflects the additional effort and considerations needed for the organisational SEES development apart from the pure software requirements.

As a consequence there may be overlappings between the sections in this document but they can be solved as follows: The sections *Project Defintion and Drivers, Project Constraints* and *Project Issues* are related to the planning of the test-bed as a whole. This high level conditions and plans are broken down to software relates requirements in the sections for the *Functional Requirements* and *Non-functional Requirements*.

The main goal of this template is to give a comprehensive list of all aspects to be considered for the planning of an SEES and to guarantee that nothing important is forgotten. Therefore if a section is omitted, the information should be provided at another appropriate place or justification should be given for omission.

Document Structure

The following sections in this guideline are structurally corresponding to the specification template:

- *Project Definitions* contains a glossary of all terms and concepts used in the specification.
- *Project Drivers* identifiy the business-related forces that led to the development and the people or organisations involved.
- *Project Constraints* defines how the intended development must fit into the world.
- *Functional Requirements* are the fundamental subject matter of the system.
- *Non-Functional requirements* are the behavioral properties that the specified functions must have.
- *Project Issues* define the conditions under which the project will be done.

These sections are detailed by numbered chapters and sub chapters - the latter are focussing on single specification aspects. In the template the chapters are empty so that you can directly start writing your specifications. In this guideline you find a detailed explanation for each (sub-)chapter, structured by the following topics:

- *Content:* describes what is expected as input for the chapter.

- *Motivation:* gives a justification why this aspect is needed for the specification.
- *Examples:* demonstrate how the specification could look like.
- *Considerations:* are issus you should think about when writing your specification of this aspect.
- *Fit Criterion:* is an objective measure for defining the meaning of a requirement or specification, and eventually testing whether a given solution satisfies the original requirement.

We recommend to keep the chapter structure and the numbering intact. This will help to give a precise feedback and to produce a consistent feasibility analysis and deliverable based on all SEESs specifications.

Specification Steps

According to the development strategy proposed for the SEES analysis and requirements specification this document will be filled out in three steps with circulation for feedback and discussions at the end of each step.

(a fourth step: development of technical specifications on the basis of the Use Case methodology – task WP 4.3 - will follow after the deliverable of D 8)

- The Steps 1 and 2 are mainly related to the sections *Project Drivers* and *Project Constraints* for the whole test-bed design.
- Step 3 is related to the first section of the *Functional Requirements* and to the *Non-functional Requirements* on the basis of general descriptions.
- The *Project Definitions* and *Project Issues* will grow through all steps.

This is not a strict rule. If a specific constraint or software requirement already raises in step 1, it should of course be noted. However, the outcomes of each step are seen as the information needed for discussing feasibility and potentially advisable corrections. Some sections of this document are mentioned in more then one step. This reflects the cyclic approach with refinements of initial ideas to more elaborated statements in each step.

Step 1

This step is intended to shape the initial SEES idea, clearly defined enough to be proofed for general technological and pedagogical feasibility at a *very high level*. This will include the following sections:

- 1a for the initial idea and general need of the SEES and 1b for its focus
- 1c for opportunities and reasoning of Grid usage compared to other solutions
  (basis for SWOT analysis)
- 2a-2d for embedding (stakeholders, 'enemies', networks, cooperations) and the competences needed / available from the stakeholders
- 4f for time scale and 4g for available budget and 24 for estimated costs
- 20 and 23 for potential problems and risks (basis for SWOT analysis)

Step 2

The aim of step 2 is to complete the organisational SEES definition with all relevant conditions that are needed to carry out the scenarios' planning properly and as preparation for the formulation of the software requirements:

- 3a/b for the target group definition, selection and user needs analysis

- 4a/b for the general technological approach
- 4c-e for other technological aspects
- 5a for the learning approach and the assumed learner image/model
- 5b-d for the learning contents, user support and training needs
- 5e-f for organisational, economic and quality aspects
- 4g for the need of additional funding and 2c for potential financiers
- refine the opportunities (1c) and problems/risks (20/23) on basis of the deeper knowledge

Step 3

This step is intended for the transition of the project constraints to the software requirements. It identifies the actors, business events and interactions within the service.

- 7a for the context of the work
- 7b for the work partitioning by business events
- 10-17 for the non functional requirements (as far as they can be concerned at this stage)
- 18-25 for common project issues (as far as needed)

Definitions used in this Guideline

The following table lists all special terms used in this guideline:

Term	Definition
Client	The person or organization for which the service is being built, usually responsible for paying for the development of the service.
Context of the Service	The boundaries between the service that we intend to build and the people, organizations, other services and pieces of technology that have a direct interface with the service.
Context of the Work	The subject matter, people and organizations that might have an impact on the requirements for the service. The context of study identifies the intersection of all the domains of interest.
Customer	The person or organization who will buy the service (note that the same person/organization might play both the client, customer and sometimes user roles)
Design or Systems Design	Crafting a solution to fit the requirements.
Developers	The people who specify and build the service.
Domain of Interest	A subject matter area that has some relevance to the context of study.
Event	We use the term business event to mean a business related happening within a system adjacent to the work that we are studying. The happening causes the work to produce an event-response.

Fit Criterion	Objective measure for defining the meaning of a requirement, and eventually testing whether a given solution satisfies the original requirement.
Functional Requirement	An action that the service must be able to take, something that the service must do. Fundamental subject matter of the system and are measured by concrete means like data values, decision making logic and algorithms.
Global Constraint	Constraints that apply to the system as a whole.
Non-Functional Requirement	Behavioral property that the specified function or service must have, such as performance, usability, etc. Non-functional requirements can be assigned a specific measurement. This template will give examples of quantifying non-functional requirements.
Project constraints	Identify how the eventual product or service must fit into the world. For example it might have to interface with or use some existing hardware, software or business practice, or it might have to fit within a defined budget or be ready by a defined date.
Project drivers	Business-related forces. For example the purpose of the service is a project driver, as are all of the stakeholders – each for different reasons.
Project issues	Conditions under which the project will be done. These are included in the requirements specification to present a coherent picture of all the factors that contribute to the success or failure of the project.
Requirement	A measurable statement of intent about something that the service must do, or a property that the service must have, or a constraint on the system.
Service	This is what we are attempting to deliver.
Stakeholder	A stakeholder is a person who can affect the outcome/success of the project and/or is affected by its outcome/success.
SWOT (Strehgths, Weaknesses, Opportunities, Threads)	A very effective way of identifying your Strengths and Weaknesses, and of examining the Opportunities and Threats you face. Carrying out an analysis using the SWOT framework helps you to focus your activities into areas where you are strong and where the greatest opportunities lie.
System	The business system whose requirements are being studied.
Systems Analysis	Detailed study of the requirements, intended to prove their workability as input to systems design.
Use Case	We use the term event-driven use case (or service use case) to mean a user-defined (or actor defined) piece of activity within the context of the service.
User or End User	Someone who has some kind of direct interface with the service.
VO	Virtual Organisation.

Project Definitions

0 SEES Glossary

This section gives definitions of all terms, including acronyms, used in your SEES specification, except of those already defined for the whole ELeGI project or in the common glossary of WP4.

Content

A dictionary containing the meaning of all the names used within the requirements specification. Select names carefully to avoid giving a different, unintended meaning.

This dictionary should build on the standard names that your organization, or industry, uses. The names should also reflect the terminology in current use within the work area.

The dictionary contains all important names that are used by the project. For each name write a succinct definition. This definition must be agreed by the appropriate stakeholders.

Motivation

Names are very important. They invoke meanings that, if carefully defined, can save hours of explanations. Attention to names at this stage of the project helps to highlight misunderstandings.

The dictionary produced during requirements is used and added to throughout the project.

Examples

Term	**Definition**
VIAD	Virtual Institute for Alphabetisation for Development

Considerations

Make use of existing references and data dictionaries. Obviously it is best to avoid renaming existing items unless they are so ambiguous that they cause confusion.

From the start of the project emphasize the need to avoid homonyms and synonyms and explain how they increase the cost of the project.

As we progress through the requirements specification each of the elementary terms will be defined in detail.

Project Drivers

1 The Purpose of your SEES

1a The user problem or background to the project effort

Content

content, motivation, examples and Considerations

A short description of the work context and the situation that triggered the development effort. It should also describe the work that the user wants to do within your SEES.

Motivation

Without this statement, the project lacks justification and direction.

Considerations

You should consider whether or not the user problem is serious, and whether and why it needs to be solved.

1b Goals of the project

Content

This boils down to one, or at most a few, sentences that say “What do we want this SEES for?” In other words, the real reason that the SEES is being developed.

Motivation

There is a real danger of this purpose getting lost along the way. As the development effort heats up, and the customer and developers discover more and more what is possible, it may well be that the system as it is being constructed wanders away from the original goals. This is a bad thing unless there is some deliberate act by the client to change the goals. It may be necessary to appoint a person to be “custodian of the goals”, but it is probably sufficient to make the goals public, and periodically remind the developers of it. It should be mandatory to acknowledge the goals at every review session.

Examples

“We want to give immediate and complete response to customers ordering our goods over the telephone.”

“We want to be able to forecast the weather.”

"The objective is to help the local municipalies "Lodévois-Lazarc" to build together an offer able to attract people i.e. a direct link between tourists and the local actors" (SEES #1, taken from the ELeGI TA)

Fit Criterion

An objective measure that will enable testing to determine if the goal has been met by the service.

Some guideline for making goals measurable are:

- Specify each adverb and adjective so that everyone on the project understands the same meaning.

- Replace pronouns with the names of specific people or organisations.

- Ensure that the meaning of every noun is defined in one place in the specification

For instance the above example could be analysed and made less ambiguous as follows:

We - Employees of XYZ Corporation

want to give

immediate - during the course of a telephone call

and

complete - service availability and price

response - verbal information

to

customers - anyone who enquires about our services

our - supplied by XYZ Corporation

goods - products that we manufacture

over the telephone

Following the analysis, the goal could be restated as:

Employees of XYZ Corporation want to tell enquirers, during the course of a telephone call, the availability and price for any product manufactured by XYZ.

Whenever you analyze a goal using this technique you will find yourself going through several iterations. The discipline imposed by making the goal measurable guides you into asking more relevant questions about the meaning.

You can use the Volere Purpose, Advantage, Measurement questioning technique to help you make goals measurable.

In ELeGI the GQM approach is applied.

1c Opportunities and "return of value"

Content

This section should describe all the expected opportunities of the SEES. It should include all opportunities and expected positive effect or any chances forseen for the future, even if they are not related to the central goals.

In special it should list the opportunities that are expected by the new pedagogical models and the use of Grid base services and should give a reasoning / justification regarding to the educational paradigm shift from conventional eLearning approaches and the "return of value" for the SEES organisation or the users.

Motivation

This section, combined with *20 New Problems* and *23 Risks* will be used for a SWOT analysis. It should give arguments for the central aspect of the SEES development: the meaningful and inevitable use of Grid for the purpose stated in 1b.

Fit criterion

An objective criterion should be given for each opportunity that will enable to determine if it is met.

2 Client, Customer and other Stakeholders

2a The client is the person/s paying for the development, and owner of the delivered system.

Content

This item must give the name of the client. It is permissible to have several names, but more than three negates the point.

Motivation

The client has the final acceptance of the system, and thus must be satisfied with the system as delivered. Where the system is being developed for in-house consumption, the roles of the client and the customer may be filled by the same person. If you cannot find a name for your client, then perhaps you should not be building the service.

Considerations

Sometimes, when building a package or a service for external users, the client is the marketing department. In this case, a person from the marketing department must be named as the client.

A SEES may have more clients: the European Commission funding ELeGI, the organisation hosting the SEES and probably needed additional funders.

2b The customer is the person/s who will pay for the SEES' service.

Content

The name of the person who plays the role of the customer for the service. In the case of in house development the roles of the client and the customer are often played by the same person. In the case of the development of a mass market service there may be several people playing the role of customer. In the case of a service that is being developed for an international market, there might be a different customer (or customer profile) in each country.

