EIE · SURVEYOR

reference point for

Electrical and Information Engineering in Europe

QUALITY and ACCREDITATION
in Europe:
implication in
ELECTRICAL and
INFORMATION ENGINEERING

EAEEIE   Nancy-Université *Université Henri Poincaré*   Directorate-General for **Education and Culture**   Tuning *Educational Structures in Europe*   techno TN *Science & Engineering Thematic Network*

EIE-Surveyor Project

QUALITY and ACCREDITATION

in Europe:

implication in

ELECTRICAL and INFORMATION

ENGINEERING

2005-2008

Based on the results of the EU-funded Thematic Network

EIE-Surveyor

Project Nr. 225997-CP-1-2005-1-FR-ERASMUS-TNPP

Table of Contents

PRESENTATION

This report has been written during the academic years 2005-2008 by a consortium composed of 107 universities, which are members of the EIE-Surveyor Thematic Network, with the cooperation of the EAEEIE (European Association for Education in Electrical and Information Engineering, http://www. eaeeie.org).

This report has been published in the summer of 2008, and therefore the available information corresponds to the situation in higher education institutions in Europe at this time.

The report consists of two parts:

1. The first part is dedicated to the Quality Assessment of Resources in EIE Available through the Internet.

2. The second concerns an analysis of the existing accreditation procedures, and proposition of a methodology.

Every effort has been made present the contents of the this report as accurate as possible, but apologies are provided in advance for any accidental errors or omissions. In order to to contribute to new releases of the report, please contact:

jean-marc.thiriet@ujf-grenoble.fr

Last corrections done by J.C. Burguillo (Universidade de Vigo, ES)

First Part

Quality Assessment of Resources in Electrical and Information Engineering Available through the Internet

1st part: Quality Assessment of Resources in EIE Available through the Internet

Main contributors: Dervis DENIZ (Eastern Mediterranean University), Jose Luis MARZO LAZARO (Universitat de Girona, Spain), Denis GENON-CATALOT (Université Pierre Mendès-France, IUT de Valence, France)

1. The EIE-Surveyor Task-2

1.1 Objectives

The EU Socrates Project EIE-Surveyor Task-2 objective is defined as the "implementation of quality assessment methodologies on some educational resources available in EIE (Electronic and Information Engineering)". This activity is seen to have critical relevance due to the proliferation and importance of e-learning in modern education. Further, there is a need to make sure that quality of education and educational materials is maintained across e-learning alternatives. The Task-2 activity is envisioned to create a mediatheque of pedagogical resources available through the Internet in the EIE field [1]. Further, the second aim of this part of the project is to define an assessment technique for establishing the quality of educational resources in the field of EIE. This means that we should be able to select and classify educational materials for EIE on the basis of: (i) the quality of content in relation to the concepts, models and competences required in EIE, and (ii) the potential effectiveness as teaching-learning tools for EIE education. Finally the aim is to make these resources and their quality evaluation results available to the EIE community.

1.2 Methodology of the Approach

The methodology of the present approach considers the aims and objectives of the project, incorporating the following steps:
- Investigate any existing approaches and any relevant studies,
- Develop a suitable quality assessment methodology appropriate for the objectives, such that a catalogue of available pedagogical resources in the field of EIE could be created,
- Design an appropriate questionnaire which can be used in a user evaluation survey in order to establish the quality of electronic learning resources,
- Design a method for assessing the survey results and mapping these to "quality",
- Design a web based software system, which will implement the methodology and allow for the extraction of the results defined in the objectives,
- Implement a web-based software system to show the applicability of the proposed ideas,
- Test the web based system and match its functionality with the objectives,
- Release the software system for using it along the project lifetime; to plan, coordinate, monitor and manage its use for collecting the necessary data,
- Generate all the reports required by the project.

1.3 Achievements on Quality of e-Resources available over the Internet

The following achievements have been made on the issue of quality of e-resources available over the Internet:

- A quality assessment methodology has been developed for evaluating online e-learning resources available through the Internet.
- The quality assessment methodology is implemented in two main parts:
  - the creation of an electronic catalogue (e-Cat), and
  - the application of an evaluation questionnaire/survey (e-Surv) for users.
- The e-Cat serves the purpose of cataloguing e-resources available in the field of Electrical and Information Engineering over the European Internet area and making them available to learners across Europe and beyond. The e-Surv is an e-Cat resource linking questionnaire comprising evaluation in the four sections previously mentioned. e-Surv is designed to allow continuous assessment of the quality of e-resources available within the e-Cat by means of user surveys.
- The quality assesment methodology, containing both the e-Cat and the e-Surv sites, will be maintained under the umbrella of a professional organization, such as the EAEEIE, beyond the lifetime of the project.

2. E-Learning: The Evolution in Network Assisted Learning

Spiralling innovations in the information and communications technologies (ICTs), coupled with ubiquitous availability of the computer networking technologies (including the Internet), has resulted in the development of multitude digital educational resources (electronic resources or e-resources) for learners. In the last fifteen years, the Internet has changed the way we carry out many of our daily activities. The web has been one of the most popular Internet applications, providing a technology where information stored, in a distributed manner, over thousands of networks servers and freely available to users. Web based access and resource sharing have made them suitable for use in learning. Hence, the proliferation of web based electronic resources (e-resources) and material need to be maintained by means of electronic catalogues (e-cats). These resources include course web pages, lecture notes, technical notes, e-books, tutorials, examples and solutions, remote and virtual laboratories, software (e.g. simulation, visualization, etc.), programming examples, experimentation set-ups or examples, research results, technical reports/manuals and in general electronic learning materials about topics of interest. In the context of the EIE-Surveyor project, all this includes the Electronic and Information Engineering (EIE) fields.

It is obvious that electronic resources available for learning can be in many forms. Hence, it is necessary to classify and distinguish what is meant by an "electronic resource". In the context of the EIE-Surveyor, an *electronic resource* (e-resource) is a separately linked and accessed "wholesome" unit of learning material that presents a topic, an idea, a concept, an approach or a method. Taking the example of an electronic book (e-book); one can say that it is an e-resource while its chapters although dealing with different sub-topics, ideas, concepts or methods, will not be considered as distinct e-resources since they will be considered as an integral part of the wholesome unit called the e-book. In a similar manner, a course web site containing the documents and objects related to a learning course is considered an e-resource. However, its constituent chapters, as well as examples, quizzes, exam questions, solutions, etc., are considered as parts of a wholesome unit.

Presently, a trend is sweeping through academia and industry for developing instructional technology and educational materials for the purposes of e-learning; standardization. A large

---

number of academic, government and private organizations are active in developing these standards. Here, two developments are taking place; we can classify one at the macro-level and the other one at the micro-level. At the macro level, Learning Management Systems (LMS) [2] are being developed. An LMS is a software platform for facilitating the design and delivery of a learning system. It also has features which allow management of learning/training and tracking of learners. LMSs facilitate distribution of learning materials as well as managing learner training records. Some also have collaborative tools for asynchronous as well as synchronous teaching-learning paradigms. The other related technology is the Learning Content Management System (LCMS) which is focused on the design, development, release and management of the content that can be delivered using an LMS. An LCMS is a software system that allows the use of an innovative instructional technology which is called "learning objects (LOs)". An example of LCMS is the AKHME platform [25]. LOs are basic instructional components based on the object-oriented technology and allow the design and development of small modules that can be aggregated to create a capstone course, other learning material or e-resource [30, 31]. Some of the most important features of a LO is its re-usability, versatility and adaptability [3, 26, 27, 29]. Developments in this latter field can be classified at the micro-level.

The proliferation in e-resources and LOs has resulted in the mushrooming of repositories for online learning materials. Two important developments have followed the proposals for LOs. These include the design, development and use of standards for representing information about data; also called metadata. Examples of metadata standards include IEEE LOM [34], SCORM [4, 32], Learning Resource Metadata (LRM) [5] and IMS-Learning Design IMS-LD [6]. All of them encompass the current trends in the use of metadata to facilitate research and information retrieval. The second development is the use of repositories for storing LOs; these are called Learning Object Repositories or LORs. Some examples are: MERLOT [7], CLOE [8], ARIADNE [9], SLOR [33] among others, a list of which is provided in [10].

Both the LCMS and LMS are software tools intended to help instructional material designers, developers and deliverers at different levels. The LCMS provides its functionality through a front end for centralized management of learning content through a LO database/repository (LOR) which is also used for efficient searching and retrieval of LOs. It provides developers, authors, instructional designers, and subject matter experts the means to create and re-use e-learning content more efficiently and reduce duplicated development efforts.

The LMS provides a web based platform for the management of e-learning and e-instruction activities [2]. It enables the planning and management of learning/teaching activities through online synchronous or asynchronous methods for delivering resources as well as providing a virtual classroom functionality. It allows communication between the learners and the instructors using a variety of tools. It also allows management of events, student's assessment and evaluation.

At the start of the project and during the definition of the methodology of the approach to achieve the objectives, it was decided that the concern in e-resources would be at a general level rather than saying at the LMS or LCMS levels. This allowed the project to consider a wider spectrum of available resources. Further, the interest was at the representation at the macro level rather than at the micro level: i.e., the task is not oriented in the cataloguing and quality assessment of small "learning objects", which are designed to be part of macro level learning objects. Another decision was to use some of the standardized techniques for data represention and for the development of the software system.

3. Quality Issues in E-Learning

Quality is paramount in every aspect of learning and teaching. Therefore, immediately as the first e-learning applications have been proposed, proponents and others have naturally been concerned with the issue of quality in e-learning. Quality in the context of e-learning has been an issue of discussion for some time. Of course the same can be said about the quality of electronic resources made available for e-learning. In order to establish the "quality" of any given resource, a method needs to be developed for applying the evaluation in a systematic way. Hence, before any commitments regarding the "quality" appraisal activity, it is necessary to define some terms and agree on a number of notions such as: what is quality?, what must be evaluated?, who will do the evaluation?, how will the evaluation be done?, what criteria are considered for the evaluation?, among other issues. As we will be seen below, some evaluators propose the "peer-review" approach, while others champion the "user-evaluation" method. The Surveyor Project Task-2 workgroup has chosen the user-evaluation method as the basis for its assessment methodology which is described in the next section.

The quality of a product or service is defined by Taguchi in [11] and taken as the "degree in which the characteristics of a product or service can cover the felt or pre-felt needs of users in a period of time" by Sarasa and Doredo [10]. According to this definition a product or service must meet the users' needs. Hence, since the users of an electronic learning material (e-resource) are learners or students, then they must be directly involved in their evaluation. Chang [11] denominates students and instructors as consumers and producers respectively. However, since instructors are also users of the learning materials, both the students and instructors could carry out the evaluation. The term "quality" is used by Chang in [11] to refer to the effectiveness and efficiency of the product. In other words, one could say that an e-resource is of good quality if, by evaluating, it one can prove that it fulfills the objectives for which it was created and makes optimal use of its resources. An example could be a case where a given concept can be learnt by a student in a shorter time using a suitable technology. It can be said that the problem of evaluating the quality of e-resources can be studied from several levels or perspectives. Sarasa and Doredo in [10] present quality in two levels: quality of the *process* and of the *product*. Two more levels; the *context* and the *entries* are added by Williams [12]. In contrast, only the product-level evaluation is considered by Sarasa and Doredo in [10] because the evaluation tool does not have control on the elaboration process of contents and serves mainly as a repository for e-resources.

In order to guarantee the quality of products, the evaluation must be done in an objective, recognized, professional way and in an iterative and continuous process as outlined by Chang in [10]. Furthermore, it is desirable that people, who partake in the evaluation, at least the tutors, must have experience in the fields of evaluation, education-learning concepts and technologies. In this way, we can say that the visions and the experiences of both the user and the creator are included in the quality evaluation of e-resources in terms of the objectives that the resource ascribes to. A third aspect could be added for certification of the evaluation which should be targeted at the product level in the first instance. This evaluation could later be targeted as a consumer oriented evaluation as treated by Worthen, Sanders & Fitzpatrick in [13] and later adopted by Nesbit et al in [14]. A study by Ehlers in [22] has found that when respondents are asked about what they understand by quality in e-learning. The predominant view expressed is that "quality relates to obtaining the best learning achievements" or "something that is excellent in performance" rather than relating quality with "best value for money or marketing". On the other hand ISO/IEC has also developed a new standard ISO/IEC 19796-1 [23] which provides a "reference framework for the description of quality approaches" (RFDQ). The standard is an instrument to develop quality in the field of e-learning.

The question "what is to be evaluated?", as it is expressed in this document is very wide since any resource in digital format, that can be used as an educational material in the field of electrical and computer engineering, needs to be considered. The types of e-learning materials that must be considered are described in section 2 and include diverse e-resources as text and graphics based lecture notes on one hand and virtual laboratories on the other to name only a few of them. The question then becomes one of: "can one find a set of common characteristics that could be used to represent any type of e-resource or learning material?". Further, in quality evaluation of each type of e-resource, can one ask a set of common questions that applies to all types of e-resources? Nevertheless, it would be good if an analysis can be used to clearly identify common characteristics among different e-resources in such a way that more appropriate parameters for each type of material can be established. A consequence of knowing exactly what it is to be evaluated is that one can design more suitable and objective strategies that will allow the collection of better results in the evaluation of each type of material and guarantee the desired quality. This work has not emphasized the different types of e-resources, because it was not the main objective of the project. Despite this, creating a catalogue of digital educative material in EIE found in Europe, grants us the possibility of evaluating these e-resources by considering quite general aspects that are pertinent to any type of resource.