In case of a SEES service the customer may be the users/students or any organisation paying for their students' or employees' access to the service.

Motivation

The customer role is ultimately responsible for deciding whether or not to buy the service from the client. The service must be built to satisfy the aims of the customer/s whilst conforming to the constraints of the client. Even if the customer/s are people who work for another part of the client's organization, they might still have the authority to decide whether or not to invest budget in the new service.

2c Other stakeholders

Content

The roles and (if possible) names of other people and organizations who are affected by the service or whose input is needed in order to build the it.

Examples of stakeholders include:

- Users (detailed in section 3)
- Sponsor
- Testers
- Business Analysts

- Technology Experts
- System Designers
- Marketing Experts
- Legal Experts
- Domain Experts
- Usability Experts
- Representatives of external associations
    - political decision makers
    - Existing networks
    - Potential cooperations
    - Potential "enemies"

For each type of stakeholder identify:

- Stakeholder Identification (some combination of role/job title, person name, organization name),
- Knowledge needed by the project,
- Necessary degree of involvement for that stakeholder/knowledge combination,
- Degree of influence for that stakeholder/knowledge combination,
- Agreement on how to address conflict between stakeholders who have an interest in the same knowledge

Motivation

Failure to recognize stakeholders results in missing requirements or in complete failure.

3 Users of the Service

3a The users of the service

Content

A list of the potential users of the service. For each category of user, provide the following information:

- User name – This is most likely to be the name of a user group like: schoolchildren, road engineers, project managers.
- User role – Summarizes the users' responsibilities.
- Subject matter experience – Summarizes the users' knowledge related to the service.
- Technological experience – this describes the users' experience with relevant technology. Rate as novice, journeyman or master.
- Other user characteristics – Describe any characteristics of the users that have an effect on the requirements and eventual design of the service. Describe things like:
    - Physical abilities/disabilities
    - Intellectual abilities/disabilities
    - Attitude to job

  - Attitude to technology
  - Education
  - Linguistic skills
  - Age group
  - Gender
  - Social context
  - Time budget
- Aspiration and objectives
  - learning needs
  - support needs
  - collaboration needs

(The userfit methodology (http://www.stakes.fi/INCLUDE/1-4.htm) may provide some useful guidance concerning the assessment of user needs)

Motivation

Users are human beings who interface with the service in some way. The role of the client is to pay for the development of the service and the role of the customer is to buy the service. The role of the user is to use the service to do work. You use the characteristics of the users to define the usability requirements for the service.

Examples

Users can come from wide, and sometimes unexpected, sources. Consider the possibility of your users being clerical staff, shop workers, managers, highly-trained operators, general public, casual users, passers-by, illiterate people, tradesmen, students, test engineers, foreigners, children, lawyers, remote users, people using the system over the telephone or Internet connection, emergency workers, and so on.

3b The priorities assigned to users

Content

Attach to each category of user a priority rating. This gives the importance and precedence of the user. Prioritize the users into:

- *Key users.* These are critical to the continued success of the service. Give greater importance to requirements generated by this category of user.
- *Secondary users.* They will use the service, but their opinion of it has no effect on its long-term success. Where there is a conflict between secondary users' requirements and those of key users the key users take precedence.
- *Unimportant users*. This category of user is given the lowest priority. It includes infrequent, unauthorized and unskilled users, and people who misuse the service.

Percentage of this type of user – this is intended to assess the amount of consideration given to this category of user.

Motivation

If some users are considered to be more important to the service, or the organization, then this should be stated because it should affect the way that you design the service.

Some users may be listed as having no impact on the service. This means that the users will make use of the service, but have no vested interest in it. In other words, these users will not complain, nor will they contribute. Any special requirements from these users will have a lower design priority.

3c User participation

Content

Where appropriate attach to the category of user, a statement of the participation that you think will be necessary to provide the requirements. Describe the contribution that you expect this user to provide – business knowledge, interface prototyping, usability requirements etc. If possible, assess the minimum amount of time that this user must spend for you to be able to determine the complete requirements.

Motivation

Many projects fail through lack of user participation, sometimes this is because the required degree of participation was not made clear. When people have to make a choice between getting their everyday work done and working on a new project, the everyday work takes priority. This requirement makes it clear, from the outset, that specified user resources must be allocated to the project.

Project Constraints

4 Mandated Constraints

This section describes constraints on the requirements and the eventual design of the service.

4a Solution constraints

Content

This specifies constraints on the way that the problem must be solved. You can think of these as mandated solutions. Carefully describe the mandated technology, include the appropriate version numbers, and a measurement of how you will test compliance. If possible, you should also explain the reason for using the technology.

Motivation

To identify constraints that must be part of the final service. Your client, customer or user may have design preferences. If these are not met then your solution is not acceptable.

Examples

The service must use the Windows NT operating system.

The service must be a hand-held device.

In ELeGI: The SEES must use a solution based on Grid services.

Considerations

We want to define the boundaries within which we can solve the problem. Be careful because anyone who has experience/exposure to a piece of technology tends to see requirements in terms of that technology. This tendency leads people to impose solution constraints for the wrong reason and it's very easy for untrue constraints to creep into a specification. If you impose untrue constraints the danger is that you do not have the creative freedom to come up with the best solution to the problem. The solution constraints should only be those that are absolutely non-negotiable. In other words, however you solve this problem you must use this particular technology. Any other solution would be unacceptable.

4b Implementation environment of the current system

Content

This describes the technological and physical environment in which the service will be installed. This includes automated, mechanical, organizational and other devices. These include the non-human adjacent systems.

Motivation

To describe the technological environment into which the service must fit. The environment places design constraints on the service. This part of the specification provides enough information about the environment for the designers to make the service successfully interact with its surrounding technology.

The operational requirements are derived from this description.

Examples

This can be shown as a diagram, with some kind of icon to represent each separate device or person (processor). Draw arrows to identify the interfaces between the processors and annotate them with their form and content.

Considerations

All the component parts of the current system, regardless of their type, should be included in the description of the implementation environment.

If the service is to affect, or be important to the current organization, include an organization chart.

4c Partner applications

Content

This describes applications that are not part of the service but with which the service will collaborate. These can be external applications, commercial packages or pre-existing in-house applications.

Motivation

To provide information about design constraints that are caused by using partner applications. By describing or modeling these partner applications, you discover and highlight potential problems of integration.

Examples

This section can be completed by including written descriptions, models or references to other specifications. The descriptions must include a full specification of all interfaces that will have an effect on the service.

In ELeGI you would have to describe the Grid services you intent to integrate into your service (more details in Section 5h)

Considerations

Examine the work context model to determine if any of the adjacent systems should be treated as partner applications. It might also be necessary to examine some of the details of the work to discover relevant partner applications.

4d ELeGI related software

Content

This section describes applications that must be used to implement some of the requirements for the service. Especially for ELeGI this will include the use of the Grid compliant prototypes of existing learning environments developed in WP8 and other tools mentioned for the project.

In the following table you see a commented list of the tools. In the template you have the same list with a free text column in which you specify *whether*, *how,* and *why* a tool will be used in your scenario.

Tools from WP8 "Grid compliant Prototypes of Existing Learning environments"		
Tool	**Description**	**Key words and properties**
GRASP Grid based Application Service provision *(refered on WP 8 for main development of the software architecture)*	An infrastructure enabling Grid based Application Service provision The GRASP platform will provide a set of core middleware services that will enable to build, on their top, a Grid based Application Service Provider. The platform includes a number of fundamental middleware Grid services that simplify the integration of distributed resources and increase the	Efficient use of resources through a dynamic coordination of distributed resources Delivering of services compliant with a service level agreement Overcomes performance

	efficiency of applications such as distributed accounting, fine grain pricing mechanism and QoS. References: http://eu-grasp.net/english/default.htm http://portal.sema.es/pls/portal30/docs/FOLDER/ELeGI_AREA/MEETINGFOLDERS/KICKOFFMEETING/4EXISTINGTOOLS/GRASPPRESENTATION.PPT	and quantity limitations by combining required resources Charging services on the basis of effective use and effective delivered QoS Security management across different administrative domains
IWT Intelligent Web Teacher *(refered on WP 8, will be made Grid-aware)*	A distance-learning platform realized by CRMPA in order to fill up the lack of support for flexibility and extensibility in existing e-learning systems. IWT an existing learning platform to be ported on the Grid References: http://voyager.diima.unisa.it/iwtportal/DesktopDefault.aspx http://portal.sema.es/pls/portal30/docs/FOLDER/ELeGI_AREA/MEETINGFOLDERS/KICKOFFMEETING/4EXISTINGTOOLS/01.03.04+IWT.PPT	Customizable web based portal. Integrated tools for the management of users, groups, roles and access rights. Extensible by plug-ins for new services or new kinds of learning objects. Content Management through Explicit Knowledge Modeling. Automatic Student Evaluation. Automatic Customistion of the Didactic Experience on real Students Needs and Learning Preferences Personalised learning.
Finesse	Finance, Accounting and Management degree programmes include courses on fund management. Finesse (Finance Education in a Scaleable Software Environment) adapted an active, experiential, collaborative learning mode that features real teamwork and real world input. Finesse is implemented on the basis of **TAGS**, a framework for the research, development, deployment and management of distributed collaborative learning environments. TAGS has an architecture, which facilitates group communication and resource sharing. For the ELeGI SEESs, the basic system TAGS will be the target of interest. References: http://finesse.ac.uk/ http://portal.sema.es/pls/portal30/docs/FOLDER/EL	Collaborative, multi-user, groups, resource sharing Real world input (uses real time stock market data) Could not work without live network connection Augmented with telepresence User Interface provides users, groups and resources abstractions to tutors Developers supported by defined interface and services System is QoS aware across a number of dimensions user-centric portal

	eGI_AREA/MEETINGFOLDERS/KICKOFFMEETING/4EXISTINGTOOLS/OU-KMI-TOOLS.PPT	generation
Virtual Control Laboratory	The general idea of the Virtual Control Lab (VCLab) is to provide a common platform for experimental courseware systems using virtual experiments in the area of control engineering. References: http://www.esr.ruhr-uni-bochum.de/VCLab/ http://portal.sema.es/pls/portal30/docs/FOLDER/ELeGI_AREA/MEETINGFOLDERS/KICKOFFMEETING/4EXISTINGTOOLS/VCLAB.PPT	Realism and Experiential; Active Learning Simulated experiments on a local or remote computer Dynamical LaTeX math display Symbolic math interaction Dynamical system structure editing Virtual reality interaction Slider interaction

Tools from WP6 "Analysis and Definition of Conversational Processes and Collaboration Aspects"		
BuddySpace *(refered on WP 6 for further software architecture development)*	Instant Messaging + Smart Maps". It provides continual 'background presence awareness' of peers, by deploying extensions to the open-source XML technology from the Jabber Software Foundation.significant References: http://www.buddyspace.org/ http://portal.sema.es/pls/portal30/docs/FOLDER/ELeGI_AREA/MEETINGFOLDERS/KICKOFFMEETING/4EXISTINGTOOLS/OU-KMI-TOOLS.PPT	Maps for geographical & office-plan visualizations in addition to standard 'buddy lists'; Built on open source Jabber, which makes it interoperable with ICQ, MSN, Yahoo and others; Implemented in Java, so it is cross-platform; 100% free with full sources readily available. Collaborative- social learning
KMi Stadium *(refered on Wp6, special the component flash meeting)*	This is KMi's existing large-scale interactive webcasting environment that has been used to bring innovative activities such as a Virtual Pub Quiz and Virtual Degree Ceremony to participants around the world in real time. Unlike other comparable media, Stadium has always encouraged the active participation and indeed content creation by remote participants to help create a sense of pride and 'atmosphere' References: http://cnm.kmi.open.ac.uk/projects/stadium/	to stage large-scale live events on-demand-replays, while giving remote participants anywhere on the Internet a sense of 'being there'. Collaborative learning authentic, realism Learning
Magpie	A semantic web method and tool tool developed at KMi. It uses a rich ontology infrastructure to semantically markup web documents on-the-fly References: http://kmi.open.ac.uk/projects/magpie/	Knowledge management, semantic web browser, ontologies, knowledge modelling, dynamic linking, semantic web services Personalised and

		contextualised learning
madkit	Multi-agent plattform by UM2-LIRMM	
Strobe	Scheme-based conversational tools UM2-LIRMM	
Webra	Web rational agent by UM2-LIRMM	
DYXWEB	Dynamic xml web-editor by UM2-LIRMM	

Motivation

To identify and describe existing commercial, free, open source, etc. products/services that must be incorporated into the eventual service. The characteristics, behavior and interfaces of the package are design constraints.