A number of approaches exist for cataloguing e-resources and learning objects. For example the eduSource [19] project in Canada has proposed collecting e-resources in a particular community. However, it makes no mention of quality assessments such as that proposed in the EU Socrates Project EIE-Surveyor. Others such as MECA-ODL [24] (methodology for the analysis of quality in open distance learning through Internet), proposes a quality assessment technique for open distance learning material but does not provide the coupling with an electronic catalogue of e-resources.

In this project the evaluation takes into account four main issues: i) type and background of users/learners, ii) quality of contents, iii) technical aspects of the resource, and iv) overall user satisfaction. The type of users/learners allows us to identify to whom the appeal is addressed, for example: education level, level of competence/expertise in the topic area, etc. Evaluating the quality of content concentrates on whether the material meets what it promotes and whether the expectations of the user are met. This is done through evaluation of the user satisfaction which enables us to determine the quality of the resources in terms of the purposes for which it was created. Evaluation of the technical aspects concentrates on the establishment of the availability of the right kind of technical infrastructure for using the facility provided. This includes the user hardware, software and access bandwidth facility evaluations amongst others. Finally, evaluation of the overall user satisfaction aims to summarize the user's overall view on the experience he/she had through visiting the web site or by studying/experiencing the learning material provided.

The quality assessment methodology that is proposed in this project is implemented in two main parts: i) creation of an electronic catalogue (e-Cat) and ii) application of an evaluation questionnaire/survey (e-Surv) for users. The e-Cat serves the purpose of cataloguing e-resources available in the field of Electrical and Information Engineering over the European Internet area and making them available to learners across Europe and beyond. The e-Surv is an e-Cat resource linked questionnaire comprising evaluation in four sections as previously mentioned. E-Surv is designed to allow continuous assessment of the quality of e-resources available within the e-Cat through user surveys. The way it is expected to be used is to have both the e-Cat and

the e-Surv sites to be maintained through the umbrella of a professional organization such as the EAEEIE [16] beyond the lifetime of the project.

4. EIE-Surveyor Methodology for Quality in E-learning

4.1 Task-2 Quality of e-Resources available over the Internet

As mentioned earlier, one of the main aims and objectives of the EIE-Surveyor Project Task-2 is to develop a suitable quality assessment methodology appropriate for evaluating the quality of pedagogical resources in the field of EIE available over the Internet. The methodology of the approach defined earlier specifies the following:

a) Development of a suitable quality assessment methodology appropriate for the objectives such that a catalogue of available pedagogical resources in the field of EIE can be created. Here the catalogue of pedagogical resources is an electronic catalogue (or e-Cat) which would store summary information about each e-resource. The information which needs to be stored about each e-resource is a design issue which needs to be defined.

b) Design of an appropriate questionnaire which can be used in a user evaluation survey in order to establish the quality of electronic learning resources,

c) Design of a method for assessing the survey results and mapping these to "quality",

In approaching these sub-tasks, the working group has decided at the outset that the quality of each resource would be based on a survey establishing user experience and satisfaction with the given resource. Further, the working group decided to define the following elements to specify the methodology:

i) a framework for assessing quality of e-resources,

ii) a questionnaire for carrying out a user survey,

iii) a technique for evaluating the user responses, and

iv) a method for representing the "quality" of a given resource.

4.2 The Quality Assessment Framework

EIE-Surveyor Project Task-2 working group concluded that the "quality assessment" must be coupled with each electronic resource in a manner that makes surveys easily executable by users. Further, the survey results for each resource need to be coupled with the e-resource. This raises the issue of the electronic survey (e-survey) which must be linked to the referenced e-resource. Combining this decision with the statement in (a) above, the quality assessment framework is defined as follows:

1. The quality assessment framework includes and must be coupled with a facility that allows the cataloguing of e-resources in an electronic catalogue or e-Cat,

2. Users should be able to select the URL of the e-resource from the e-Cat and be able to display and study the e-resource material,

3. Users will have a link to a survey questionnaire through the e-Cat in order to carry out their surveys in an easy and effortless manner,

4. Some form of on-the-fly assessment (re-assessment) must be carried out based on the addition of each new survey to the system,

5. The results of the survey assessment must be displayed on the e-Cat summary of the e-resource; it is thought that a "star-rating" of the resources would be adequate for the purposes of the Task-2.

4.3 The Quality Assessment Questionnaire

The user survey is composed of a quality assessment questionnaire which is composed of 24 questions categorized in four different sections as given in Table 1 below:

I.   Evaluation of the type of the users/learners,
II. Evaluation of the quality of contents,
III. Technical evaluation of the resource,
IV. Overall user satisfaction

The first section is composed of four questions and aims to evaluate the user/learner type and his/her background knowledge in the topic area. The first question establishes the level of current education and weather the user is using the material for learning or teaching a related course. From the answers, it could also be known if the learner is using the material for organized learning, self learning or continuous education. The second and third questions provide information about the learner's level of knowledge about the topic area and the prerequisites of the topic area respectively. These questions are all optional since the user is given the option of replying as NoT (None of These).

The second section of nine questions aims to establish the pedagogical usefulness/quality of the presented material as assessed by users. The range of questions investigate the user evaluation of the following: clearness of the course objectives, level of the material, clear explanation of information and concepts, use of visualization techniques, capability of the provided material to help the learners learn more widely on the subject matter, adequate examples for understanding the concepts in the material, availability of useful problems helping to exercise one's knowledge in the area, ability of the material to fill the learner's expectation in scope and detail, sufficiency of the recommended time to follow the material.

The third section comprises of six questions and aims to evaluate the technical aspects relating to the learner's access platform and of the resource as well. First three questions establish the user's hardware, software and access bandwidth conditions to find out if the learner's access capabilities were adequate to fully experience the material and its presentation. The fourth question is about the clearness of the layout and logical design of the navigational features of the learning material. The final two questions are not directly related to resource quality, but rather indicate how the learner has reached this material.

Finally, the fourth section aims to establish the level of overall user satisfaction. This section is composed of five questions. The first three questions establish the user's satisfaction and how useful the material is found by the learner. The first question asks if the learner will recommend this resource to his/her friends. The second question aims to establish how useful the material has been found by the learner in his/her education and career. The third question aims to determine if the learner has found a different approach to the topic. The fourth question allows the user to compare this resource with similar ones to get a comparative user rating of the material. The penultimate question requests the provision of other useful resources in the area, if any. This question is also optional to answer. The aim here is to collect references for future entry into the e-resource database (e-Cat).

The questionnaire, selectable answers and the assigned numerical weights are given in Table 1 below. It should be noted that since questions in the 1st and 3rd group provide either a "none of these" or "I don't know" type of answers, they are optional to answer and can be ignored by the surveying user. Further, the final question is also optional. This leaves the total number of questions mandatory for answer to be 13 out of the 24 available questions. This has purposefully

---

been designed in this manner to make survey filling easy for users and hence to increase the number of surveys filled by learners.

4.4 The Evaluation Rubric for Responses

Table 1 shows the selected answers and their numerical weights to be used in this project. It should be noted that group I and III set of questions are valued in the range of 0-4 marks while group II and IV set of questions are valued in the range 1-5 marks of Lickert Scale. User responses are to be collected in a database for on the fly (on-line or real-time) as well as later (off-line) analysis. In general two types of evaluation approaches are possible:

1. Correlated evaluation: i) weighted averaging and ii) binary averaging.
2. Non-correlated evaluation.

In the correlated evaluation approach, the answers entered by each surveying user are investigated in order to find correlations among the individual answers. This would then be used to associate a weighting to the overall average of the answers by a particular user so that his/her contribution is added to the overall average using its weighted average. This is needed to prevent uncoordinated or haphazard survey fillings and their resultant affect on the realistic evaluation by many well-meaning and careful surveyors. It may also be more equitable for relative quality measures of different e-resources. This approach is certainly one that could yield a much more refined assessment strategy but is more complex to implement.

An alternative approach to the weighted averaging is that of binary averaging. In this technique based on broad grouping of the questions, controls can be made to check that the answers in different groups correlate. If a positive correlation is to be expected and the answers indicate otherwise, then the whole of the answers in that survey may be left out of the assessment process.

Non-correlated evaluation of the survey results means that no measure is taken to find any correlations between answers or answer groups. Hence, this is a much simpler approach than the correlated evaluation approach. In this approach it is adequate to decide on the use of the answers of the selected questions which will be added to the averaging process. This is the approach taken for implementation in this project because of its simplicity.

In this project, evaluation of the quality of contents and the overall user satisfaction groups of questions (see Table 1) are decided to be used for the overall assessment of the "quality" of a given resource, since these are based on the pedagogical issues as well as overall user satisfaction.
This means that the important questions for establishing a quality measure are Q5-Q13 and Q20-Q23. The total number of questions is thirteen and are ranged between 1 and 5 marks. Hence, once these are averaged for a given user, the evaluator average is obtained as: $1 \leq$ evaluator-average ≤ 5.

A sample application of the evaluation rubric is given in latter parts of this report.

4.5 Representation of Quality of e-Resources

Based on the defined quality assessment framework (see section 4.2), the results of the survey assessment must be displayed on the e-Cat summary of the e-resource; a "star-rating" the

resources has been chosen for the representation of the quality of any given electronic resource within Task-2.

It is assumed that 0 to 5 stars with half-ratings (i.e. in steps of 0.5 stars) must be used to represent the quality as a result of user evaluations through answering to pedagogical and user-satisfaction based questions. For example, for a given e-resource, if the mean assessed value for all evaluators is 2.75, then this level of quality measure can be represented with a 3 star-rating. The mean assessed quality value versus star-rating is shown in Table 2 below.

Table 1. Questionnaire for User Survey; Selectable Answers and their Weights

Q#	QUESTIONNAIRE	Selectable ANSWERS & WEIGHTS				
I.	**Evaluation of the type of the users/learners**					
1	Please indicate your current level of education	PhD (4)	MS (3)	UG (2)	Pre-Univ (1)	None of These (0)
2	Please indicate your level of competence/expertise in the topic area	Expert (4)	Advanced (3)	Intermediate (2)	Beginner (1)	NoT (0)
3	Please indicate your level of competence/expertise in the prerequisites of the topic area	4	3	2	1	0
4	Please indicate whether you are using the material for learning or teaching a related course	Teaching (4)	Organised Learn (3)	Self-Learn (2)	Cont.-Learn (1)	NoT (0)
II.	**Evaluation of the quality of contents**					
5	The objectives of the course are presented clearly	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
6	The level of the material is adequate for my current level of education	5	4	3	2	1
7	The material provided in this resource clearly explains information and difficult concepts in a simple and easy to understand manner	5	4	3	2	1
8	Visualisation techniques have been used adequately in presenting the material	5	4	3	2	1
9	Materials provided in this resource helped me to learn more widely on the subject	5	4	3	2	1
10	I found enough examples that helped me to understand the material	5	4	3	2	1
11	Useful problems helped me to exercise my knowledge in the area	5	4	3	2	1
12	The material fulfilled my expectation in scope and detail	5	4	3	2	1
13	The recommended time to follow the material was adequate	Much Longer (5)	Longer (4)	Adequate (3)	Shorter (2)	Much Shorter (1)
III.	**Technical evaluation of the resource**					
14	My computer has adequate hardware features to read the resource	More than Enough (4)	Enough (3)	Not Enough (2)	Poor (1)	I Don't Know (0)
15	My computer has adequate software features to read the resource	4	3	2	1	0
16	My computer has adequate bandwidth to access the E-resources	4	3	2	1	0
17	The layout of the material was clear and the links allowed easy navigation in the resources	4	3	2	1	0
18	Did you reach this material directly from the EIE-Surveyor Website			YES	NO	No Answer
19	If No please indicate the source of the link of the page: (e.g. Google, Altavista, etc…).	If NO is answered to Q18; enter hyperlink of referring page				
IV.	**Overall user satisfaction**					
20	I will recommend this material to my colleagues or students	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
21	I think the material is useful for my career/education	5	4	3	2	1
22	I think the material provided me a different approach to the topic	5	4	3	2	1
23	Please rate this material in relation to similar ones	Excellent (5)	Good (4)	Average (3)	Fair (2)	Poor (1)
24	Give reference (link) of other valuable resources in the area (if any).	Reference to valuable resources in the area (if any)				

Table 2. Mean Assessed Quality Value vs. Star-Rating

Mean for all evaluators				
Lower value	Upper value	Mean Value	Star-Rating	Samples
0.00	0.24	0.00	0	
0.24	0.74	0.50	(½ *)	
0.75	1.24	1.00	*	
1.25	1.74	1.50	* (½ *)	
1.75	2.24	2.00	**	
2.25	2.74	2.50	**(½ *)	
2.75	3.24	3.00	***	★★★☆☆
3.25	3.74	3.50	***(½ *)	★★★⯨☆
3.75	4.24	4.00	****	
4.25	4.74	4.50	****(½ *)	
4.75	5.00	5.00	*****	

5. EIE-Surveyor Task-2 Implementation

5.1. Specification of Requirements

The Quality Assessment Framework, given in section 4.2 of this report, defines user requirements at a high level. Based on this framework:

1. An electronic catalogue (e-Cat) must be designed to allow the cataloguing of electronic resources (e-resources) that are of interest to the EIE related learners.
2. The e-Cat must use a well defined and standardized structure for its database records which will hold the information about each resource.
3. Easy navigation to the e-resource material should be available from the e-Cat, so that users could select the URL of the e-resource from the record within the e-Cat and be able to display and study the e-resource material,
4. Users will have a link to a questionnaire through the e-Cat to carry out their surveys in an easy and effortless way once they have studied the material,
5. The results of each user evaluation must be stored in an electronic survey (e-Surv) database to be able to carry out quality assessment for each resource.
6. An evaluation rubric will be applied to the available survey results for each e-resource using an on-the-fly assessment (re-assessment) technique,
7. The results of the survey assessments must be displayed on the e-Cat summary of the e-resource using a "star-rating" method.

Further requirements include the following:

- The whole system should be web based and both, the e-Cat and e-Surv, systems should preferably work together on the same server. The EIE-Surveyor Task-2 server will also house the e-Cat and the e-Surv databases. The server-side system should allow the integration of server side scripts and the database interface. The databases must be relational database technology being SQL the target language. The e-Cat will have a web based "front-end" to display the information from the database. Further, a "form based"

web user interface must be designed to allow users to enter new catalogue data into the system through database records holding catalog entries. The fields of the records would contain information identifying the resource uniquely, provide information about its contents and provide a link to its web or Internet site [15].

- The e-Surv should also have a similar structure and requirements as the e-Cat described above. The e-Surv will have a web based "front-end" to display the information in the database to users accessing the e-Surv. Further, a "form based" web user interface must be designed to allow users to display and enter surveys for the relevant e-resources. Once submitted, the user surveys will be stored in the survey database as separate records which identify the specific e-resource. The fields of the survey records must contain user responses to the quality survey questionnaire [15].

- A final requirement includes the definition of different classes of users (admin, super-user, and user) with each having different access rights. It is also required that non registered users (also known as guests) should also be able to browse and search through the e-Cat. However, only registered users can enter new e-Cat records, or modify their own records, and carry out online e-survey for any resource apart from the one they have entered into the system ("owned records"). Another important requirement is the use of the SCORM metadata definition standard [18,19] as the format for classification of the e-learning resources. Main components of the required system are shown in Figure 1.
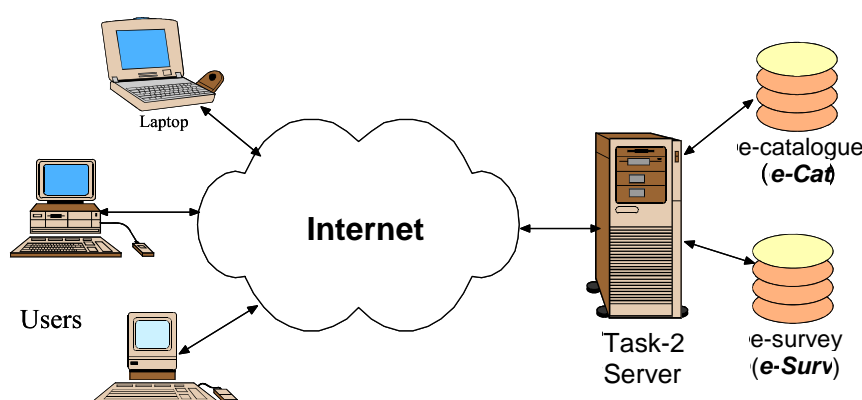
Figure 1. Network schema showing main components of the simplified system

5.2 Data Representation

One of the well known standards for educational contents classification is the SCORM metadata format. The T2-working group has established early in the project that the use of the SCORM, or a modified version, would be preferred to any other technique since it provides a standard metadata format and may be exchanged with similar projects. A subset of the SCORM metadata format was selected later as the target format. This version is conformant with the EU selected version and the one adopted by Portugal [19].

The educational conformity levels for SCORM are given below:
Level1: ADL (Advanced Distributed Learning) mandatory fields are included [18],
Level2: Level 1 + recommended fields,
Level3: Level 2 + at least one more optional field.

An educative content will be considered at level 3 if there is information in all the fields demanded for level 2 and at least in one optional field. This is a level for which each institution can recommend the fields in accordance to its own requirements. Table 3 shows the fields which exist in SCORM Level 3.

Table 3. Definition of SCORM levels

Level	Section	Relates to	Sub-fields
1.0	General:	(general items description):	Identifier, Title, Catalog Entry, Language, Description, Keyword
2.0	Life Cycle:	version control information	Version, Status, Contribute, Role, Entity, Date
3.0	Meta-Metadata:	metadata information	Metadata schema
4.0	Technical:	technical requirements	Format, Size, Location, Requirement, Duration
5.0	Educational:	educational & pedagogical requirements	Interactivity Type, Learning Resource Type, Context
6.0	Rights:	copyrights information	Cost, Copyright and other restrictions, Description
9.0	Classification:	localization information	Purpose, Entry, Description, Keyword

5.3 System Realisation

The system requirements defined in 5.1 have been further defined and the complete system has been implemented first as a pilot application, to get an early experience and identify other user-requirements as well as identify improvements for the full system. This system has then been used as a prototype to get further user requirements. Figure 2 depicts the main components of the overall system built. The system diagram shows the e-Cat, e-Surv and the e-Contact (e-Cont) databases which form the main repositories of the system. The diagram also shows users connected through the Internet.

I. e-CAT: Electronic Catalogue of Learning Resources Available over the Internet

An electronic catalogue (e-Cat) is designed and implemented to register related resources in EIE and make them available to users. The e-Cat record is designed with fields defined in Table 4, the modified SCORM details for Task-2. Thirty record fields have been defined to describe the e-resource effectively. Additional fields exist for system design and control. One specific field is about the userID# (user identifier number) which is used to identify the "owner" (or the user who entered the record into the system). A number of modifications exist from the standard Level 3 SCORM. The number of mandatory fields is 14 in all and has been kept as low as possible to allow speedy entry of e-resource summary information into the system. Field 15 of the e-Cat record specifies the link to the e-resource for which this summary record has been kept in the e-Cat. It is a hyperlink and hence by selecting this field, the user can go to the web page of the e-resource. This is depicted in Figure 3. The e-Cat comprises of a user-interface for allowing user interacting with the e-Cat database. This interface includes a form based e-resource catalogue registration tool and a search tool. As a result, the e-Cat is a specialized repository of information and links to e-learning resources in the field of Electrical and Information Engineering. The search facility in the e-Cat covers all fields in each record. Hence, the search

facility in the e-Cat can be used for searching the repository for specific topics and types of resources available at the European (or global) scale.

Table 4. Modified SCORM details for Task-2

Field ID	M/O	Level/Number	FIELD NAME	TYPE	Example
			GENERAL		
1	A	1.1	Identifier	Text Field	**Content identifier** (a unique ID through auto-increment)
2	M	1.2	Title	Text Field	**Title of the e-resource**
3	O	1.3.1	Catalogue System	Combo Box	**Select or ISBN or ISSN or Other**
4	O	1.3.2	Entry	Text Field	**Select or ISBN number**
5	M	1.4	Language	Combo Box	**Course/Object Language (Select one of the languages listed) (Pls. note that currently only English is supported by this site) Default: English**
6	M	1.5	Description	Text Box	**Course/Object description (Text)**
7	M	1.6	Keywords	Text Field	**Related Keywords (comma separated)**
			LIFE CYCLE		
8	O	2.1	Version	Text Field	**e.g. 1.0 (version of e-resource)**
9	O	2.2	Status	Combo Box	**Select or Draft or Final**
10	O	2.3.1	Role	Combo Box	**Select or Author; Editor; Contributor; Publisher; Unknown**
11	O	2.3.2	Contributors (Entity)	Text Box	**None or Authors/organizations that contributed for the course/ object (comma separated list; e.g. person, dept., agency, etc.)**
12	O	2.3.3	Contribution Date	Text Field	**Last Update**
			TECHNICAL		
13	O	4.1	Format	Text Field	**.pdf; .txt; .doc; .dcr; or a mixture of formats**
14	O	4.2	Size	Text Field	**Approx. size of resource in MBytes**
15	M	4.3	Location	Text Field	URL: **http://www.test.com/** (link to e-resource)
16	O	4.4	Requirement	Text Field	**Technical requirement for accessing/using e-learning material**
			EDUCATIONAL		
17	O	5.1	Interactivity Type	Combo Box	**Select or Active; Expositive; Mixed; Undefined**
18	M	5.2	Learning Resource Type	Combo Box	**Select or CWP; Lecture Notes; e-book; Tutorial; Examples; Solutions; R-LAB; V-LAB; Simulation; Software; Other.**
19	O	5.3	Interactivity Level	Combo Box	**Select or Very low; Low; Medium; High; Very high**
20	M	5.6	Context	Combo Box	**(*)**
21	M	5.8	Difficulty Level	Combo Box	**Select or Very easy; Easy; Medium; Difficult; Very difficult**
22	O	5.9	Typical Learning Time	Combo Box	**Select or Less than 1 hr; 1-2 hrs; 3-5 hrs; 6-10 hrs; greater than 10 hrs.**
			RIGHTS		
23	M	6.1	Cost	Combo Box	**Select or Yes or No or Don't know**
24	M	6.2	Copyright & other restrictions	Combo Box	**Select or Yes or No or Don't know**
25	O	6.3	Description of Copyright	Text Box	**Description of copyright or other restrictions or how to get permission etc.**

			CLASSIFICATION		
26	M	9.1.1	Discipline	**Combo Box**	**(**) e.g. Electrical & Electronic Eng.; Computer Eng.; Computer Science; IT; etc..**
27	O	9.1.2	Idea	**Text Box**	**Purpose of objective of the content**
28	M	9.1.3	Prerequisite	**Text Box**	**Prerequisite knowledge needed to follow the e-resource material**
29	M	9.1.4	Educational Objective	**Text Box**	**Aims and objectives of the learning material provided by the e-resource**
30	M	9.1.6	Educational Level	**Combo Box**	**Select or Introductory or Normal or Advanced**

KEY (for Table 4):

A/M/O: Auto-increment/Mandatory/Optional

(*) Further Education (Further Edu.); University 1st Cycle; University 2nd Cycle; University 3rd Cycle; Tech. School 1st Cycle; Tech. School 2nd Cycle; Professional Formation (Professional); Continuous Formation (Continuous Edu.); Vocational Training (Vocational)

(**) Combo box: Select or one of the following selections: (Electrical Engineering, Electronic Engineering, Electrical and Electronic Engineering, Electrical and Computer Engineering, Electronic and Computer Engineering, Electrical and Information Engineering, Electronic and Information Engineering, Electrical Engineering and Computer Science, Electronic Engineering and Computer Science, Communications Engineering, Communications and Control Engineering, Computer Network Engineering, Computer Studies, Computing, Computer Science, Computer Engineering, Computer Science and Engineering, Information Engineering, Informatics, Software Engineering, Management Information Systems, Computer Education and Instructional Technology, Electronics and Computer Education), or Other (If Other is selected a new text box will open and accept the new entered Discipline/Program/Department name)

## II. e-SURV: Electronic Survey of Resources Provided Through the e-Cat

Electronic resources (e-resources) available through the web include the following: course web pages, lecture notes, technical notes, e-books, tutorials, examples and solutions, remote and virtual laboratories, software (e.g. simulation, visualization, etc.), programming examples, and in general, electronic learning materials about topics in the Electronic and Information Engineering (EIE) fields. These e-resources are easily accessible and can be utilized for learning through the web. Electronic catalogues (e-cats) are needed to categorize, group, list and provide hyperlinks to the learning materials. Quality is a paramount issue in learning; be it traditional or e-learning based. Hence, the need for quality assessment of e-resources has been a concern for educators for some time. There is a special need to carry this out for resources freely available over the Internet and provide users with an idea of how well the resource meets user expectations. The approach taken in the EIE-Surveyor is one where user reviews form the basis of such an evaluation. In order to implement this decision and to provide an easy technique for carrying out electronic surveys for e-resources, each e-resource has a hyperlink to a software module that is activated by selection and it provides the user interface for the survey questionnaire. Figure 3 depicts the e-Cat summary resource page which is obtained from the e-Cat database either through a directed search or through listing of resources in a given field. This page has two hyperlinks: one for the e-resource page and one for the e-Surv evaluation form. It is expected that users first visit the e-resource page and use the resource. Through accessing the learning resource page, a user experiences the features or contents of the facility. The user is then expected to fill out a survey form for that resource to rate its usefulness. A notion of quality is then developed based on the assessment of user surveys.