Considerations

The use of a specific package has been mandated. When gathering requirements you may discover requirements that are in serious conflict with the behavior and characteristics of the package. Keep in mind that the use of the package was mandated before the full extent of the requirements was known. In light of your discoveries you must consider whether the package is a viable choice when all the requirements are known. If the use of the package is not negotiable, then the conflicting requirements will have to be discarded.

You should also consider if there are any legal implications arising from your use of the software. You might also cover this in section 17 – Legal Requirements.

4e Anticipated workplace environment

Content

This describes the environment in which the users will work and use the service. This should describe any features of the environment that could have an effect on the design of the service.

Motivation

To identify characteristics of the physical settings so that the service is designed to compensate for any difficulties.

Examples

The printer is a considerable distance from the user's desk. This constraint suggests that printed output should be de-emphasized.

The workplace is noisy, so audible signals might not work.

In eLeGI: the user might be mobile. This means that mobile access to the service has to be provided

Considerations

The physical work environment constrains the way that work is done. The service should overcome whatever difficulties exist, however you might consider a redesign of the environment as an alternative to having the service compensate for it.

4f How long do the developers have to build the system?

Content

Any known deadlines, or windows of opportunity, should be stated here.

Motivation

To identify critical times and dates that have an effect on service requirements. If the deadline is short, then the requirements must be kept to whatever can be built within the time allowed.

Examples

To meet scheduled software releases.

There may be other parts of the business or other software products that are dependent on this service.

In ELeGI, the ovrall work plan sets external time constraints.

Considerations

State deadline limitations that exist by stating the date and describing why it is critical. Also identify prior dates where parts of your service need to be available for testing.

You should also ask questions about the impact of not meeting the deadline like:

What happens if we don't build the system by ......?

What is the financial impact of not having, the system by…?

4g What is the financial budget for the SEES?

Content

The budget for the software and SEES development, expressed in money or available resources.

If possible split the budget available for design, implementation, testing and continous service providing. Consider, what budget is available inside the ELeGI project and what is expected/you need from additional financiers or customers of the provided service.

Motivation

The requirements must not exceed the budget. This may constrain the number of requirements that can be included in the product or service.

The intention of this question is to determine if the service is really wanted.

In ELeGI, e.g., the intention is to develop new learning approaches, the intention is not, to develop learning content

Considerations

Is it realistic (and justified) to build a service within this budget? If the answer to this question is no, then either the client is not really committed to building the service or does not place enough value on the service. In either case you should consider whether it is worthwhile continuing.

5 Test-Bed Design

This section is intended to shape all aspects of the learning system / service planned for an SEES.

5a Pedagogical / didactical approach

Content

Specify the intended learning model and the learner image and model. Express what formal or informal learning activities are planned. Terms and basic concepts defined in the WPs 5 and 6 should be included in the common SEESs glossary and used here.

In the following table you see a commented definition of pedagogical concepts that are mentioned for the ELeGI project. In the template you have the same list with a free text column in which you specify *whether*, *how,* and *why* a concept will be used in your scenario.

Pedagogical goals -> Requirements on the learning environment		
Term	**Definition**	**Comment**
Collaborative learning, cooperative learning, social learning, project related learning	Active collaboration/cooperation with other students, teachers, tutors, experts or, in general, available human actors, by using different kinds of collaboration technologies.	The role of collaboration in the respective learning domain has to be defined. The right balance of instructional parts, individual learning and collaboration for the specific domain has to be considered. The individual needs for collaboration and non-collaboration have to be respected. The appropriate balance of synchronous and asynchronous collaboration has to be found. The collaboration tools have to be easy to use and adapted to the learning objective and domain. The 'lightest' tool with respect to a given objective should be chosen. In project related learning, a group of learners is engaged in the same project. Learning goal may be in the cooperation process or in the outcome.
Constructivist learning	The key feature of a constructivist learning environment is that the student is in charge of constructing and testing his or her own understanding	The goal of constructivist instruction is to aid the student in gaining the capability to ask relevant questions, to generate authentic contexts for the use of the knowledge to guide the interpretation of the information, to test his or her views against alternative views, and to become aware of the knowledge construction process. The learner is enabled to integrate new knowledge into existing knowledge structures or to adapt existing structures in the light of new information. She/he is supported in assimilation/akkomodation processes. She/he gets feedback from human (peers, tutors, actors) and non-human actors and has access to tools which foster autonomous structuring. The system allows self-assessment. The same concept may be applicable to virtual communities.
Experiential learning, active learning, Problem based learning (PBL)	Experiential learning involves a, 'direct encounter' with the phenomena being studied rather than merely thinking about the encounter, or only considering the possibility of doing something about it. In PBL the curriculum consists of carefully selected and designed problems that demand from the learner acquisition of critical knowledge,	A relevant, stimulating field of experience/ problem is provided to the learner which allows the derivation of respective relevant rules and assumptions. The assumptions can be tested against reality in order to confirm or to falsificate the assumptions. This calls for manipulation and control of the experimental field/interactivity. The rules' derivation process has to be accompanied. The validity of assumptions has to be proven in predictions and transfer to reality tasks.

	problem solving proficiency, self-directed learning strategies, and team participation skills	
Personalised, individualised learning	Each student is seen as an individual, with individual goals, aims and aptitudes.	The learning systems supports the learners' individuality. The learner has the option to choose her/his adapted learning path. The learning support is individualised, the learning technology is adapted to the learners' specific needs. The degrees of freedom are adapted to the learners' eLearning history and experience.
Ubiquity and accessibility	Wider, more flexible access to educational resources, often referred to as learning “anytime/anywhere” for everyone.	The learning system should be scalable to mobility conditions, in terms of content, bandwidth, devices, communication. Specific devices for disabled. Not a specific pedagogical approach. Interesting in combination with contextualised learning.
Contextualised, adaptive, situated learning	a) The learning content is adapted to the learners‘ context of practice. b) Changes in the learners' context influence the learning offer.	a) The learning content is adapted to the learners‘ context of practice. The learner recognises the relevance learning offer for problems encountered in her/his work/life context. The learner is stimulated to solve real life problems with the new knowledge. Feedback is provided about the degree of success of transfer efforts. b) the learning system is context sensitive.

Pedagogic demands and requirements on the Grid technology		
Pedagogical demands	**Needs**	**Technological challenge**
Group working	shared interactive resources	concurrency control and awareness of others activities
Active learning	interactive resources must be properly responsive a quality of service (QoS) issue that depends on many components of a distributed system – the low-level infrastructure (hardware, OS, network), the middleware and the interface software	Concurrency control and interactive responsiveness can make conflicting demands on a system - bandwith - computing power - hot spots - scheduling of rare resources
Realism	Real world input (e.g. stock exchange market, remote sensing)	network connection is mandatory QoS issues such as fault detection, masking and tolerance for the learning environment
Accessibility anytime/anywhere	requires availability Accessibility also means adapting to available	replication of resources (this creates further tension with responsiveness and concurrency control)

	capabilities (e.g. through low-bandwidth mobile devices and high-bandwidth multimedia workstations)	and concurrency control)
Personalisation	semantic tagging and profiling	
Contextualisation	Dynamicity of the services.- frequent change (“perhaps even more times a day”)	

Motivation

This section will provide the linkage to the AL2 activities. Expectations stated here will be taken into account by the Workpackages of AL2. The right pedagogical approach is crucial for the learners' motivation and for the learning success.

Considerations

Not all learning approaches are effective for all learning needs. Think in terms of learning economy. The learner is interested in learning the most in the shortest possible time.

5b Learning contents

Content

Define the focus of the content. List what existing content can be used and what has to be produced newly (including amount, e.g. in learning hours).

If existing content is intended to be used, consider copyright and licencing and whether the content can be modified to be used in the SEES context.

If new content has to produced, who will produce it in which way? Will it be tailored for the SEES or generic for different purposes?

What didactical approach is followed in the content, what formats and media are used? What kinds of interactions are included, what standards are applied and what interfaces are expected from the learning environment?

Motivation

The expected system must be able to handle the content and enable its contextualisation or use in group collaborations, if intended. The production of new content has to be planned (5e) including training needs for the authors on production tools and didactical gudelines, if special tools are needed. The costs for content production or purchasing have to be estimated.

Considerations

Again, a spirit of economy has to be adopted: What is the appropriate media mix for a defined goal? Multimedia is expensive. It has to be didactically justified. Think about reuse

5c User support

Content

Define the type and extend of user support that will be available in the learning service provided by the SEES. This includes human and non-human support concerning content, motivation, technology, and organisation.

Motivation

Support activities have to be included as tasks in 5e and must be included in the cost estimation. This section shall give an overview of all support activities needed in the SEES, e.g. tutorial support on the content or the leaning process. The supporting functions of the used software components shall be stated as a system requirement in 14c.

Learning without support will fail.

Examples

"Support will be given by personally assigned tutors, each responsible for a group of X learners."

"A tutor will monitor the usage of the collaboration tools and animate the learners, if needed, by ..."

Considerations

What support facilities must be provided by the developed tools and what capacities for personal support must be available? What conversational processes are foreseen for the support activities and how will this be reflected in the architecture of the learning system?

Think about an intelligent and economic mix of human and non-human support. Foresee the predictable and be prepared for the unpredictable. Learners do not like over-support.

5d Training needs

Content

What training needs are needed and foreseen for authors, tutors, technical people and others. This section includes all training activities for the SEES, e.g. training on the didactical approach, authoring guidelines, tutoring activities, software installation, maintenance usage.

Motivation

Training activities have to be included as tasks in 5e and must be included in the cost estimation.

Untrained actors may cause high risks and financial losses.

Example

"New tutors must be trained in a one month eLearning course with about 15 learning hours per week".

Considerations

What training will be neccessary? Who will design the training? Who will provide the training?

5e Organisational aspects

Content

Define the relationships between the stakeholders, the processes and communication flows. Provide a list of tasks to be done for establishing and performing the SEES and an assignment to the stakeholders. Identify which work can be done in the context of ELeGI and which has to be done outside and needs external funding. Give a time scale for building up the organisation and list the decisions that have to be taken until certain milestones.

Motivation

In contrast to *7. Scope of Work* that is part of the functional software requirements this section is about the organisational aspects of the whole test bed. The identified scope of organisational aspects should be complete enough to enable a first effort estimation.

Examples

Organisation chart and (if applicable) a business process or value chain diagram. Task list and time plan.

Considerations

Only if all organisational aspects of your service are thought about a priori, your service has a chance to succeed.

5f Economic aspects

Content

Estimate the economy of the learning system, its economy of scale and sustainability.

All components of your service have to be checked in terms of fix and variable costs.

Motivation

The opportunities and the "return of value" proposed in 1c should be set in relation to the efforts needed for the SEES implementation (excluded the development of the software tools provided by ELeGI). Costs are a potential killer argument.

Considerations

What is the break even point for all human or non-human sub-services you have foreseen in your system?

For which number of users or learners and learning objects or services is the test-bed designed? What happens to the efforts and the effectiveness if this number increases or decreases? Are there any interdependencies that have an influece on it? What efforts and fundings are needed for the sustainability of the solution after the ELeGI project what are the plans for a long term development?