The e-Surv comprises a simple form based interface which houses the quality assessment questionnaire (see Table 1 in section 4.3 and 4.4). The user needs to answer only the mandatory questions. A total of 24 questions are presented and of these 2 are optional. Q1 through 4 and Q14 through Q17 allow the user to select "None of These" and "I don't know" type of answers respectively and hence can be easily by-passed by the user. Other questions are marked with weights from 1 to 5. Each filled questionnaire is added to the e-Surv database. Two main fields are added additionally to each record: ResID# and the UID#, which are the resource and user identification numbers. In this way, questions like "who has done which surveys" as well as "to

which e-resource this particular survey refers to" may be answered. There are two main requirements from the survey part: i) that a user should not be able to carry out surveys for e-resources entered by him(her)-self and ii) that if a user repeats a survey for a given resource, the new one is used to update the already existing one. Hence, only one survey per e-resource and user is allowed.
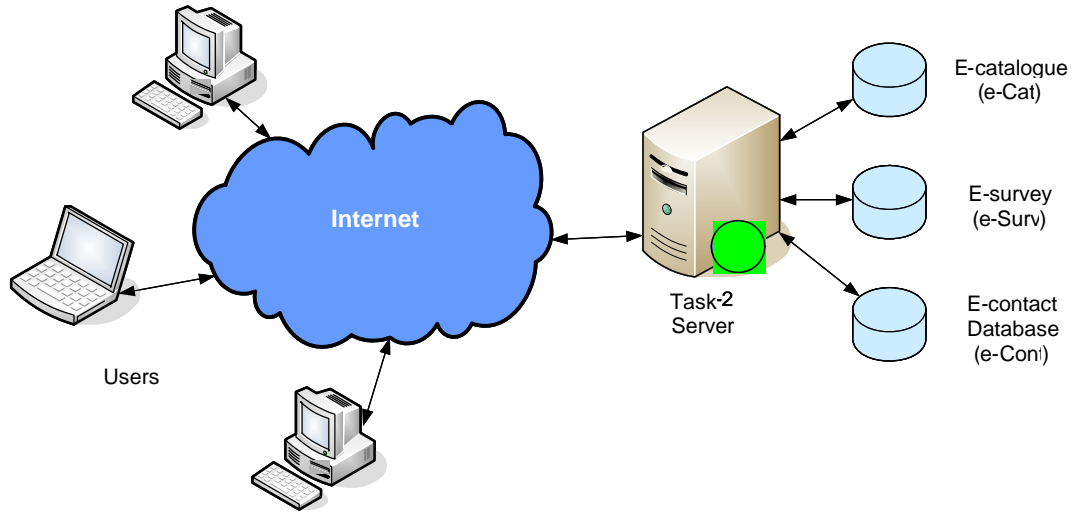
Figure 2. Network schema showing main components of the implemented system
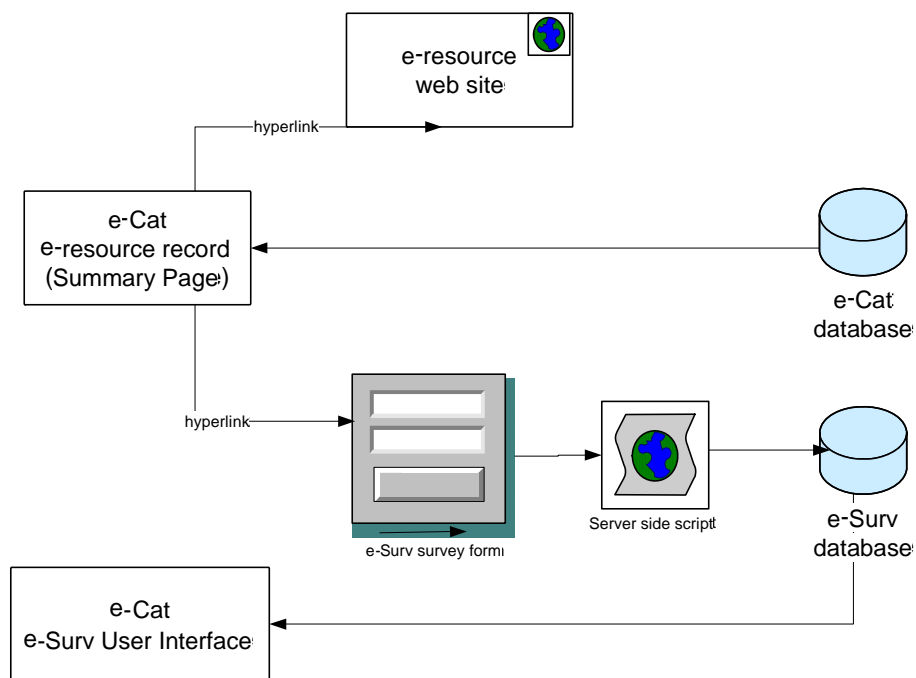
Figure 3. e-Cat and e-Surv links for survey by means of web forms and user interface

III. e-Cont: Electronic Contact Management of Users through the e-Cat

This is an add-on facility intended to follow up system registered users as well as other users who have shown interest, but have not been registered yet. It has a contact database where users are identified and their e-mails are recorded. It also has a web based user interface. The system then allows the administrator to send general mails, personal e-mails and, in general, manage the user contacts and potential new users. It is intended for increasing the use of the system, or for encouraging learners to carry out surveys on resources using the e-Cat. Another aim of this software package is to migrate it later to future projects that may need "contact management".

IV. User Types

Users are classified as unregistered and registered users. On the one hand, unregistered users are guests of the system. They can browse through and/or search the e-Cat. However, they can not enter any data into the system. They can only see the e-Cat records but they can not see any results about the surveys except the star-rating, which is available for all users. On the other hand, registered users are those who register to the system. They can behave as the administrator, super-users and ordinary users. Ordinary users can enter new e-catalogue entries as well as carry out evaluations for educational resources listed in the e-Cat by accessing the e-Surv system. They can not however carry out e-Surv evaluations for e-Cat entries which have been entered into the system by them. Super-users can do everything that an ordinary user can do and in addition they can see the results of the evaluations on the e-Cat entries. The administrator user can not do surveys but has system administration capabilities. The administrator can limit any bogus user further access to the system as well as the list all users, all surveys registered within the system and (s)he has the capability of re-setting passwords if needed.

6. Main Results and Sample Application

6.1 Main Results and Discussions

The main results of EIE-Surveyor Task-2 are the following:
1. Definition and establishment of a quality assessment methodology for electronic resources available over the Internet in the field of EIE.
2. Design and development of a web based software system that:
   - Provides a method for electronic cataloguing of e-resources (e-Cat),
   - Implements the EIE-Surveyor quality assessment methodology (e-Surv).

Further unexpected results are:
3. Development of the Contact Management Software (e-Cont).

The EIE-Surveyor Task-2 Quality Assessment Methodology and the relevant framework is given in section 4 of this report and it defines system requirements at a high level. The fundamental contribution of this methodology is the coupling of the electronic cataloguing of e-resources with that of e-resource surveying for quality assessment. The approach is based on "user-evaluation" technique but also allows "peer-evaluation" since the questionnaires can be filled by both the learners and instructors. Hence, it provides a hybrid approach in this sense. It is found through the testing phases that the electronic catalogue and electronic surveying of the learning material is a powerful technique and one that makes sense. Design of the e-Cat is based on the SCORM standard metadata defined for classifying learning objects. Design of the

questionnaire provides a flexible facility for quality assessment through a mixture of demographic, pedagogical, and technical questions. Design of the e-Surv allows storage of user filled surveys and can be used in different ways to establish the "quality" of the learning material referenced. The net result of the design of the e-Cat and the e-Survey is an integrated application with two separate databases. The evaluation rubric can be as complex as desired, however, for the purposes of this project a simplistic approach is taken where the answers to the pedagogical questions are evaluated. On the fly assessment allows the aggregation of the results for each resource and immediate display within the system. The evaluation results are linked to a star-rating for ease of understanding and representation.

On the unexpected results side, a number of unexpected facilities have resulted from the software development. These include the following:

i)   A dynamic web based software tool for cataloging, classifying and reporting instructional and learning material available over the Internet in the European area; and indeed globally if needed. The software allows classification according to a number of information fields. These classification information fields include the following: keywords, authors, language, interactivity type, interactivity level, type of learning resource, context, difficulty level, discipline and educational level.

ii) The software allows entry and maintenance of e-resource information, can be built over time, and may be maintained well beyond the lifetime of the project support period.

iii) A facility for searching and listing these resources based on the available search criteria.

iv) A facility allowing assessment and evaluation of the e-resources in the database by learners (e.g. students) and instructors again that can be accumulated over time leading to more dependable results.

v)   A facility for allowing statistics and evaluation data, obtained as a report from the e-resource evaluation database anytime such need arises.

vi) Contact management software which can be used to automate communications with contacts both in the context of EIE-Surveyor, Task-2 and other project contexts.

6.2 Project Achievements

The project has mostly met its targets in terms of outcomes. Under-achieved aspect is that during the lifetime of the project it has not been possible to collect a mediatheque of resources for quality surveying. Instead, more emphasis has been given to building up of a sound methodology, demonstrating that its works and also developing a web based electronic cataloguing system, and a web based surveying system, that is open ended and can be used to collect data at any time. The over achievement of the Task 2 is the fact that the tool developed is capable of open-ended collection of electronic learning resource data from users and it is also capable of providing continuous facility for survey. All these features make it very flexible and extensible in terms of data collection and analysis. Another over achievement of this task is the development of the contact manager software providing a facility for automated correspondence with users.

6.3 Sample Applications

In order to test the evaluation rubrics for the survey results the evaluator-answers matrix is used. Table 6 shows the sample application of the evaluation rubric for a hypothetical resource. The user survey answers are randomized and the necessary averages are indicated. It can be seen that the averages for individual questions can be used to determine globally about the result of the question. For example, in Q1, the average is 2.0 and this corresponds to the undergraduate (UG) selection. Similarly Q4 gives an average of 2.9 which is closest to organized learning activity,

indicating that the mean responder is a student in an institution. Individual assessor's average value of answers can be calculated as shown in Tables 5 and 6. Table 5 is a summary of Table 6 and it specifically shows the average of answers to specific questions for each evaluator and can be considered as an overall indication of quality measure for the hypothetical e-resource.

Table 5. Averaging answers to the pedagogical questions (for a hypothetical resource)

Evaluator#	Average of Q5-13 & Q20-23; (out of 5)
Evaluator1	3.71
Evaluator2	4.28
Evaluator3	2.86
Evaluator4	1.31
Evaluator5	3.31
Evaluator6	1.96
Evaluator7	3.03
Evaluator8	3.22
Evaluator9	2.86
Evaluator10	4.44
AVERAGE	**3.10**

Table 6. Sample Application of the Evaluation Rubric (for a hypothetical resource)

	Type of Users				Evaluation of the Quality of Contents									Technical Evaluation						Overall User Satisfaction					AVG of Q1-4	AVG of Q5-13	AVG of Q14-17	AVG of Q20-23	AVG of Q5-13 & Q20-23 (Out of 5)
	Evaluator Level of Education	Evaluator Level of Competence/Expertise	Evaluator Level of Competence in Pre-Req	Teaching, Org-Learning, Self-Learn, Cont-Learn, NoT	Clear presentation of objectives	Material at Correct Level	Clear & Easy to Understand	Visualisation techniques used	Increased my knowledge	Adequate examples given	Useful exercise/problems available	Material fulfilled expectation	Time recommended was OK	My computer has adequate HW	My computer has adequate SW	My computer has adequate BW	Clear Material Layout & Easy to Navigate	Reached this material from Surveyor	If NO; Source of the Link	I will recommend to my friends	Material useful for my career/education	Material provided a different approach	Rate this material in relation to others	Reference to other valuable resources					
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24					
Max. Rating:	4	4	4	4	5	5	5	5	5	5	5	5	5	4	4	4	4	N/A	N/A	5	5	5	5	N/A					
Evaluator1	4	4	4	4	5	5	5	3	1	3	4	4	3	4	4	4	3			4	3	4	4		4.00	3.67	3.75	3.75	3.71
Evaluator2	3	3	3	1	4	5	3	4	3	4	3	4	2	4	3	3	4			5	5	5	5		2.50	3.56	3.50	5.00	4.28
Evaluator3	2	2	1	3	4	2	2	1	2	2	3	3	2	3	3	3	3			3	3	4	4		2.00	2.22	3.00	3.50	2.86
Evaluator4	1	1	1	2	1	1	1	2	1	1	1	1	1	4	4	4	2			2	1	2	1		1.25	1.11	3.50	1.50	1.31
Evaluator5	0	4	4	1	3	3	3	4	4	3	2	3	3	2	4	3	1			3	3	4	4		2.25	3.11	2.50	3.50	3.31
Evaluator6	3	1	1	4	1	1	1	2	2	1	1	3	3	4	3	3	4			2	2	2	3		2.25	1.67	3.50	2.25	1.96
Evaluator7	2	3	4	3	2	3	4	5	4	2	3	4	5	1	2	3	4			4	3	2	1		3.00	3.56	2.50	2.50	3.03
Evaluator8	2	4	4	3	5	4	3	2	3	5	4	3	2	1	4	3	2			3	4	3	2		3.25	3.44	2.50	3.00	3.22
Evaluator9	2	4	1	4	1	2	3	4	5	2	3	4	5	3	4	2	1			3	2	1	4		2.75	3.22	2.50	2.50	2.86
Evaluator10	1	4	4	4	5	5	5	4	5	5	5	5	5	4	4	4	4			5	5	5	1		3.25	4.89	4.00	4.00	4.44
AVGs	2	3	2.7	2.9	3.1	3.1	3	3.1	3	2.8	2.8	3.4	3.1	3	3.5	3.2	2.8	N/A	N/A	3.4	3.1	3.2	2.9	N/A	2.65	3.04	3.13	3.15	3.10
AVG. nearest to	UG	ADV.	Int-Adv.	Org-Learn	Neutral	Neutral	Neutral	Neutral	Neutral	Disag-Neutr	Disag-Neutr	Neutr-Agree	Neutral	Enough	Enough-MTE	Enough	NE-Enough			Neutr-Agree	Neutral	Neutral	Neutral						

7. Conclusions and Suggestions for Future Use

E-learning or perhaps network assisted learning, together with computer assisted learning, has become a new educational paradigm in the last decade. The web has made available a huge amount of e-learning applications and material. A large number of Internet based electronic (e-resources) are now available around Europe. The aim of EIE Surveyor Project's Task-2 was to develop a methodology for quality assessment of e-resources. The methodology developed is composed of two main parts. A web based electronic catalogue (e-Cat) system for storing summary information about the e-resources comprises the first part. This has been developed and tested. It has been found that a number of useful type classifications of available e-resources can be done using this catalogue. The second part is composed of a web based electronic survey (e-Surv) which allows registered users to evaluate any e-resource linked through the summary information records in the e-Cat. The methodology incorporates a method for determining quality. This is based on the simple averaging of the answers by users to the pedagogical questions posed in the survey questionnaire. The evaluation rubric consists of averaging individual assessor's answers and then finding the mean over all the assessments carried out for that particular e-resource. This overall average value of marks is then used to provide a star rating for the e-resource under evaluation. Hence, a star-rating of from 0 to 5 stars can be obtained for any e-resource listed in the catalogue. This star rating method, obtained from user evalutaions generates an averaged index value of user satisfaction, displayed next to each resource subscribing to the e-Cat. Star-rating as a measure of user satisfaction, which in turn is related to the issue of "what is claimed by the e-resource" and what is "measured or assessed by the user". This could also be a measure of the usefulness of the resource as far as the user group is concerned.

The software development is completed and it incorporates the quality assessment methodology proposed. It has been tested extensively as a pilot task and further improvements have been achieved. It has been shown that the simple minded approach to the assessment of "quality" of e-resources can be carried out with additional benefits for users, indicating user satisfaction as a star-rated measure.

It is observed that both the e-Cat and the e-Survey can be used beyond the lifetime of this project. Indeed, through discussions with colleagues responsible for both the European Association for Education in Electrical and Information Engineering (EAEEIE) and the new EU Socrates Thematic Network project the ELLEIEC (Enhancing Lifelong Learning for the Electrical and Information Engineering Community), it has found wide acclaim for using it within both domains. One particular use within the EAEEIE would be to run the software on a server which is supported continuously and invite academicians and others to enter e-resource information and links into the catalogue. After some initial time, this could prove to be a very useful repository for EIE related material for e-learning. Further, the surveys can be carried out at any time resulting in the star-rated assessment of each resource by users. It could provide a useful tool within the EIE community for research as well as teaching and learning. In the case of ELLEIEC, the software tool can be further developed to include the various classification techniques for the e-resources as well as adopt it for use in lifelong learning activities within the field of EIE.

8. References

[1] J-M. Thiriet, "EIE-Surveyor: Reference Point for Electrical and Information Engineering in Europe", (Project Number: 225997-CP-1-2005-1-FR-ERASMUS-TNPP), EIE-Surveyor Proposal Document Version 5, March, 2005.

[2] E. E. Beck, "Learning Management Systems: The Need for Critical Analyses", ACM CC '05: Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility, CC'05, pp. 173-176, 2005.

[3] D. Wiley, "Connecting learning objects to instructional design theory: a definition, a metaphor, and a taxonomy", in D. A. Wiley (Ed.), "The instructional use of learning objects". [Online]. Available: http://reusability.org/ read/chapters/wiley.doc, (last accessed: 11/09/2008).

[4] ADL (Advanced Distributed Learning), "SCORM 2004 3rd Ed.", [Online]. Available: http://www.adlnet.gov/scorm/index.aspx (last accessed: 10/09/2008).

[5] IMS Global Learning Consortium, "LRM - Learning Resource Metadata", [Online]. Available: http://www.imsglobal.org/metadata/ (last accessed: 10/09/2008).

[6] IMS Global Learning Consortium, "LDS - Learning Design Specification", [Online]. Available: http://www.imsglobal.org/learningdesign/index.html

[7] MERLOT - Multimedia Educational Resources for Learning and Online Teaching, [Online]. Available: http://www.merlot.org/merlot/index.htm, (last accessed: 10/09/2008).

[8] CLOE - Cooperative Learning Object Exchange, [Online]. Available: http://learnware.uwaterloo.ca/projects/CCCO/cloe_stories.html , (last accessed: 10/09/2008).

[9] ARIADNE, Foundation for the European Knowledge Pool. [Online]. http://www.ariadne-eu.org/ . (last accessed: 11/09/2008).

[10] BCCAMPUS, "Final Report on Software Evaluation for a Learning Object Repository for BCcampus", [Online]. Available: http://www.bccampus.ca/Page227.aspx , (last accessed: 10/09/2008).

[11] G. S. Peace, "Taguchi Methods: A hands-on approach to quality engineering". Addison Wesley, 1995.

[12] A. Sarasa and J. Dodero, "Towards a Model of Quality for Learning Objects", Proc. of the IEEE International Conference on Advanced Learning Technologies (ICALT'04), September, 2004.

[13] K. Chang, "Learning Objects: Draft Quality Criteria and Quality Assurance Approach for LearnAlberta.ca and the Society of Advancement of Exellence in Education", FuturEd Consulting Education Futurists, (2006).

[14] D. Williams, "Evaluation of learning objects and instruction using learning objects", in D. A. Wiley (Ed.), The instructional use of learning objects. [Online]. Available: http://reusability.org/read/chapters/williams.doc , (last accessed: 10/09/2008).

[15] B.R. Worthen, J.R. Sanders and J.L. Fitzpatrick, "Program evaluation: Alternative approaches and practical guidelines", New York: Longman, 1997.

[16] J. Nesbit, K. Belfer, and J. Vargo, "A Convergent Participation Model for Evaluation of Learning Objects", Canadian Journal of Learning and Technology, Volume 28(3) Fall/Autumn, (2002), [Online]. Available: http://www.cjlt.ca/content/vol28.3/nesbit_etal.html (last accessed: 10/09/2008).

[17] D. Z. Deniz, J. L. Marzo, S. Stefanova and J-M. Thiriet, "Cataloguing and Quality Assessment of Some Resources in EIE Available Through the Internet", Proc. of EAEEIE'07, Praha, Czech Republic, 2-4 July, 2007.

[18] EAEEIE. [Online]. Available: http://www.eaeeie.org/

[19] CANARIE, "eduSource Canada: Canadian Network of Learning Object Repositories", [Online]. Available: http://www.edusource.ca/english/home_eng.html, (last accessed: 10/09/2008).

[20] Carlos Vaz Carvalho and Isabel Azevedo, SCORM summary: SCORM metadata for educational contents classification, private correspondence to EIE-Surveyor T2 members, April, 2006.

[21] U.-D. Ehlers, L. Goertz, B. Hildebrandt, J. M. Pawlowski, "Quality in e-Learning", EQO-European Quality Observatory, Cedefop Panorama Series, 2005.

[22] ISO/IEC JTC1 SC36, "ISO/IEC 19796-1: How to Use the New Quality Standard for Learning, Education, and Training", Publication Number: N1440, 2005.

[23] D. Z. Deniz, J. L. Marzo, Denis Genon-Catalot and J-M. Thiriet, "A Quality Assessment Methodology for EIE Resources Available Through the Internet", Proc. of EAEEIE'08, Tallinn, Estonia, 29 Jun - 2 Jul., 2008.

[24] MECA-ODL: Methodology for the Analysis of Quality in ODL Through Internet, [Online]. Available: http://www.adeit.uv.es/mecaodl/ , (last accessed: 14/09/2008).

[25] H. Rego, T. Moreira, F.J.G. Peñalvo, "Learning Objects Management and Evaluation in an e-Learning Environment", [Online]. Available: http://www.usal.es/~teoriaeducacion/rev_numero_06_2/n6_02_art_rego_moreira_garcia.htm (last accessed: 10/09/2008).

[26] E. Morales Morgado et al, "Learning objects evaluation", Proc. of m-ICTE'05, Caceres, Spain, June 7-10, 2005, pp. 1032-1037.

[27] M.E. Del Moral and D.A. Cernea, "Design and Evaluate Learning Objects in the New Framework of the Schematic Web, Proc. of m-ICTE'05, Caceres, Spain, June 7-10, 2005, pp. 1032-1036

[28] BECTA, [Online]. Available: http://www.becta.org.uk/ , (last accessed: 10/09/2008).

[29] F. Paulsson and A. Naeve, "Establishing technical quality criteria for Learning Objects", To be published in the proceedings of eChallenges 2006, Barcelona, Spain, 2006.

[30] F. Paulsson and A. Naeve, "Virtual Workspace Environment (VWE): A Taxonomy and Service Oriented Architecture Framework for Modularized Virtual Learning Environments - Applying the Learning Object Concept to the VLE", Int. Journal on E-Learning, vol. 5, 2006, pp. 45-57.

[31] D.A. Wiley (Ed.), "The Instructional Use of Learning Objects", 1st Edition, Bloominton: Agency for Instructional Technology and Association for Educational Communications & Technology, 2002, pp. 15-19.

[32] W. Kraan and S. Wilson, "Dan Rehak: SCORM is not for everyone", vol. 2006: the Centre for Educational Technology Interoperability Standards (CETIS), 2003.

[33] J. Soto, E. García, and S. Sánchez-Alonso, "Semantic learning object repositories", International Journal of Continuing Engineering Education and Life-Long Learning, 2007. [Online]. Available: http://www.cc.uah.es/ssalonso/papers/Soto_Garcia_Sanchez_IJCEELL.pdf , (last accessed: 10/09/2008).

[34] IEEE LOM (2002). IEEE Learning Object Metadata Specification, [Online], Available: http://ltsc.ieee.org/wg12/ (last accessed: 14/09/2008).

9. Appendices

9.1 Task-2 Web Site Screen Shots

The EIE-Surveyor Task-2 Web site can be found at the URL: http://www.bahar.web.tr/Survey/ . This site provides an implementation of the Task-2 objectives defined in the report. Below are some relevant screen shots showing different functionalities of the site.
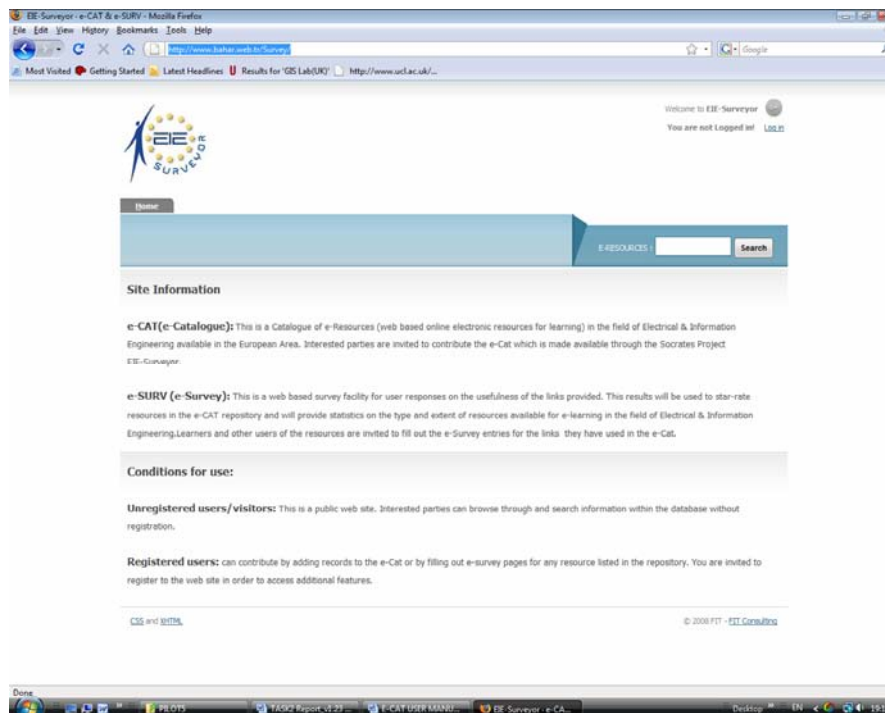