5g Quality Aspects

Content

Define how quality management is applied in the SEES organisation and how the stakeholders will be involved in it. Define how the SEES will be evaluated.

Motivation

Quality Management is of course important for every service or organisation. In case of the ELeGI you have to guarantee that the measures and evaluations collected in an SEES relate to the usage of the new pedagogical approaches and Grid based tools, but not to other factors that may lower the quality of the learning system.

Considerations

How will it be guaranteed that the different components (environments, curricula, content and tools) are seamlessly integrated in a consistent, homogenous offer to the users (e.g. by authoring or tutoring guidelines)?

How will the measures for the fit criteria of the goals, objectives and requirements be collected? What tools and resources have to be provided for this task?

5h Technology

Content

Specify the Grid-based functionalities that you forsee as needend for the development of your services.

In the following tables you see a commented list of the functionalities. The comments give an explanation of the functionalities use for a Learning Grid in general. In the template you have the same list with a free text column in which you specify *whether*, *how,* and *why* a functionality will be used in your own scenario.

If you have chosen some of the tools listed in 4d, please specify which of the functionalities you expect from which tool.

Main application areas of Grid technology	
Application	**Explanation**
Mass calculation	Providing high computing power by distributed calculation, e.g. for complex simulations or visualisations.
Distributed resources	Location-transparent, coordinated access to distributed resources, e.g. data, services or physical resources with single sign-on.
Peer-to-peer	Resource sharing and communication between devices without the involvement of a central server, e.g. for virtual conferences, group simulations, shared editing or file sharing.

Functional requirements to Grid technology	
Functionality	**Comments**
Discovery and brokering	Users and Organizations must be able to discover services and resources inside the Grid. A learner must be able to use discovery services in order to obtain a detailed list of learning services and a organization must be able to discover services/resources needed to provide the personalized offer. Discovery functionalities must be improved in order to perform intelligent searches and provide similar features to those made available by Semantic Web research. Furthermore, brokerage functionalities are needed to prepare the learning offer.
Metering and accounting	These functions are the base upon which is possible to realize a “pay per use” mechanism where clients pay for the effective resources/services usage. Learners pay for their learning sessions. These offers are personalized also on the basis of user requirements and the resources needed to provide the offers are not known a priori. Each organization must have its Metering/Accounting/Billing subsystem in order to record and account resources usage and duration and to provide, on the basis of its business policies, a bill to the bank organization, which is able to provide a business transaction.

	Business transactions can happen also between organizations.
Service Level Agreement Negotiation	This functionality is needed for personalized learning training. Learners pay for the training sessions and they must be guarantee on the QoS provided. SLA Negotiation functionalities are required every time an agreement between a client and provider must be reached. SLA contains information about the cost of the service, the QoS guarantee and the penalties for the provider and it must be human and machine understandable.
Monitoring	Information on the status of the resources is very important to realize learning sessions based on SLA. Monitoring has to be managed on two levels. Each organization has to monitor its own resources and a global VO monitoring of resources is needed. Application and service monitoring systems are needed to control if the SLA is respected.
Data, information and knowledge management	Functionalities for information and knowledge management are useful for a Learning Grid. This includes services to acquire, use, retrieve and maintain knowledge.
Virtual organizations and groups	Creation and management of VOs and groups are needed. The provisioning of learning session happens only after the creation of a group inside the VO. Groups can be created by mentors and are finalized to provide a session with the learners. The mentors rely on these functionalities to add the interested learners in a group and to invite expert learners in a group. Groups can have a short lifetime (e.g. the time of a single learning session) or a long lifetime (e.g. a complex offer composed of multiple learning sessions). Generally, lifetime of a group is dynamic and it should be possible to manage it (e.g. extend the group lifetime if a learning activity has required more time). Functions for the management of relationships between groups are useful.
Load Balancing	Strong load balancing functionalities are used by the organizations, in combination with the monitoring ones, to guarantee that low-level requirements on QoS (e.g. CPU usage, memory available) are respected.
Fault tolerance	Used to support fault management and load redistribution. Fault tolerance functionalities are particular important during specialized learning sessions, e.g. a videoconference between a tutor and some learners. Mechanisms are required in order to avoid the Grid shut down during this period.
Advance Resource Reservation	Based on user requirements, it must be possible to reserve the resources needed for delivery of requested QoS. Furthermore, advance resource reservation is needed also to reserve particular kinds of resources for specialized learning session, e.g. a collaborative lesson between a tutor and some learners.
Notification/Messaging	Used by the actors when they request something (learner requests a mentor sending messages, a learner requests a remedial work,..) or when they need to obtain information on which they express a kind of interest. Furthermore, these functionalities are also used for create virtual discussion (e.g. instant messaging in a chat room)

P2P/Collaboration	These functionalities are fundamental in a cooperative and collaborative environment. Members of a VO or a group can use these functionalities for realizing basic collaboration activities. For example, every time learners with a similar skill sit on a discussion table they can be able to join a peer group in which the can collaborate sharing knowledge. Furthermore, these functionalities are used for the provisioning of collaborative and experiential learning session based on human centred methodology and on the learning by doing paradigm.
Workflow management	Organization provides complex services developed as workflows that coordinate resources and services form other organizations. Functionalities to parse and execute these workflows are required.
Certification	A trusted party certificates a particular content provided by a Content Provider.
Authentication, Authorization and Accounting (AAA)	These functionalities are needed when a user access to the VO. They are used, also, to establish the privileges of different users (learner, expert learner and so on). Single Sign On capabilities must be supported inside a VO in order to reduce the number of authentications and authorizations on the different resources
Trust Management	The emerging of new forms of collaboration, based on the concept of Virtual Organization, requires the set up of a secure environment where the controls and procedures are automated based on clear specifications of trust. Based on these motivations, trust management functionalities are required.
Digital and intellectual rights	Functionalities needed to prevent an unauthorized use of digital contents and to guarantee some rights to content developers.

Group activities to be supported by Grid services	
Activities	**Functionalities**
Communication	eMail, fora, instant messaging, chat, audio conferences, video conferences
Collaboration	Shared editing of documents
	Shared collection of structured information (databases)
	Shared structuring of knowledge (ontologies)
	Shared maintenance of knowledge (resource centres, repositories)
	Shared projects (planning of tasks, timelines resources)
	Collaborative simulations, games

Motivation

Your identification of the needed functionalities will help the other workpackages to set the priorities for the development of a Learning Grid architecture.

6 Relevant Facts and Assumptions

6a External factors that have an effect on the product or service, but are not mandated requirements constraints.

Content

Statements describing business rules, systems, activities in the world that have an effect on this service.

Motivation

Relevant facts might contribute to requirements. They will have an effect on the eventual design of the service.

Examples

The existing application is 10,000 lines of C code.

In ELeGI: The medium length of a student's essay is 1.500 words.

6b Assumptions that the team are making about the project

Content

A list of the assumptions that the developers are making. These might be about the intended operational environment, but can be about anything that has an effect on the service.

Motivation

To make people declare the assumptions that they are making. Also to make everyone on the project aware of assumptions that have been made. Implicit assumptions, e.g. about the learners, about learning models, determinate the spirit of your project more than you might imagine.

Examples

Assumptions about new laws or political decisions.

Assumptions about the technological environment in which the service will operate. These assumptions should highlight areas of expected compatibility.

The software components that will be available to the developers.

Availability and capability of bought-in components.

Dependencies on computer systems or people external to this project

In eLeGI: Assumption on learners' behavior or expectations, assumptions on the nature of the Grid.

Considerations

We often make unconscious assumptions. It is necessary to talk to the members of the project team to discover any unconscious assumptions that they have made. Ask stakeholders (both technical and business-related) questions like “What software tools are you expecting to be available, will there be any new software products, are you expecting to use a current product in a new way, are there any business changes you are assuming we will be able to deal with....?” It is important to state these assumptions up front. You might also consider the probability of whether or not the assumption is correct, and where relevant, a list of alternatives if something that is assumed does not happen.

The assumptions are intended to be transient. That is, they should all be cleared by the time the specification is released. In other words, the assumption should have become either a requirement or a constraint. For example, if the assumption was about the capability of a service that is intended to be a partner service to yours, then the capability should have been proven satisfactory, and thus it becomes a constraint to use it. On the other hand, if the bought-in service is not suitable, then it becomes a requirement for the project team to construct the needed capability.

Functional Requirements

7 The Scope of the Work

7a The context of the work

Content

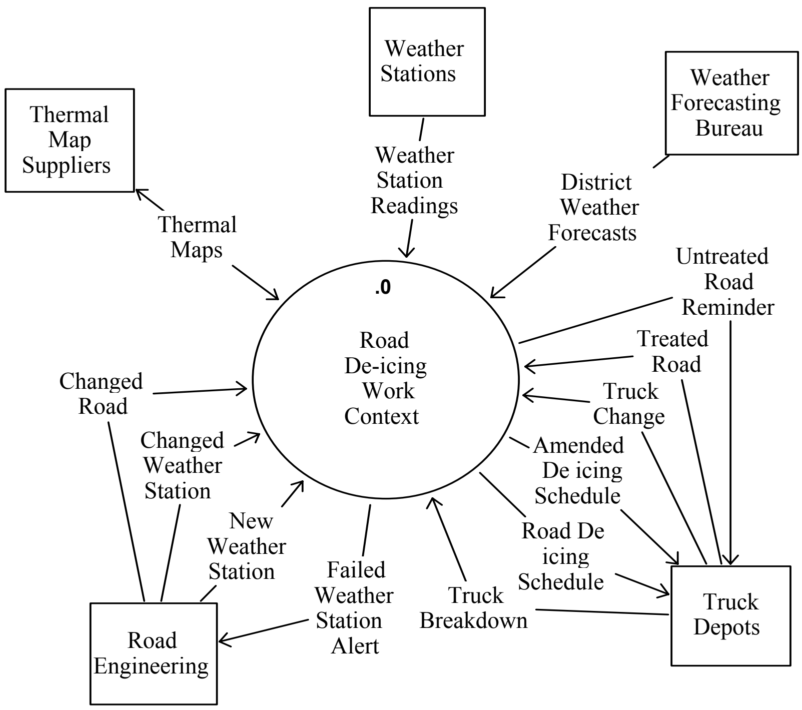
The work context diagram identifies the work that we need to investigate in order to be able to build the service. Note that this includes more than the intended service. Unless we understand the work that the service will support, there is little chance of building a service that will fit cleanly into its environment.

The adjacent systems on the example context diagram e.g. Weather Forecasting Bureau, indicate other subject matter domains (systems, people and organizations) that need to be understood. The interfaces between the adjacent systems and the work context indicate why we are interested in the adjacent system. In the case of Weather Forecasting Bureau, we can say that we are interested in the details of when, how, where, who and why they produce the District Weather Forecast information.

Motivation

To clearly define the boundaries for the work study and requirements effort. Without this definition, there is little chance of building a service that will fit seamlessly into its environment.

Examples



Considerations

The names used on the context diagram should be consistent with the SEES glossary.

7b Work partitioning

Content

An event list, identifying all the business events to which the work responds. The business events are user-defined. The response to each event represents a portion of work that contributes to the total functionality of the work.

The event list includes:

- Event Name
- Input from other systems (identical with name on context diagram)
- Output from other systems (identical with name on context diagram)
- Involved or affected actors (identical with the users defined in 3 and 5e)

Internal objects/entities that are connected to this business event. For example, both events 8 and 9 would be connected to an internal object called road. In other words there is a need within the context to remember information about roads and that information is relevant to events 8 and 9 (and many other events as well). It is this identification of common internal objects that provides a link between events.

Motivation

To identify logical chunks of the system that can be used as the basis for discovering detailed requirements. These business events also provide the subsystems that can be used as the basis for managing detailed analysis and design.

Example

Event Name	**Input & Output**	**Affected / Involved Actors**
1. Weather Station transmits reading	Weather Station Readings (in)	-
2. Weather Bureau forecasts weather	District weather Forecast (in)	Weather Forecasting Bureau
3. Road engineers advise changed roads	Changed Road (in)	Road Engineer
4. Road Engineering installs new weather station	New Weather Station (in)	Road Engineer
5. Road Engineering changes weather station	Changed Weather Station (in)	Road Engineer
6. Time to test Weather Stations	Failed Weather Station Alert (out)	Truck Depot Engineer
7. Truck Depot changes a truck	Truck Change (in) Amended De-icing Schedule (out)	Truck Depot Engineer
8. Time to detect icy roads	Road De-icing Schedule (out)	Road Engineer
9. Truck treats a road	Treated Road (in)	Truck Depot Engineer

10 Truck Depot reports problem with truck	Truck Breakdown (in) Amended Gritting Schedule (out)	Truck Depot Engineer
11. Time to monitor road gritting	Untreated Road Reminder (out)	Road Engineer

Considerations

Attempting to list the business events is a way of testing the work context. This activity uncovers uncertainty and misunderstanding about the project and helps with precise communications.

8 The Scope of the Service

8a Service Boundary

This information will be gathered with a requirements defintion tool in task 4.3 after the production of D8.

8b Use case list

This information will be gathered with a requirements defintion tool in task 4.3 after the production of D8.

9 Functional and Data Requirements

9a Functional Requirements

This information will be gathered with a requirements defintion tool in task 4.3 after the production of D8.

9b Data requirements

This information will be gathered with a requirements defintion tool in task 4.3 after the production of D8.

Non-Functional Requirements

10 Look and Feel Requirements

10a The interface

Content

The section contains requirements relating to spirit of the interface. Your client may have given you particular demands such as corporate branding, style, colors to be used, degree of interaction and so on. This section captures the requirements for the interface rather than the design for the interface.

Motivation

To ensure that the appearance of the service conforms to the organization's expectations.

Examples

"The service shall comply with corporate branding standards."

"The service shall appear authoritative."

Considerations

Interface design may overlap the requirements gathering process. This particularly true if you are using prototyping as part of your requirements process. As prototypes develop it is important to capture the requirements that relate to the look and feel. In other words, be sure that you understand your client's intentions for the service's look and feel. Record these as requirements instead of merely having a prototype to which the client has nodded his approval.

10b The style of the service

Content

A description of salient features of the service that are related to the way a potential customer will see the service. For example, if your client wants the service to appeal to the business executive, then a look and feel requirement is that the service has a conservative and professional appearance. Similarly if the service is for sale to children, then the look and feel requirement is that it be colorful and look like it's intended for children.

You would also consider here the design of the package if this were to be a manufactured service. The package may have some requirements as to its size, style, and consistency with other packages put out by your organization, etc.

The requirements that you record here will guide the designers to produce a service as envisioned by your client.

Motivation

Given the state of today's market and people's expectations, we cannot afford to build services that have an inadequate appearance. Once the functional requirements are satisfied, it is often the appearance of services that determines whether they are successful or not. Your task in this section is to determine precisely how the service shall appear to its intended consumer.

Considerations

The look and feel requirements specify the your client's vision of the service's appearance. The requirements may at first seem to be rather vague – "conservative and professional appearance" – but these will be quantified by their fit criterion. The fit criterion in this case give you the opportunity to extract from your client precisely what is meant, and gives the designer precise instructions on what he is to accomplish.

11 Usability Requirements

11a Ease of use

Content

This section describes your client's aspirations for how easy it will be for the intended users of the service to operate it. The service's usability is derived from the abilities of the expected users of the service and the complexity of its functionality.

The usability requirements should cover such things as:

Efficiency of use – how quickly or accurately the user can use the service.

Error rates – for some services it is crucial that the user commits very few, or no, errors.

Overall satisfaction in using the service – this is especially important for commercial, interactive services where there is a lot of competition. Web sites are good example of this.

These requirements normally are collected in a User Needs Analysis

Motivation

To guide the service's designers into building a service that will meet the expectations of its eventual users.

Examples

"The service shall help the user to avoid making mistakes."

"The service shall make the users want to use it."

"The service shall be used by people with no training, and possibly no understanding of English."

Fit Criterion

These examples may seem simplistic, but they do express the intention of the client. To completely specify what is meant by the requirement it is necessary to add a measurement of acceptance. We call this a fit criterion. The fit criterion for the above examples would be:

One month's use of the service shall result in a total error rate of less than [an agreed percentage, say 2%]

An anonymous survey shall show that [an agreed percentage, say 75%] of the users are regularly using the service after [an agreed time] familiarization period.

Considerations

Refer back to Section 3, the Users of the System, to ensure that you have considered the usability requirements from the perspective of all the different types of users.

It may be necessary to have special consulting sessions with your users and your client to determine whether there are any special usability considerations that must be built into the service.

11b Personalization and internationalization requirements

Content

This section describes the way in which the service can be altered or configured to take into account the user's personal preferences or choice of language.

The personalization requirements should cover such things as:

Languages, spelling preferences, language idioms

Currencies including the symbols and decimal conventions

Personal configuration options – there are a myriad of these

Motivation

To ensure that the service's users do not have to struggle with, or meekly accept, the cultural conventions of the builder.

Examples

"The service shall allow the user to select a chosen language."

Considerations

Consider the locations of the potential customers and users of your service. Any out of country users will welcome the opportunity to convert to their home spelling and expressions.

By allowing users to customize the way in which they use the service, you are giving them the opportunity to participate more closely with your organization, as well as give them their own personal user experience.

You might also consider the configurability of the service. This allows different users to have different functional variations of the service.

11c Ease of learning

Content

A statement of how easy it should be to learn to use the service. This will range from zero time for services intended for placement in the public domain (for example a parking meter or a web site) to a considerable time for complex, highly technical products. (We know of one product where it was necessary for graduate engineers to spend 18 months in training before being qualified to use the product.)

Motivation

To quantify the amount of time that your client feels is allowable before a user can successfully use the service. This requirement will guide designers in how users will learn the service. For example, the designers may build elaborate interactive help facilities into the service, or the service may be packaged with a tutorial. Alternatively the service may have to be constructed so that all of its functionality is apparent upon first encountering it.

Examples

"A clerk shall be able to be serviceive within a short time."

"The service shall be able to be used by members of the public who will receive no training before using it."

"The service shall be used by engineers who will attend 5 weeks of training before using the service."

In eLeGI: The learners should be able to use the service after one 2 hours training session.

Fit Criterion

Fit criterion for the above example requirements are:

An engineer shall produce a [specified result] within [specified time] of beginning to use the service, without needing to use the manual.

After receiving [number of hours] training a clerk shall be able to produce [quantity of specified outputs] per [unit of time].

[Agreed percentage] of a test panel shall successfully complete [specified task] within [specified time limit].

The engineers shall achieve [agreed percentage] pass rate from the final examination of the training.

Considerations

Refer back to Section 3, the Users of the System, to ensure that you have considered the ease of learning requirements from the perspective of all the different types of users and to section 5d, where the training needs during the deployment period are considered.

11d Accessibility requirements

Content

The requirements for how easy it should be for people with common disabilities to access the service. These disabilities might be to do with sight, physical disablement, hearing, cognitive, or others.

Motivation

In many countries it is required that some services are made available to the disabled. In any event, it seems self-defeating to exclude this sizable community of potential customers.

Examples

In eLeGI: Blind students should be able to use the service as well.

Considerations

There are users with disabilities other than the commonly-described ones. Similarly, there are partial disabilities that are fairly common. A simple, and not very consequential example, is that approximately 20% of males are red-green color blind.

12 Performance Requirements

12a Speed and latency requirements

Content

Specifies the amount of time available to complete specified tasks. These often refer to response times. They can also refer to the service's ability to fit into the intended environment.

Motivation

Some services, usually real-time services, must be able to perform some of their functionality within a given time slot. Failure to do so may mean catastrophic failure (for example a ground-sensing radar in an airplane fails to detect an upcoming mountain) or the service will not cope with the required volume of use (an automated ticket selling machine).

Examples

"Any interface between a user and the automated system shall have a maximum response time of 2 seconds"

"The response shall be fast enough to avoid interrupting the user's flow of thought"

In eLeGI: A complex simulation should be executed in 30 seconds.

Fit Criterion

Unit of measurement

Required range of values

Considerations

There is a wide variation in the importance of different types of speed requirements. If you are working on a missile guidance system then speed is extremely important. On the other hand, an inventory control report that is run once every 6 months has very little need for split second speed.

Customize this section of the template to give examples of the speed requirements that are important within your environment.

12b Safety critical requirements

Content

Quantification of perceived risk of possible damage to people, property and environment.

Motivation

To understand and highlight the potential damage that could occur when using the service within the expected operational environment.

Examples

In eLeGI: The service should be operational for a driving person without significant disturbance.

Fit Criterion

Description of the perceived risk

Factors that could cause the damage

Unit for measuring the factors that could cause the damage

Considerations

The sample requirements given above apply to some, but not all, services. It is not possible to give examples of every variation of safety critical requirement. To make the template work in your environment, you should customize it by adding examples that are specific to your services.

12c Precision requirements

Content

Quantification of the desired accuracy of the results produced by the service.

Motivation

To set the client and user expectations for the precision of the service.

Examples

In eLeGI: The learner needs contextualised information in a range of one kilometre to the object of interest

Fit Criterion

Unit of measure plus degree of precision

Considerations

If you have done any detailed work on definitions, then some precision requirements might be adequately defined by the *SEES glossary*.

12d Reliability and Availability requirements

Content

This section quantifies the necessary reliability of the service. This is usually expressed as the allowable time between failures, or the total allowable failure rate.

It also quantifies the expected availability of the service.

Motivation

It is critical for some services not to fail too often. This section allows you to explore the possibility of failure and to specify realistic levels of service. It also gives you the opportunity to set client and user expectations about the amount of time that the service will be available for use.

Examples

"The service shall be available for use 24 hours per day, 365 days per year."

"The service shall be available for use between the hours of 8:00am and 5:30pm."

"The service shall achieve 99% up time."

Considerations

Consider carefully whether the real requirement for your service is that it is available for use, or that it does not fail at any time.

Consider also the cost of reliability and availability, and whether it is justified for your service.

12e Robustness requirements

Content

Robustness specifies the ability of the service to continue to function under abnormal circumstances.

Motivation

To ensure that the service is able to provide some or all of its services when there is some abnormal happening in its environment.

Examples

"The service shall continue to operate in local mode whenever it loses its link to the central server."

In eLeGI: The Grid service should stay operational even with deceasing bandwidth.

Considerations

Abnormal happenings can almost be considered normal. Our services are so large and complex that there is a good chance that at any given time, one component will not be functioning correctly. Robustness requirements are intended to prevent total failure of your service.

You could also consider disaster recovery in this section.

12f Capacity requirements

Content

This section specifies the volumes that the service must be able to deal with and the numbers of data stored by the service.

Motivation

To ensure that the service is capable of processing the expected volumes.

Examples

“The service shall cater for 300 simultaneous learners within the period from 9:00am to 11:am. Maximum loading at other periods will be 150.”

Fit Criterion

In this case, the requirement description is quantified, and thus can be tested.

12g Scalability or extensibility requirements

Content

This specifies the expected increases in size that the service must be able to handle. As business grow (or are expected to grow) our software products must increase their capacities to cope with the new volumes.

Motivation

To ensure that the designers allow for future capacities.

Examples

“The service shall be able to process 50,000 transactions an hour within two years of its launch.”

13 Operational Requirements

13a Expected physical environment

Content

This section specifies the physical environment in which the service will operate.

Motivation

To highlight conditions that might need special requirements, preparations or training. These requirements ensure that the service is fit to be used in its intended environment.

Examples

“The service shall be usable in a temperature range from –10 to +45 degrees Celsius.”

Considerations

Is the service to operate in some unusual environment? Does this lead to special requirements? Also see section 11 - Usability.

13b Expected technological environment

Content

Specification of the hardware and other devices that make up the operating environment for the new system.