Figure 4. Main (index) page of EIE-Surveyor (Task-2 web site)
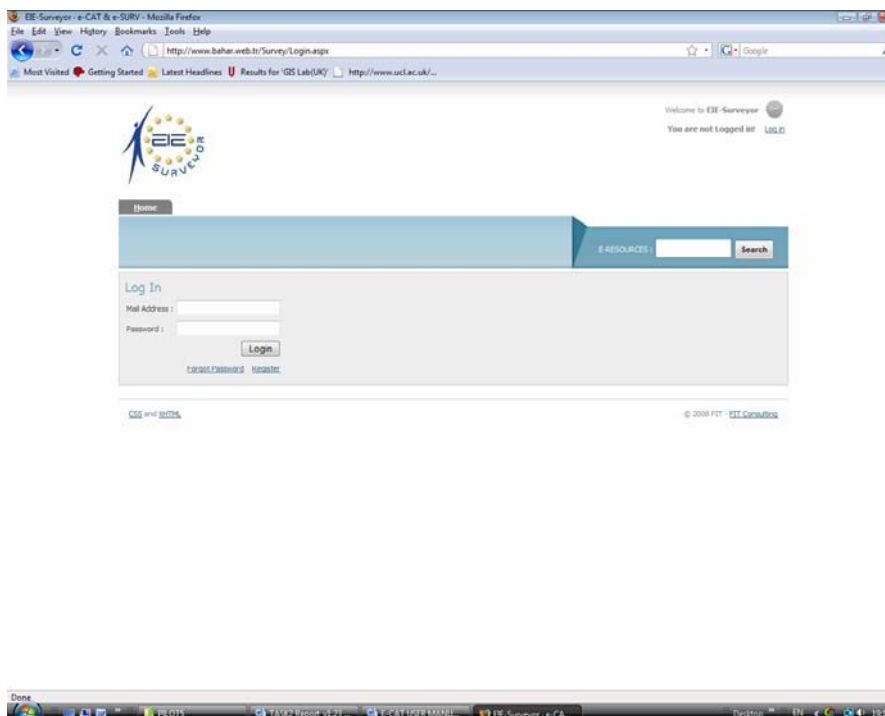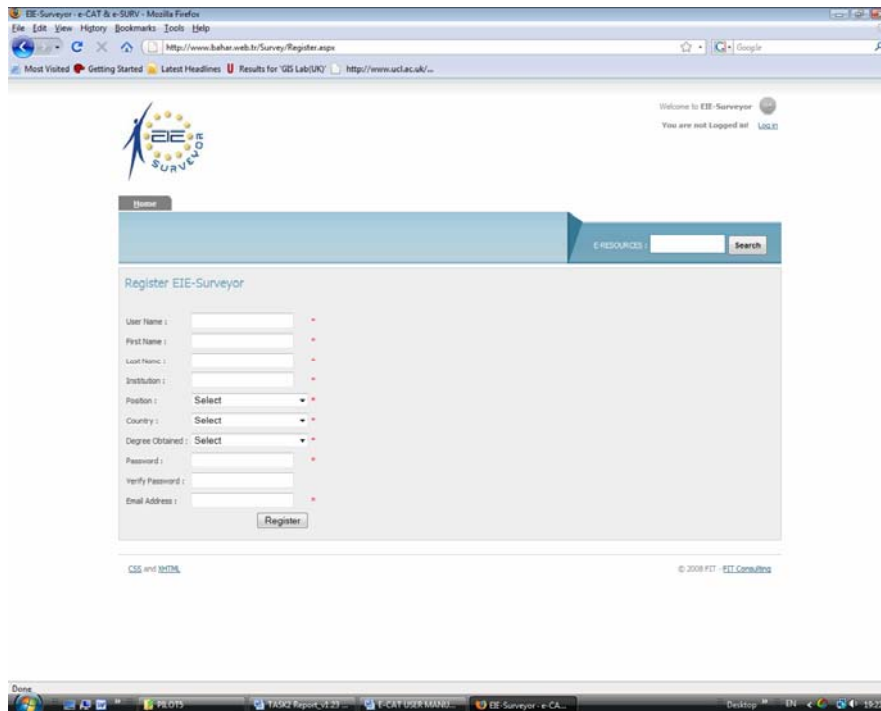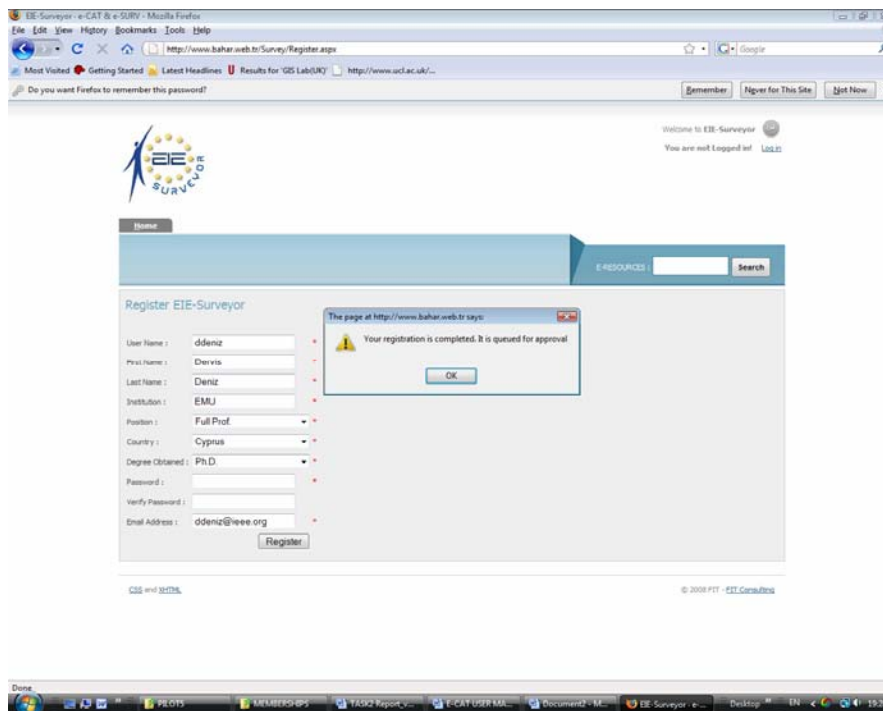

Figure 5. Login page (Task-2 web site)

Figure 6. Page for registration of a new user (Task-2 web site)

Figure 7. Registration complete page of a new user (Task-2 web site)

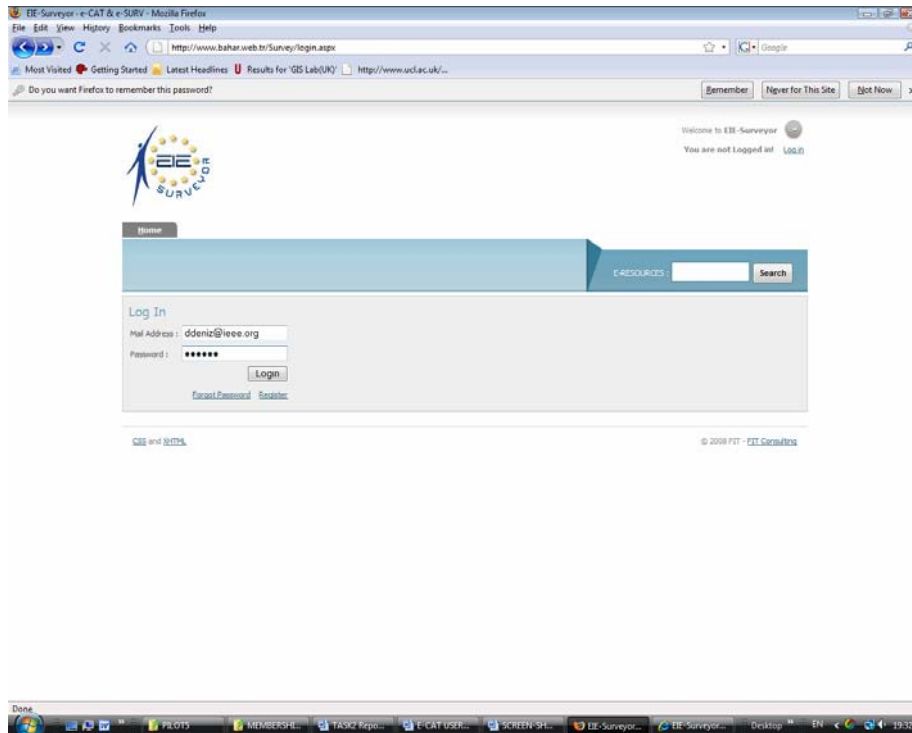**Figure 8.** Login page for the new user (Task-2 web site)
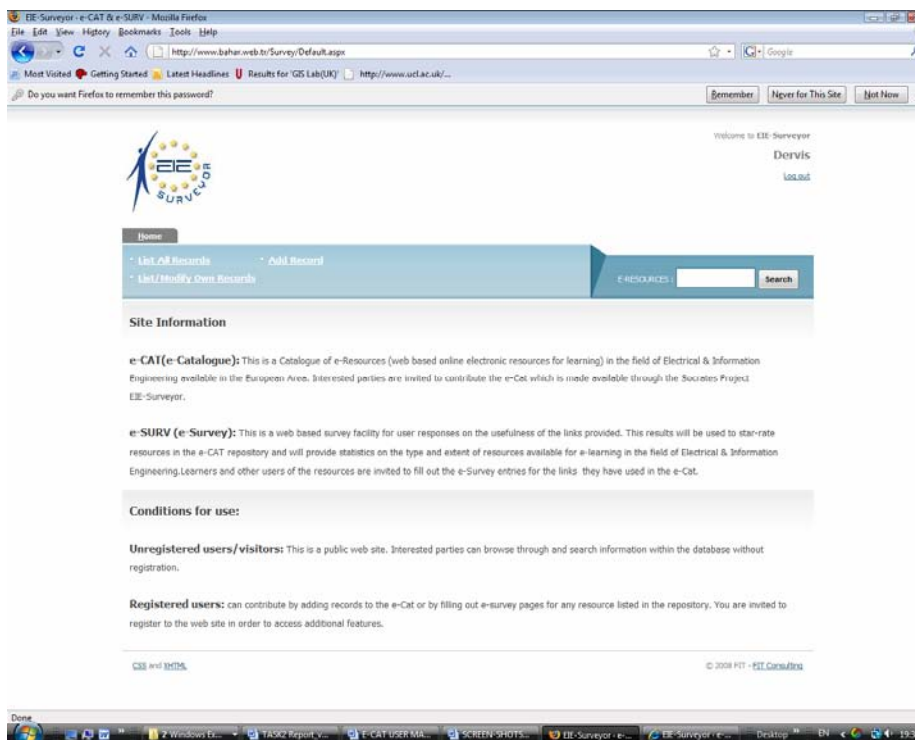
Figure 9. Main page after logging in for the new user (Task-2 web site)
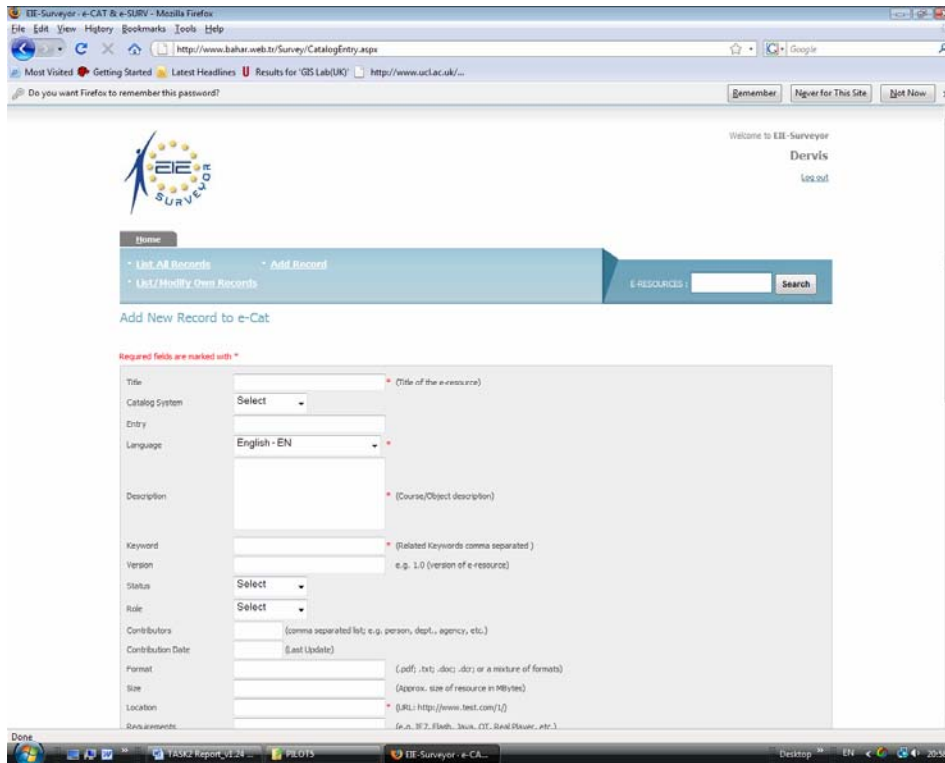
Figure 10. Record selection for the new user (Task-2 web site)

Figure 11. Record selection (bottom of page) for the new user (Task-2 web site)

Figure 12. Admin user login main page (Task-2 web site)