Motivation

To identify all the components of the new system so that the acquisition, installation and testing can be effectively managed.

Examples

"The service has to run on X, Y, Z mobile devices"

Considerations

Describe the hardware and other devices that make up the operating environment for the new system. This may not be known at the time of the requirements process, as these devices may be decided at design time.

It may be that the operating environment is complex, and becomes a subject of requirements study itself.

Special considerations should also be given if the service is to be embedded in a device.

If the expected operating environment is the same or similar to the current one, then this might be adequately covered in section 4b - Implementation Environment of the Current System.

13c Partner applications

Content

Description of other applications that the service must interface with.

Motivation

Requirements for interfacing to other applications often remain undiscovered until implementation time. Avoid a high degree of rework by discovering these requirements early.

Examples

"We must be able to interface with any html browser."

In eLeGI: The system must cooperate with the existing University mail servers.

Fit Criterion

For each inter-application interface specify:

The data content

The physical material content

The medium that carries the interface

The frequency

The volume

13d Productization Requirements

Content

Any requirements that are necessary to make the service into a distributable or saleable item. It is also appropriate to describe here the operations to be performed to have a software product successfully installed.

Motivation

To ensure that if work has to be done to get the service out the door, then it becomes part of the requirements.

Examples

"The service shall be able to be installed by an untrained user without recourse to separately-printed instructions."

"The product shall be of a size that it can fit onto one CD."

Considerations

Some services have special needs to turn them into a saleable, or usable service. You might consider that the service has to be protected such that only paid-up customers can access it. This might be implemented as a dongle, a daily keyword.

Most commercial services have some needs in this area.

14 Maintainability and Support Requirements

14a How easy must it be to maintain this service?

Content

A quantification of the time necessary to make specified changes to the service.

Motivation

To make everyone aware of the maintenance needs of the service.

Examples

In eLeGI: A new content module must be ready within two weeks

Considerations

There may be special requirements for maintainability, such as this service must be able to be maintained by its end-users, or developers who are not the original developers. This has an effect on the way that the service is developed, and there may be additional requirements for documentation or training.

You might also consider writing testability requirements in this section.

14b Are there special conditions that apply to the maintenance of this service?

Content

Specification of the intended release cycle for the service and the form that the release will take.

Motivation

To make everyone aware of how often it is intended to produce new releases of the service.

Examples

"The maintenance releases will be offered to end-users once a year."

"Every registered user will have access to our help site via the Internet."

Fit Criterion

Description of type of maintenance + amount of effort budgeted

Considerations

Do you have any existing contractual commitments or maintenance agreements that might be affected by the new system?

14c Supportability

Content

This specifies the level of support that the service requires. This is often done using a help desk. If there are to be people who provide support for the service, is that considered part of the service and are there any requirements for that support. You might also build support into the service itself, in which case this is the place to write those requirements.

Motivation

To ensure that the support aspect of the service is adequately specified.

Considerations

Consider the anticipated level of support, and what forms it might take. For example, there may be a constraint that there is to be no printed manual. Or you might consider that the service is to be entirely self-supporting.

14d Portability requirements

Content

Description of other platforms or environments to which the service must be ported.

Motivation

To quantify client and user expectations about the platforms on which the service will be able to run.

Examples

“The service is expected to run under Windows XP and Linux”

Fit Criterion

Specification of system software on which the service must operate.

Specification of future environments in which the service is expected to operate.

Time allowed to make the transition.

Considerations

Ask questions from your marketing department to discover unstated assumptions that have been made about the portability of the service.

15 Security Requirements

15a Access requirements

Content

Specification of who has authorized access to the service, and under what circumstances that access is granted, and to what parts of the service access is allowed.

Motivation

To understand the expectations for confidentiality aspects of the system.

Examples

“Only cours managers can see the learners' records.”

“Only holders of current security clearance can enter the building.”

In eLeGI: Only the learners in the same group can see the ongoing virtual discussion, Only lesrner X can use services Y, Z.

Fit Criterion

System function name or system data name

User role/s and/or names of people who have clearance

Considerations

Is there any data that is sensitive to the management? Is there any data that low-level users do not want management to have access to? Are there any processes that might cause damage or might be used for personal gain? Are there any people who should not have access to the system?

15b Integrity requirements

Content

Specification of the required integrity of databases and other files, and of the service itself.

Motivation

To understand the expectations for the integrity of the system's data. To specify what the service will do to insure its integrity in the case of an unwanted happening such as attack from the outside of unintentional misuse by an authorized user.

Examples

"The service shall prevent its data from incorrect data being introduced."

"The service shall protect itself from intentional abuse."

Considerations

Organizations rely more and more on their stored data. If this data should be come corrupt or incorrect, or indeed disappear, then it could be fatal. For example, it is true that almost half of small businesses go bankrupt after a fire destroys their computer systems. Integrity requirements are aimed at preventing complete loss, as well as corruption, of data and processes.

15c Privacy requirements

Content

Specification of what the service has to do to insure the privacy of individuals that it stores information about. The service must also ensure that all laws about privacy of individual's data are observed.

Motivation

To ensure that the service complies with the law, and to protect the individual privacy of your customers. Few people today look kindly on organizations that do not observe their privacy.

Examples

"The service shall make its user aware of its information practices before collection data from them."

"The service shall notify customers of changes to its information policy."

"The service shall protect private information in accordance with relevant privacy laws / the organization's information policy."

Considerations

Privacy may well have legal implications, and you are advised to consult with your organization's legal department about the requirements to be written in this section.

Consider what notices are required to be issued to your customers before collecting personal information. This can go so far as to warn them if you intend to put a cookie in their computer. Also, do you have to do anything to keep the customer aware that you hold personal information?

The customer must always be in a position to give or withhold consent when private data is collected or stored. Similarly, the customer should be able to view any private data, and where appropriate, ask for correction of the data.

Also consider the integrity and security of private data. A common example of this is the storage of credit card information.

15d Audit requirements

Content

Specification of what the service has to do (usually retain records) to permit the required audit checks.

Motivation

To build a system that complies with the appropriate audit rules.

Considerations

This section may have legal implications. You are advised to seek the approval of your organization's auditors for what you write here.

You should also consider whether the service should retain information on who has used it. The intention is to provide security in the form that a user may not later deny having used the service, or participated in some form of transaction using the service.

15e Immunity requirements

Content

The requirements for what the service has to do to protect itself from infection by unauthorized or undesirable software programs, such as viruses, worms, Trojan horses and others.

Motivation

To build a service that is as secure as possible from malicious interference.

Considerations

Each day brings more malevolence from the unknown, outside world. People buying software, or any other kind of service, expect that it can protect itself from outside interference,

16 Cultural and Political Requirements

16a Are there any special factors about the service that would make it unacceptable for some political reason?

Content

This section contains requirements that are specific to the sociological and political factors that affect the acceptability of the service. If you are developing a service for foreign markets then these requirements are particularly relevant.

Motivation

To bring out in the open requirements that are difficult to discover because they are outside the cultural experience of the developers.

In the case of political requirements the requirements sometimes appear irrational.

Examples

"The service shall not be offensive to religious and ethnic groups."

"The service shall be able to distinguish between Greek and American curricula."

Considerations

Question whether the service is intended for a culture other than the one with which you are familiar. Ask whether people in other countries or in other types of organizations will use the service. Do these people have different habits, holidays, superstitions, cultural norms that do not apply to your own culture?

Whether you agree with these political requirements has little bearing on the outcome. The reality is that the system has to comply with political requirements even if you can find a better/more efficient/more economical solution. A few probing questions here may save some heartache later.

17 Legal Requirements

17a Does the system fall under the jurisdiction of any law ?

Content

A statement specifying the legal requirements for this system..

Motivation

To comply with the law so as to avoid later delays, law suits and legal fees.

Examples

"The service has to be compliant with the state curriculum."

Fit Criterion

Lawyers' opinion that the service does not break any laws.

Considerations

Are there any copyrights that must be protected? Alternatively, do any competitors have copyrights that you might be in danger of infringing?

Is there any pending legislation that might affect the development of this system?

17b Are there any standards with which we must comply ?

Content

A statement specifying applicable standards and referencing detailed standards descriptions.

Motivation

To comply with standards so as to avoid later delays.

Example

"The service shall comply with SCORM, Grid standards."

Fit Criterion

The appropriate standard-keeper that the standard has been adhered to.

Considerations

It is not always apparent that there are applicable standards because their existence is often taken for granted.

Are there any special development steps for this type of service?

Project Issues

18 Open Issues

18a Issues that have been raised and do not yet have a conclusion.

Content

A statement of factors that are uncertain and might make significant difference to the service.

Motivation

To bring uncertainty out in the open and provide objective input to risk analysis.

Examples

“Our investigation into whether or not the new version of the processor will be suitable for our application is not yet complete.”

“The government are planning to change the rules for regional development funding.”

Considerations

Are there any issues that have come up from the requirements gathering that have not yet been resolved? Have you heard of any changes that might occur in the other organizations/systems on your context diagram? Are there any legislative changes that might affect your system? Any rumors about your hardware/software suppliers that might have an impact?

19 Off-the-Shelf Solutions

19a Is there a ready-made system that could be bought?

Content

List of existing services that should be investigated as potential solutions. Reference any surveys that have been done on these services.

Motivation

To give consideration to whether or not a solution can be bought.

Considerations

Is it possible to buy something that already exists or is about to become available? It may not be possible at this stage to say with a lot of confidence, but any likely services should be listed here.

Also consider whether there are products/services that must not be used.

19b Can ready-made components be used for this service?

Content

Description of the candidate components, either bought-in or built by your company, that could be used by this project.

Motivation

Reuse rather than reinvention.

19c Is there something that we could copy?

Content

List of other similar systems.

Motivation

Reuse rather than reinvention.

Examples

In eLeGI: Another learning system supplier has built a new LMS. Their requirements are different from ours but we could buy their specification and cut our analysis effort by approximately 60%."

Considerations

While a ready-made solution may not exist, there may well be something that, in its essence, is similar enough that you could copy, and possibly modify, to better effect that starting from scratch. This is dangerous because it relies on the base system being of good quality.

This question should always be answered. The act of answering will force you to look at other existing solutions to similar problems.

20 New Problems

20a What problems could the new system cause in the current environment?

Content

A description of how the new system will affect the current implementation environment. This section should also cover things that the new service should *not* do.

Motivation

The intention is to discover early any potential conflicts that might otherwise not be realized until implementation time.

Examples

In eLeGI: The learning system you are going to implement in ELeGI may conflict with well established system already in place.

Considerations

Is it possible that the new system will damage some already existing system? Can people be displaced, or affected by the new system?

This requires a study of the current environment. A model highlighting the effects of the change is a good way to make this information widely understandable.

20b Will the new development affect any of the installed system?

Content

Specification of the interfaces between new and existing systems.

Motivation

Very rarely is a new development intended to stand completely alone. Usually there is some existing system that the new one must coexist with. This question forces you to look carefully at the existing system and examine it for potential conflicts with the new development.

20c Will any of our existing users be adversely affected by the new development?

Content

Details of any adverse reaction that might be suffered by existing users

Motivation

Sometimes existing users are using a service in such a way that they will suffer ill effects from the new system/feature. Identify any likely adverse user reaction, determine whether we care and what precautions we will take.

20d What limitations exist in the anticipated implementation environment that may inhibit the new system?

Content

Statement of any potential problems with the new automated technology or new ways of structuring the organization.

Motivation

The intention is to make early discovery of any potential conflicts that might otherwise not be realized until implementation time.

Examples

The planned data line is not powerful enough to cope with our projected growth data transfer volume.

Considerations

This requires a study of the intended implementation environment.

20e Will the new system create other problems?

Content

Identification of situations that we might not be able to cope with.

Motivation

To guard against situations where the service might fail.

Considerations

Will we create a demand for our service that we are not able to give? Will the new system cause us to fall foul of laws that do not currently apply? Will the existing hardware cope?

There are potentially hundreds of unwanted effects. It pays to answer this question very carefully.

21 Tasks

21a What steps have to be taken to deliver the system?

Content

Details of the life cycle and approach that will be used to deliver the service. A high level process diagram showing the tasks and interfaces between them is a good way to communicate this information.

Motivation

To specify the approach that will be taken to deliver the service so that everyone has the same expectations.

This is related to the deployment of the software components for the SEES. The tasks for the whole SEES development are shaped in 5e.

Considerations

Depending on the level of maturity of your process, the new service will be developed using your standard approach. However, there are some circumstances that are special to a particular service and will necessitate changes to your lifecycle. While these are not a service requirement, they are needed if the service is to be successfully developed.

If possible, attach an estimate of the time and resources need for each task based on the requirements that you have specified. Tag your estimates to the events/use cases/functions that you specified in sections 8 and 9.

Do not forget data conversion, user training and cutover. We have listed these because they are usually ignored when projects set implementation dates.

21b Development phases

Content

Specification of each phase of development and the components in the operating environment.

Motivation

To identify the phases necessary to implement the operating environment for the new system so that the implementation can be managed.

Fit Criterion

Name of the phase

Required operational date

Operating environment components included

Functional requirements included

Non-functional requirements included

Considerations

Identify which hardware and other devices are necessary for each phase of the new system. This may not be known at the time of the requirements process, as these devices may be decided at design time.

22 Cutover

22a What special requirements do we have to get the existing data, and procedures to work for the new system?

Content

A list of the Cutover activities. Timetable for implementation.

Motivation

To identify cutover tasks as input to the project planning process.

Considerations

Will you be using phased implementation to install the new system? If so, describe the requirements that will be implemented by each of the major phases.

What data conversion has to be done? Are there special programs to be written to transport data from an existing system to the new one? If so, the requirements for this program(s) are to be described here.

What manual backup is needed while the new system is installed?

When are each of the major components to be put in place, when are phases of the implementation to be released?

This section is the timetable for implementation of the new system.

22b What data has to be modified/translated for the new system?

Content

List of data translation tasks.

Motivation

To discover missing tasks that will affect the size and boundaries of the project.

Fit Criterion

Description of the current technology that holds the data

Description of the new technology that will hold the data

Description of the data translation task/s

Foreseeable problems

Considerations

Every time you make an addition to your dictionary (see *SEES glossary*) ask the question "What are all the places that this data is currently held and will the new system affect that implementation?".

23 Risks

All projects involve risk. By this we mean the risk that something will go wrong. Risk is not necessarily a bad thing, as no progress is made without taking some risk. However, there is a difference between unmanaged risk – say shooting dice at a craps table – and managed risk where the probabilities are well understood, and contingencies made. Risk is only a bad thing if the risks are ignored and they become problems. Risk management is assessing which risks are most likely to apply to the project, deciding a course of action if they become problems, and monitoring projects to give early warnings of risks becoming problems.

This section of your specification should contain a list of the most likely and the most serious risks for your project. Against each risk include the probability of that risk becoming a problem. Capers Jones' book *Assessment and Control of Software Risks*. Prentice-Hall, Englewood Cliffs, NJ. 1994 gives comprehensive lists of risks and their probabilities, you can use these as a starting point. For example, Jones cites the following risks as being the most serious:

- Inaccurate metrics
- Inadequate measurement
- Excessive schedule pressure
- Management malpractice
- Inaccurate cost estimating
- Silver bullet syndrome
- Creeping user requirements
- Low quality
- Low productivity

• Cancelled projects

It is also useful input to project management if you include the impact on the schedule, or the cost, if the risk does become a problem.

24 Costs

The other cost of requirements is the amount of money or effort that you have to spend building them into a service. Once the requirements specification is complete, you can use one of the estimating methods to assess the cost, and express this in a monetary amount or time to build.

There is no best method to use when estimating. However your estimates should be based on some tangible, countable, artifact. If you are using this template then, as a result of doing the work of requirements specification, you are producing many measurable deliverables.

Software related:

- Number of input and output flows on the work context
- Number of business events
- Number of service use cases
- Number of functional requirements
- Number of non-functional requirements
- Number of requirements constraints
- Number of function points

Service related:

- Number of users
- Number of tutors
- Learning hours per user
- Number of available learning objects
- ...

The more detailed work you do on your requirements the more accurate will be your deliverables. Your cost estimate is the amount of resources you estimate each type of deliverable will take to produce within your environment. You can do some very early cost estimates based on the work context. At that stage, your knowledge of the work will be general and you should reflect this by making the cost estimate a range rather than one figure.

As you get more knowledge about the requirements we suggest you try using function point counting – not because it is an inherently superior method - but because it is so commonly accepted. So much is known about it, that it is possible to make easy comparisons with other services, and other installations' productivity.

It is important that your client knows at this stage what the service is likely to cost. You usually express this as a total cost to complete the service, but you may also find it advantageous to be able to point out the cost of individual requirements.

Whatever you do, do not leave the costs in the lap of hysterical optimism. Make sure that this section includes meaningful numbers based on tangible deliverables.

25 User Documentation

25a The plan for building the user documentation

Content

List of the user documentation that will be supplied as part of the system.

Motivation

To set expectations for the documentation and to identify who will be responsible for creating it.

Considerations

What level of documentation is expected? Will the users be involved in the production of the documentation? Who will be responsible for keeping the documentation up to date? What form will the documentation take?

B) Topics and Questions for the Organisational and Pedagogical Feasibility Analysis

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1 Organisational and pedagogical feasibility

1.1 Motivation

Recognition of added value: is the added value of the learning scenario obvious?

Pedagogical effectiveness: will learners learn what they need?

Innovation: is the learning scenario innovative?

Empowerment: does learning contribute to empowerment?

1.2 Organisational and pedagogical analysis

1.2.1 Learner/user-centred aspects of interest

Motivation: how will motivation for users/learners be provided?

Emotional aspects: how will the emotional effects from the learning activity/experience be understood and taken into account?

Knowledge: how will individual knowledge be taken into account?

Subject competences:

How will subject competences be identified, evaluated/assessed?

- Learners
- Teacher/author
- Mentor/tutor/teacher

Previous knowledge:

How will previous knowledge (self-)assessment be provided?

Which strategies are foreseen to overcome existing knowledge gaps?

Key qualifications:

How will key qualifications/competences on the learners' side be assessed/identified, integrated and improved?

- Communication
- Self-management skills
- Team-work skills
- ICT skills

1.2.2 Learning environment

Technique and Delivery:

- Which technology-based procedures will be adopted in order to give access to the different resources?
- Which technology solutions for providing individual and group support are foreseen?
- Will the delivery platform be appropriate for the pedagogical model envisaged?
- Can the platform and tools be used by all users?
- Which technology-based measures will be adopted for monitoring and rectifying common technical problems?

Content (in most cases not specified):

- Content according to learners' needs? Adaptation of the learning materials into learners' profile possible, foreseen?
- Content according to the learning setting/media?
- Content according to the envisaged learning model?
- Is the pedagogic model (e.g. simulation) appropriate for the learner profile?
- Content according to the teaching subject?
- Transferability or integration of the learning content into the outside world?

Organisational:

Previous knowledge: recognition, enquiry, level differences in-between learners

- How will previous knowledge be integrated in the learning environment?

Learning targets: clear definition of the learning targets?

Target group:

- Are the characteristics of the target group well taken into account and well integrated into the learning environment?
- Are learning needs like support, guidance or construction of individual learning paths taken into account?
- Which strategy will be followed to integrate heterogeneous learner/user profiles into the learning environment?

Pacing and timing: are there defined schedules and timelines for the different users and do they fit into the learner/user profile?

Roles definitions: are the roles of the different actors clearly defined?

Interaction: have the processes among the different actors been defined?

Technical resources: have the technical resources been identified and integrated?

Support:

Learner/user support:

- Have effective and appropriate tutoring and support systems been foreseen?
- Is there a provision for the technical and pedagogical support of all other actors?

Social support:

- Are there mechanisms to promote group cohesiveness? and to support 'lonely learners'?
- Are there available systems and services to support communication and collaboration among learners/users and staff/other users?

Skills:

- As training provided for all users/learners in order to use the new technology?

Resources:

- are there resources available to support learning?

Evaluation

- Has the implementation of an **evaluation process** been foreseen? Which aspects of the learning scenario will be evaluated?
- How will the evaluation results be transferred into teaching/learning/management practice?

C) Definitions, Acronyms and Abbreviations

Author(s)/Responsible:	KTU

1 Objective and Technology

The aim of glossary is to facilitate discussions and understanding among WP4 partners by developing portal (or virtual space) for sharing terms and definitions along with their interpretation. The scope of this glossary is only definitions used in WP4. At the WP4 meeting in Stuttgart (Apr. 26-27, 2004) the Pmichoud.com tool Wiki has been offered to support collaborative authoring and maintenance for glossary document system. The Wiki tool will let WP4 partners interactively edit existing and to add new definitions.

A wiki is a server program that allows users to collaborate in forming the content of a Web site. With a wiki, any user can edit the site content, including other users' contributions, using a regular Web browser. Basically, a wiki Web site operates on a principle of collaborative trust. [www.whatis.com].

We have chosen PmWiki as a base for ELeGI-WP4 wiki page. This WikiWikiWeb system is developed in the PHP scripting language. The software is freely available under GNU Public License and may be downloaded from http://www.pmichaud.com/pub/pmwiki. This site is running pmwiki-0.6.16.

Features of PmWiki include:

- Easy installation, maintenance, setup, and upgrades.
- Pages can be edited by any standard web browser - just click the "Edit Page" link on any page.
- Simple and powerful Text Formatting Rules.
- Automatic linking between pages, including WikiWord links and free links.
- Password-protect pages to restrict viewing or editing.
- Ability to organize pages into WikiGroups, with headers and access controls shared among the pages in the group.
- Tracking of page revisions, with ability to easily recall and restore previous versions of a page.
- And more…

The Pm-Wiki kernel to support and maintain E-LeGI WP4 glossary has been installed at Kaunas University of Technology. The page can be found at address: http://pilis.if.ktu.lt/tt/wiki. The original PmWiki interface was changed a little in order to meet our needs. The main goal was to make user interface very clear and as simple as possible. So we just added some new menu items for common glossary and left some the most important menu items with information about text editing rules and PmWiki itself.

Simple scenario, how to add new term into ELeGI-WP4 wiki page:

- Choose *CommonGlossary* from the main menu.
- Push *EditPage* link in the upper right corner of page or at the bottom of the page.
- In the editable area add new line with term you want to enter. The syntax of the line:

***{{ term }}.** * - for bullet lists; {{}} - for a free link. If other text formatting needed, you can find some tips at the bottom of page or choose *TextFormattingRules* from the main menu.

- Press *Save* button.
- Return to Common Glossary page, press the question-mark (it is hyperlink) by the term you just entered and add description about the term. The question-mark means, that definition has no description yet. When you add description, the question-mark will disappear and the term itself will be hyperlinked.

2 The content of the glossary

At the first stage an initial content has been uploaded. It covered terms and definitions being used by WP4 partners in their SEES Requirements Specifications and global terms concerning WP4 from ELeGI project annex. Later we tried to harmonize the concepts within all SEES by discussing them between partners.

All the definitions first of all are taken from the SEES specifications. If meanings for the same definition are different then several variants are listed. Also some more precise descriptions of definition can be taken from other sources listing the source it was taken from. Then for some terms will appear commonly accepted definition suggested, for instance, by Standardization bodies.

The Glossary portal is open for all project partners. The user interface of wiki page is quite simple and clear, so every partner can write his opinion about various questions concerning concrete definition.

SEES specification examination is carried out regularly, trying to find all the new definitions. All new terms found are written into common glossary on wiki page. If some definitions are different within SEES specifications, then the term must be discussed between partners trying to find commonly acceptable meaning for that term.

3 Glossary Content up to date August. 2004

AC: Activity.