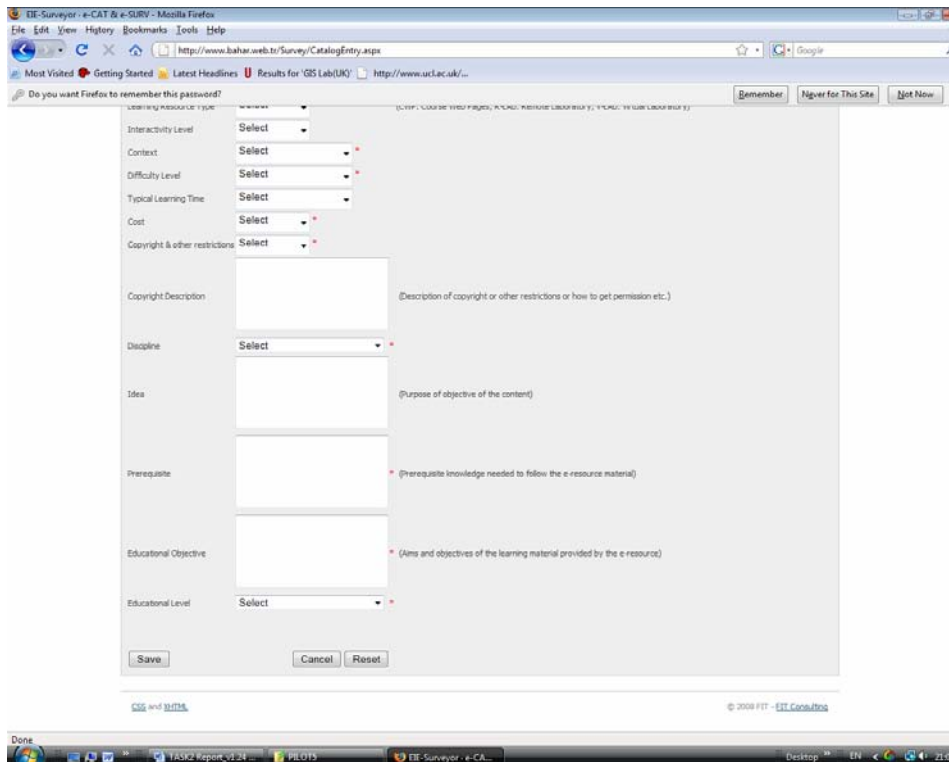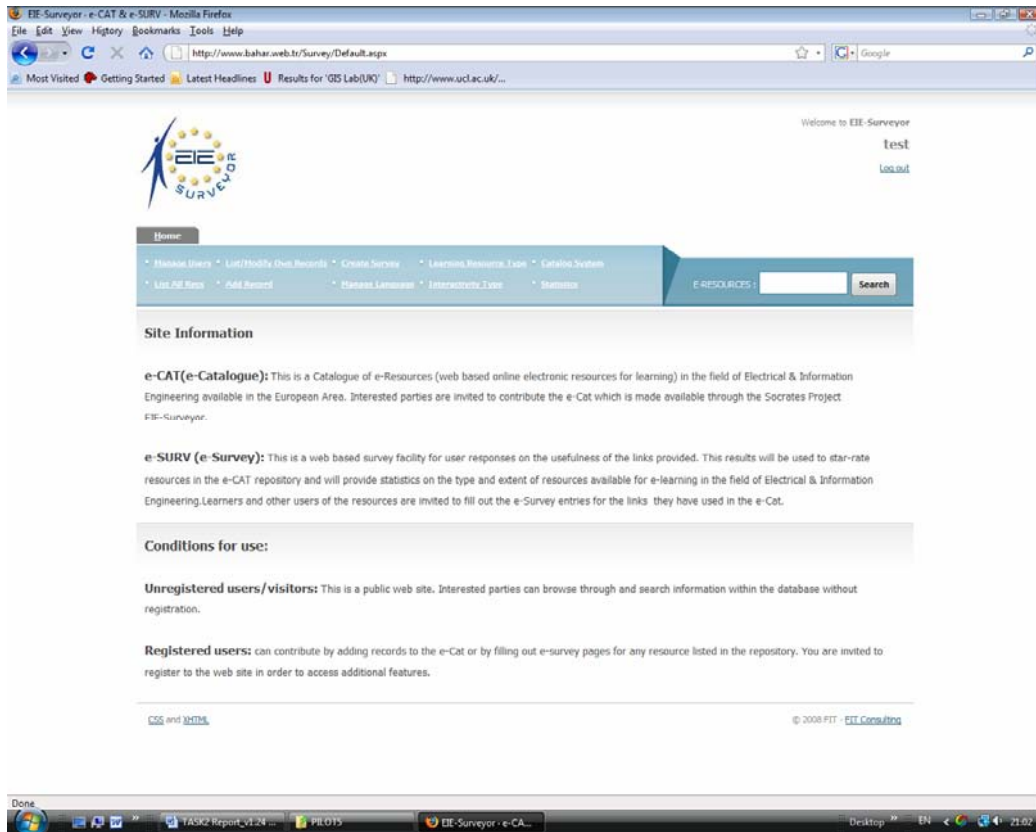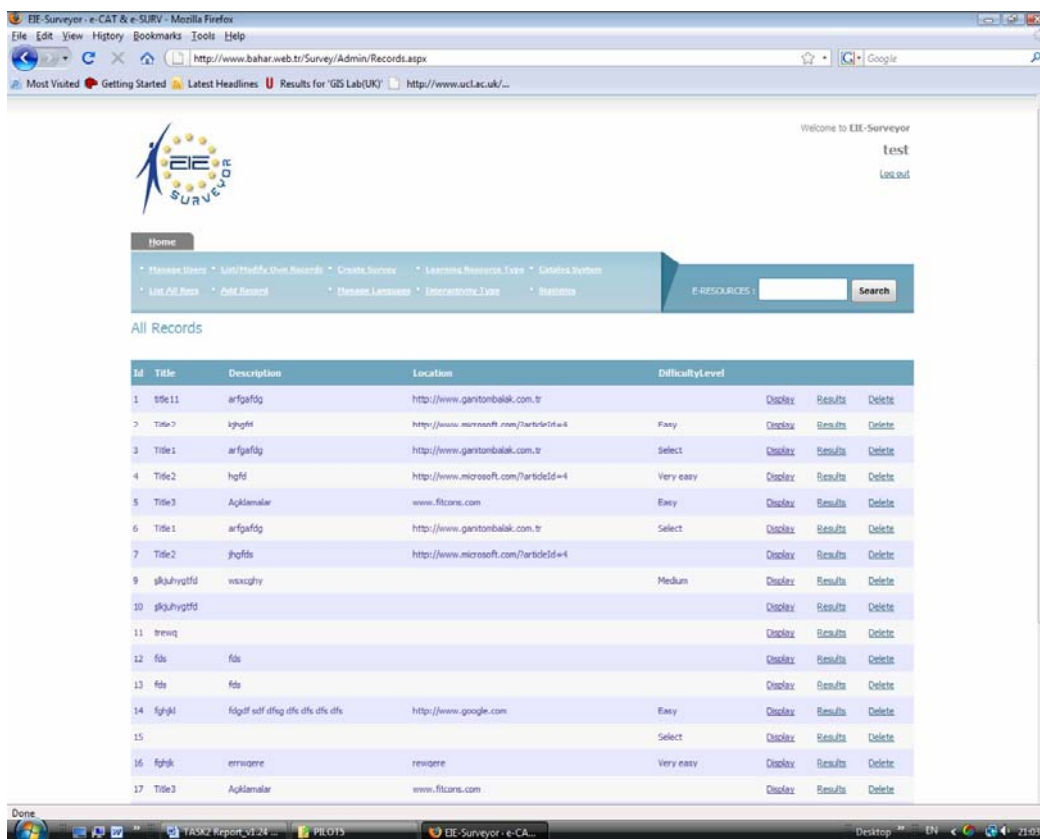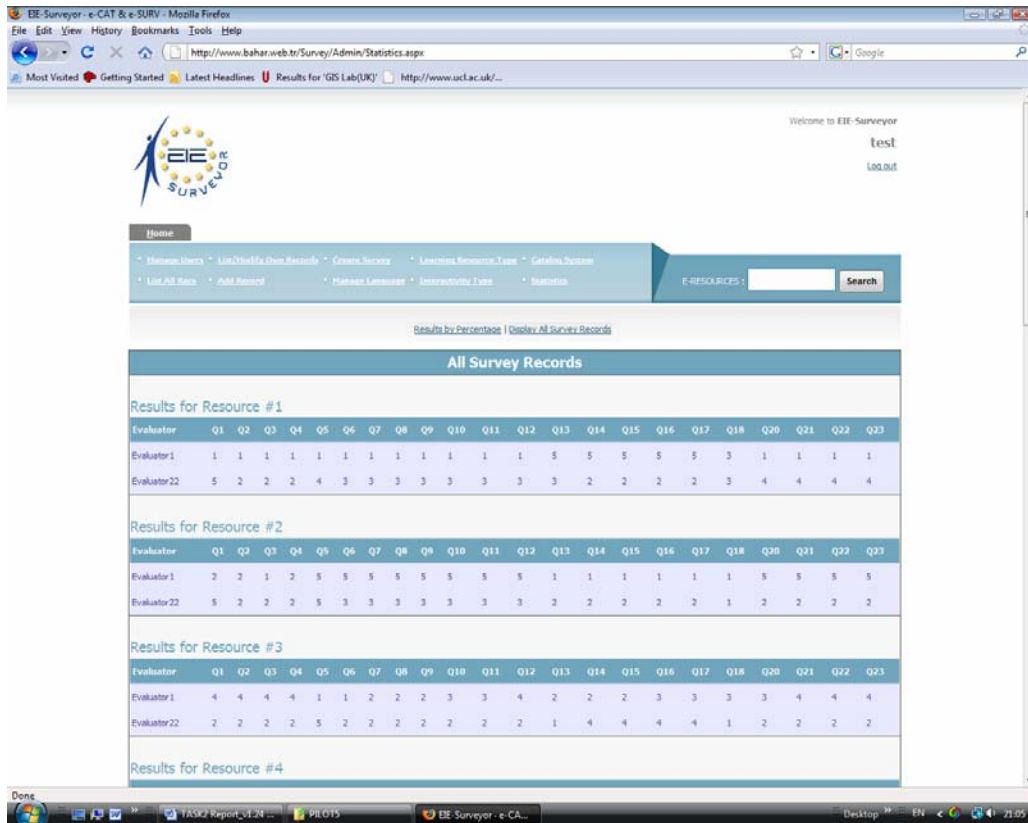**Figure 13.** Admin user list all records page (Task-2 web site)

Figure 14. Admin user statistics → display all survey records page (Task-2 web site)
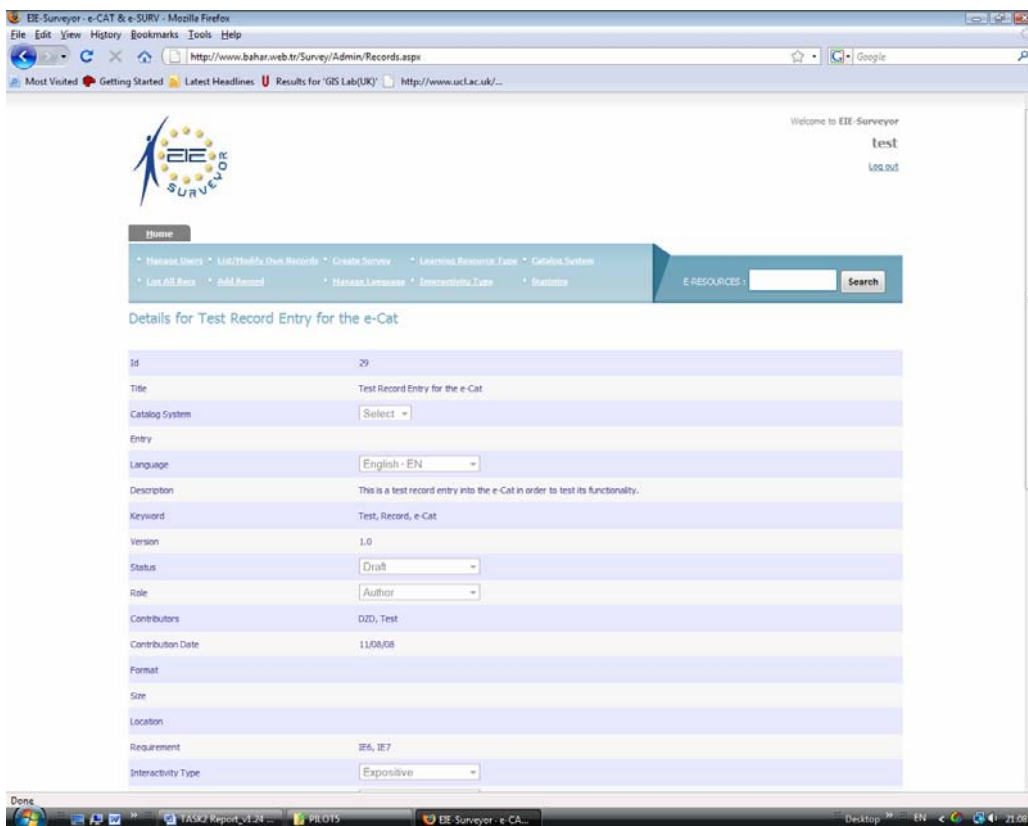

Figure 15. Admin user display details of a test record entry (Task-2 web site)

e-Catalogue and e-Survey
Web Portal of
EIE-Surveyor Project - Task 2

User Manual
(v3.0)
Date: 10th September, 2008

Descriptions:

EIE-Surveyor: This is the EU Socrates project (2005-2008) with the declared objectives of:

- Reflection on generic competences and subject-specific competences in Electrical and Information Engineering (EIE)
- Implementation of quality assessment methodologies on some educational resources available in EIE
- Reflection and proposition of a methodology for accreditation, to enhance comparability and common certification procedures
- Proposition of a census of the existing curricula in EIE in Europe, the multinational degrees, and the situation of the implementation of the Bologna-process in EIE, at the bachelor, master and PhD levels.