Each action line contains one or more Activities.

AL: Action Line.

Major themes corresponding directly to the objectives of the project.

Application sharing.

A software (or feature of a teleconferencing application) that enables the participants of a teleconference to simultaneously run the same application. The application itself resides on only one of the participants sites and can be controlled by anyone (one at a time). [www.webopedia.com]

CBT:Computer-based Training.

The learning process is based on the execution of a special program (tutorial, instructional multimedia…) on a computer. The learner learns by dialoguing with this software (answering questions, making decisions, moving in a scenario, etc.), it can include more or less multimedia elements.

Chat.

Synchronous text-based communication between 2 or more participants who exchange messages by typing them on their computer. It is based on Internet and used in the framework of a teleconference.

Client.

The person or organization for which the service is being built, usually responsible for paying for the development of the service.

CMC:Computer Mediated Communication.

Communication based on the computers features (emission, reception, storage and routing of messages). CMC includes information retrieval, e-mail and computer conferencing.

CMI:Computer Managed Instruction.

Software for the management of a CBT environment: users administration, evaluation, results tracking, resources management, etc.

Collaborative learning.

Collaborative learning, cooperative learning, social learning, project related learning.

Definition: Active collaboration/cooperation with other students, teachers, tutors, experts or, in general, available human actors, by using different kinds of collaboration technologies.

Comment: The role of collaboration in the respective learning domain has to be defined. The right balance of instructional parts, individual learning and collaboration for the specific domain has to be considered. The individual needs for collaboration and non-collaboration have to be respected. The appropriate balance of synchronous and asynchronous collaboration has to be found. The collaboration tools have to be easy to use and adapted to the learning objective and domain. The 'lightest' tool with respect to a given objective should be chosen. In project related learning, a group of learners is engaged in the same project. Learning goal may be in the cooperation process or in the outcome.

Comment: A pedagogical situation in which the learning process is based on the communication between learners. In Distance Learning, collaboration between learners and between teacher(s) and learner(s) implies the use of networked software to interact together with the same object.

Constructivist learning.

Definition: The key feature of a constructivist learning environment is that the student is in charge of constructing and testing his or her own understanding.

Comment: The goal of constructivist instruction is to aid the student in gaining the capability to ask relevant questions, to generate authentic contexts for the use of the knowledge to guide the interpretation of the information, to test his or her views against alternative views, and to become aware of the knowledge construction process. The learner is enabled to integrate new knowledge into existing knowledge structures or to adapt existing structures in the light of new information. She/he is supported in assimilation/accommodation processes. She/he gets feedback from human (peers, tutors, actors) and non-human actors and has access to tools which foster autonomous structuring. The system allows self-assessment. The same concept may be applicable to virtual communities.

Context of the Service.

The boundaries between the service that we intend to build and the people, organizations, other services and pieces of technology that have a direct interface with the service.

Context of the Work.

The subject matter, people and organizations that might have an impact on the requirements for the service. The context of study identifies the intersection of all the domains of interest.

Contextualised learning.

Contextualised, adaptive, situated learning.

Definition:

a) The learning content is adapted to the learners‘ context of practice.

b) Changes in the learners' context influence the learning offer.

Comment:

a) The learning content is adapted to the learners‘ context of practice. The learner recognises the relevance learning offer for problems encountered in her/his work/life context. The learner is stimulated to solve real life problems with the new knowledge. Feedback is provided about the degree of success of transfer efforts.

b) the learning system is context sensitive.

CSCW:Computer Supported Collaborative Work.

It is a field of research that examines how technology affects group interaction, and how technology can be improved to facilitate this type of group work.

Customer.

The person or organization who will buy the service (note that the same person/organization might play both the client, customer and sometimes user roles).

Design or Systems Design.

Crafting a solution to fit the requirements.

Developers.

The people who specify and build the service.

Distributed resources.

Location-transparent, coordinated access to distributed resources, e.g. data, services or physical resources with single sign-on.

Domain of Interest.

A subject matter area that has some relevance to the context of study.

eAssessment.

Marking student answers to free form, short essay questions.

e_Learning.

Synonyms: Web-based learning, and distance learning, Internet learning, networked learning, virtual learning, computer-assisted learning, distributed learning.

The use of the Internet to access learning materials, to interact with the content, instructor, and other learners and to obtain support during the learning process, in order to acquire knowledge, to construct personal meaning, and to grow from the learning experience.

Source: M. Ally Foundations of Educational Theory for Online Learning. The book “Theory and Practice of Online Learning Ed. T. Anderson & F. Elloumi

e-Qualification.

To designate the successive construction of knowledge from an initial state of knowledge to an expert knowledge state through several reviewed states.

Event.

We use the term business event to mean a business related happening within a system adjacent to the work that we are studying. The happening causes the work to produce an event-response.

Experiential learning.

Experiential learning, active learning, Problem based learning.

Definition: Experiential learning involves a, 'direct encounter' with the phenomena being studied rather than merely thinking about the encounter, or only considering the possibility of doing something about it. In PBL the curriculum consists of carefully selected and designed problems that demand from the learner acquisition of critical knowledge, problem solving proficiency, self-directed learning strategies, and team participation skills.

Comments: A relevant, stimulating field of experience/ problem is provided to the learner which allows the derivation of respective relevant rules and assumptions. The assumptions can be tested against reality in order to confirm or to falsificate the assumptions. This calls for manipulation and control of the experimental field/interactivity. The rules' derivation process has to be accompanied. The validity of assumptions has to be proven in predictions and transfer to reality tasks.

Fit Criterion.

Objective measure for defining the meaning of a requirement, and eventually testing whether a given solution satisfies the original requirement.

Functional Requirement.

An action that the service must be able to take, something that the service must do. Fundamental subject matter of the system and are measured by concrete means like data values, decision making logic and algorithms.

Global Constraint.

Constraints that apply to the system as a whole.

Grid.

The Grid was originally designed for e-Science and was primarily concerned with supercomputing applications, but the framework it engendered to realize effective sharing of distributed heterogeneous resources (OGSA: the Open Grid Services Architecture) is now being applied to many other areas, especially enterprise computing and e-Commerce. Reciprocally, by progressing Grid technologies for learning, we will also contribute towards the advancement of the open Grid service model itself. We see the use of the Grid to support a paradigm shift in pedagogy to advance effective learning as a natural step in the recent historical progress of technology enhanced learning: Internet -> Web -> Grid.

LCMS: Learning Content Management System.

Used to author, approve, publish, and manage learning objects; combines the administrative and management dimensions of a traditional Learning Management System (LMS), such as Plateau® , with the content creation and personalized assembly mechanisms of a Course Management System (CMS), such as WebCT® . In an LCMS, libraries of LOs can be used either independently, or as a part of larger instruction sets allowing one LO to many courses, and to many learners. The LCMS enables the separation of content from presentation.

Learning.

The acquisition of knowledge or skill acquired by experience, instruction, or studying information which results in new or improved skills, knowledge, behaviors, and/or attitudes.

LO: Learning Object.

A "learning object" is "any digital resource that can be reused to mediate learning." (Wiley & Edwards, 2002) For example, a text document, Flash file, Web site, or video could be a learning object.

Mass calculation.

Providing high computing power by distributed calculation, e.g. for complex simulations or visualizations.

MUD:Multiple-User Dialogue.

A virtual space where users can have real-time interaction with one another (in the form of avatars). Chat is the usual communication medium. The participants are communicating by sharing the same context and the main utilization is for social role-playing.

Non-Functional Requirement.

Behavioral property that the specified function or service must have, such as performance, usability, etc. Non-functional requirements can be assigned a specific measurement. This template will give examples of quantifying non-functional requirements.

ODL:Open and Distance Learning.

Learning processed without the physical presence of the participants together (trainers and learners) and following flexible modalities (in term of location, time, rhythm, methods, etc.) to facilitate its accessibility.

OGSA: Open Grid Services Architecture.

OGSA enables the integration of services and resources across distributed, heterogeneous, dynamic environments and communities. To achieve this integration, the OGSA model adopts the Web Services Description Language (WSDL) and defines the Grid service concept.

OGSI: Open Grid Services Infrastructure.

The Open Grid Services Infrastructure specification version 1.0 (OGSI), released in July 2003, defines a set of conventions and extensions on the use of Web Service Definition Language and XML Schema to enable stateful Web services.

Peer-to-peer.

Resource sharing and communication between devices without the involvement of a central server, e.g. for virtual conferences, group simulations, shared editing or file sharing.

Personalised learning.

Personalised, individualised learning.

Definition: Each student is seen as an individual, with individual goals, aims and aptitudes.

Comment: The learning systems supports the learners' individuality. The learner has the option to choose her/his adapted learning path. The learning support is individualised, the learning technology is adapted to the learners' specific needs. The degrees of freedom are adapted to the learners' eLearning history and experience.

Project constraints.

Identify how the eventual product or service must fit into the world. For example it might have to interface with or use some existing hardware, software or business practice, or it might have to fit within a defined budget or be ready by a defined date.

Project drivers.

Business-related forces. For example the purpose of the service is a project driver, as are all of the stakeholders – each for different reasons.

Project issues.

Conditions under which the project will be done. These are included in the requirements specification to present a coherent picture of all the factors that contribute to the success or failure of the project.

Requirement.

A measurable statement of intent about something that the service must do, or a property that the service must have, or a constraint on the system.

SEES: Service Elicitation and Exploitation Scenario.

The purpose of the SEES is to develop and gain insight into the processes involved from formulating pedagogic requirements to the implementing environments that meet these requirements.

Service.

This is what we are attempting to deliver. (not appropriate, can only be understood in the context of the guidelines, more to come from LIRMM).

That's what computer and software manufacturers, and third-party service companies, offer to customers. [www.webopedia.com]

Stakeholder.

A stakeholder is a person who can affect the outcome/success of the project and/or is affected by its outcome/success.

SWOT: (Strehgths, Weaknesses, Opportunities, Threads).

A very effective way of identifying your Strengths and Weaknesses, and of examining the Opportunities and Threats you face. Carrying out an analysis using the SWOT framework helps you to focus your activities into areas where you are strong and where the greatest opportunities lie.

System.

The business system whose requirements are being studied.

Systems Analysis.

Detailed study of the requirements, intended to prove their workability as input to systems design.

Ubiquity and accessibility.

Definition: Wider, more flexible access to educational resources, often referred to as learning "anytime/anywhere" for everyone.

Comment: The learning system should be scalable to mobility conditions, in terms of content, bandwidth, devices, communication. Specific devices for disabled. Not a specific pedagogical approach. Interesting in combination with contextualized learning.

Use Case.

We use the term event-driven use case (or service use case) to mean a user-defined (or actor defined) piece of activity within the context of the service.

A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. The use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal. [www.whatis.com]

User or End User.

Someone who has some kind of direct interface with the service.

Virtual classroom.

A Distance Learning pedagogical situation in which a lesson is diffused to a group of learners not physically together with communication based on audio, video or computer tools. It tends to reproduce the traditional classroom.

VO: Virtual Organisation.

A virtual organization is a network of organizations and/or individuals, with a commonality of purpose or interest, which collectively makes up an identifiable, coherent, entity.

VOLERE.

Volere is a collection of resources for the elicitation and specification of requirements. This combination of experience, in many industries and a wide range of academic research, provides the basis for you to improve your requirements specifications.

Volere requirements specification template is used as a basis for your specifications. The template provides sections for each of the requirements types appropriate to today's software systems.

Whiteboard.

A software (or feature of a teleconferencing application) that enables the participants to work together on a common area of the display (writing, drawing and pointing).

WP: Work Package.

Each Activity is divided in one or more Work Packages (WP).

Web Service.

Web services (sometimes called application services) are services (usually including some combination of programming and data, but possibly including human resources as well) that are made available from a business's Web server for Web users or other Web-connected programs. Web services range from such major services as storage management and customer relationship management (CRM) down to much more limited services such as the furnishing of a stock quote and the checking of bids for an auction item.