URL: http://www.eie-surveyor.org/

Relationship to the EIE-Surveyor Questionnaire Web Portal:
This web portal has a link from the EIE-Surveyor Questionnaire Web Portal.
URL: http://laraweb.fei.tuke.sk/questionnaires/

EIE-Surveyor Task 2: This is the task within the EIE-Surveyor project that deals with the "quality" assessment of some educational resources available through the Internet in the field of Electrical and Information Engineering. In order to do this "quality" assessment e-resources need to be catalogued. This is done using the *e-Catalogue* system. Quality assessment is to be done using an online form based questionnaire that accepts user responses to a number of questions designed to help assess the popularity/usefulness of e-resources from the point of users. This is done using the *e-Survey* system.

e-Cat (e-Catalogue): This is an electronic catalogue (e-Cat) system. It is a repository of electronic resources (e-Resources: web based online electronic resources for learning) available in the field of Electronic and Information Engineering (EIE) within the European arena.
   This web site provides a facility for interested parties to contribute to the e-Cat. This can be done by entering summary information about their e-resources available over the Internet. These resources could include resources such as course web pages, course/lecture notes, tutorials, solution manuals, visualisation packages, simulators, virtual labs, remote labs, software, and other e-learning materials. Each e-Cat entry is a record for an e-resource or a collection of e-

resources reachable through a given URL (link). E-cat entries keep summary data about each e-resource in a modified SCORM (Sharable Content Object Reference Model) metadata format.

   It is advised that each e-Cat entry be used to have a link directly to the resource described. Multiple e-resources available from one URL may be entered separately as distinct e-resources for ease of classification and access.

e-Surv (e-Survey): This is a web based survey facility for user responses on the usefulness of the links provided. These results will be used to star-rate resources in the e-Cat repository and will provide statistics on the type and extent of the resources available for e-learning in the field of Electronic and Information Engineering. Learners and other users of the resources are invited to fill out the e-Survey entries for the links they have used in the e-Cat.

1. e-Cat (e-Catalogue) and e-Surv (e-Survey) GENERAL

i) Unregistered Users/Visitors:
Unregistered users or visitors to the e-Catalogue web page can search material entered in the database through the e-Cat using the "Search" link on the right hand side of the main page. E-survey is not available for use by unregistered users/visitors.

ii) Registered Users:
Registered users can enter new records (summary information and link to e-resources) into the e-Cat, they can maintain these records, they can search through the e-Cat for information and they can carry out e-Survey on any record within the e-Cat except the ones that they have added to the repository.

a) Registration: to register to the system please select the "Register" option on the login page which is opened by selecting the login button on the upper right hand side of the main page. The registration page requests the entry of the following information: First Name, Surname, Institution, Position (optional), Country, Degree, E-mail, Username, Password and Confirmation of Password. Once the "Register" button is pressed, the record is entered into the users' repository and the user is sent a confirmation mail that his account is opened. The mail is sent to the e-mail address provided. The user is authorised to enter the system after approvals by the site administrator.

b) Using the e-Cat: Registered users can "List All Records", "List/Modify Own Records", "Add Record", and "Search" within the e-Cat.

c) Using the e-Surv: Once a registered user logs in, e-Survey can be carried out by first selecting "List All Records" or by searching the records in the e-Cat, (visiting the link indicated in the e-cat record to assess its usefulness) and then by selecting the "Evaluate" option on the page. Once this is selected, a questionnaire is presented which must be filled as indicated and submitted to the e-Surv repository. Persons entering new records into the system can not evaluate their own e-resources. However, they can evaluate as many of the other resources as they like but for each resource this can be carried out only once. Multiple evaluations from a given user for a given resource just over-writes the previously entered values. This is designed as described to avoid multiple evaluations of one resource by a given user.

d) Displaying the e-Survey Results: This function is only available for super-users. Super users are determined by the administrator. Survey results for any e-resource can be displayed through either the "List All Records" or the "Search e-Cat" option and then by selecting the individual

resource, the resource's page is brought up on the screen where it allows the selection and hence displaying of the results of the survey accumulated so far on the selected resource.

2. Using the e-Cat
i) Add Record:
Each record in the e-Cat consists of the following fields (with explanations and examples):
Key: [A]/[O]/ [M]: Auto-increment/Optional/Mandatory field.

General
[A] 1.1 Identifier: This is the content identifier and is auto-incremented by the system and hence this field is not displayed for the user at new record entry.

[M]1.2 Title: Title of the Internet based resource (e-resource); e.g. "EE456 Multimedia Networking Course Web Page".

[O] 1.3.1 Catalogue System: Name of a known cataloguing system (e.g. ISBN or ISSN) if any.

[O] 1.3.2 Entry: Value representing the e-resource within the catalogue system: e.g. ISBN 100220304.

[M]1.4 Language: Course/object language (e.g. English, French, German, etc.)

[M]1.5 Description: Descriptive text for the e-resource (e.g. Technical Elective Course web page).

[M]1.6 Keyword(s): Comma separated list of keywords appropriate for the content of e-resource; e.g. Multimedia, Networking, etc.).

Life Cycle
[O] 2.1 Version: Version number of the e-resource document/facility (if any); e.g. v1.0

[O] 2.2 Status: Indication of whether the e-resource is Final or Draft.

[O] 2.3.1 Role: Select; Author; Editor; Contributor; Publisher; Unknown.

[O] 2.3.2 Entity (Contributor(s)): None or Comma separated list of contributing authors/organisations for the course/object (e.g. person, dept., agency, etc.)

[O] 2.3.3 Contribution Date: Contribution date; e.g. date of last update.

Technical
[O] 4.1 Format: Format of the document/site, tool, or e-resource; e.g. .html, .doc, .pdf, .xml, etc.

[O] 4.2 Size: Approx. size of the e-resource (i.e. in mega bytes); if appropriate.

[M]4.3 Location: URL of the resource; e.g. http://www.utopia.edu/ECE/ee456/index.htm

[O] 4.4 Requirement: Technical requirements for object/course commitment; e.g. Flash, Direct X, etc.

Educational
[O] 5.1 Interactivity Type: Indicate the amount of interactivity required by the e-resource (e.g. Select; active, expositive (just display and read), mixed, undefined.

[M]5.2 Learning Resource Type: Indicate what best describes the type of the e-resource; Select;
> CWP (Course Web Page/Site); Lecture Notes; e-book; Tutorial; Examples; Solutions; R-LAB (Remote Laboratory); V-LAB (Virtual Laboratory); Simulation; Software; Other.

[O] 5.3 Interactivity Level: Indicate what best describes the type of the e-resource; Select; Very low; Low; Medium; High; Very high.

[M] 5.6 Context: Further Education (Further Edu.); University 1st Cycle; University 2nd Cycle; University 3rd Cycle; Tech. School 1st Cycle; Tech. School 2nd Cycle; Professional

Formation (Professional); Continuous Formation (Continuous Edu.); Vocational Training (Vocational)

[M] 5.8 Difficulty Level: Select; Very easy; Easy; Medium; Difficult; Very difficult

[O] 5.9 Typical Learning Time: Select; Less than 1 hr; 1-2 hrs; 3-5 hrs; 6-10 hrs; >10 hrs.

Rights

[M] 6.1 Cost: Indicate whether the e-resource usage is at cost or is free; Select; Yes; No; Don't Know.

[M] 6.2 Copyright: Indicate if the e-resource has a copyright (i.e. select yes or no).

[O] 6.3 Description of Copyright: Describe the nature of the copyright; (e.g. (c) Univ. of Padoa).

Classification (Purpose and Objective of the Course)

[M] 9.1.1 Discipline: Indicate the title of the program/discipline area within/related to the Electrical and Information Engineering the e-resource relates to: Select; or one of the following in the list: (Electrical Engineering, Electronic Engineering, Electrical and Electronic Engineering, Electrical and Computer Engineering, Electronic and Computer Engineering, Electrical and Information Engineering, Electronic and Information Engineering, Electrical Engineering and Computer Science, Electronic Engineering and Computer Science, Communications Engineering, Communications and Control Engineering, Computer Network Engineering, Computer Studies, Computing, Computer Science, Computer Engineering, Computer Science and Engineering, Information Engineering, Informatics, Software Engineering, Management Information Systems, Computer Education and Instructional Technology, Electronics and Computer Education), or Other (If Other is selected a new text box will open and accept the new entered Discipline/Program/Department name)

[O] 9.1.2 Idea: Indicate the idea behind the e-resource (purpose & objective of the content); e.g. To provide in-depth analysis of the subject area or to provide supplementary notes for the EE456 Multimedia Networking Course given at the Univ. of Padoa.

[M] 9.1.3 Pre-requisite: Indicate the prerequisite knowledge areas or course needed to follow the contents of the e-resource; e.g. Computer Networks.

[M] 9.1.4 Educational Objective: Indicate the educational objective of the e-resource; e.g. covers the course requirements of the technical elective for computer Engineering BS degree 4th year course.

[M] 9.1.6 Educational Level: Select; Introductory; Normal; Advanced.

ii) List/Modify Own Records:

This selection brings up the list of the records entered by the user. Using this option a user can maintain his/her own records. By selecting any of the records entered by oneself, a user can then display and modify/update any record entered into the system by himself/herself. No record entered by others can be modified. If any errors are spotted in any record by non-owners of the record, this can be corrected by editing the record by pressing the edit button at the bottom left hand corner. Alternatively these errors can be corrected by reporting these to the administrator of the site.

iii) Search:

A text based search is available within the whole of the e-Catalogue. By entering a text all records within the e-Cat can be searched and the results are displayed. Results are the records

that contain the "text" entered anywhere within the record. This way either title, keyword or author searches are included in such a search.

3. Using the e-Surv
E-Survey results are only visible to the administrator and super-users. Normal users can carry out surveys but they can not see the survey results. Authorised persons are given super-user status by which they can access the survey results. E-Survey provides a summary of the answers as a percentage of answers falling to selections. User answers are kept anonymously for making the statistics of the survey results available. Hence, no user information is kept to identify the person who has carried out the survey. To activate from "home" do: "Search (with no text) / List all records → Display of all records available in the system appears → select "Results" button on the right hand side of the record that you want to see the statistical evaluation of.

Second Part

Analysis of existing accreditation procedures, proposition of a methodology

2nd part: Analysis of existing accreditation procedures, proposition of a methodology

Main contributors: Daniel PASQUET (Ecole Nationale Supérieure de l'Electronique er de ses Applications, Cergy, France), Fernando MACEL-BARBOSA (Faculdade de Engenharia da Universidade do Porto, Portugal), Cyril BURKLEY (University of Limerick, Ireland), Michael HOFFMANN (Universität Ulm, Germany)

1. Introduction

During the follow-up conferences to Bologna, the Ministers recognized the important role that quality assurances systems play in ensuring high quality standards and in facilitating the comparability of qualifications throughout Europe. Universities and other institutions were encouraged to share information on best practice and to design scenarios for mutual acceptance of evaluation and accreditation processes. As a result national accreditation agencies have been established in many countries, but at present the accreditation process differs between the different countries. Building on the preliminary study that was undertaken in the THEIERE project, the EIE-Surveyor project collected information on the various processes and procedures of accreditation and evaluated the accreditation processes in the participating countries.

The EIE-Surveyor project also reviewed the results of the EUR-ACE project (European accreditation of European Engineering and graduates) [1], which was a consortium of 14 partners, supported by the European Commission. The objectives of the EUR-ACE project were (i) to ensure consistency between existing national engineering accreditation systems, (ii) establish a European "quality label" for accreditated programmes and (iii) assist with the establishment of accreditation in European countries where it does not yet exist, thus improving the quality of engineering education, facilitating transnational recognition and mobility of engineering graduates.

The EIE Surveyor task also considered how the EUR-ACE results could be applied to the field of electrical and communication engineering.

2. Main points to be considered

The EUR-ACE project evaluated the various factors that should be taken into consideration when assessing an engineering programme. These have been used as the guideline for constructing the questionnaire. They are gathered into six domains.

2.1. General information and curriculum
The general points concerning the curriculum are:
- Identification of educational goals
- Profile of the programme
- Duration, workload, ECTS
    A difference must be made between the duration of courses, tutorials and practical works and the actual workload, which includes the personal unsupervised study time of the students.

- Teaching methods
- Programme structure
- Programme content
- Number and duration of internships or work placements
 The internships may be in academic laboratories or in industry.

2.2. Professors and academic staff
- Teaching staff (number, specialisation, qualification)
   The ratio between professors and other academic staff is considered. Their area of specialisation must be close to the topic of the curriculum.
- Academic staff – student ratio
- Technical and support staff
   Qualifications of the technical and support staff are also important.
- Research activities of staff
   The research activity should inform the development of the curricula.
- Professional activities and consultancy

2.3. Admission and educational standards
- Admission requirements
   Students may be admitted to the programme on the basis of a general national or state examination or by a selective entrance examination.
- Assessments of demand for the programme
- Assessments of student performance
   This relates to the different ways of assessing the student performances (grading, oral assessment, practical results of a device).
- Student performance
   The performance must be evaluated according to ECTS criteria. The distributions of the results among the different grades may be evaluated.
- Graduate employment opportunities

2.4. Quality assurance measures and development
- Quality assurance measures
- Plans for the future development of the programme

2.5. Institutional context
- General requirements (organizing, management,…)
   This point relates to how the institution operates and is managed.
- Cooperation with Higher Educational Institutions
- Industry cooperation
   The industrial cooperation is important for technical fields. It can be at different levels (internships, Teaching engineers, facilities)
- Finances
- Facilities
   Many facilities are required for technical fields (laboratories, computers) but also for general needs (library, duplicated notes, …)

2.6. Internationalisation
- Study abroad opportunities
   Most of institutions propose studies abroad for their students. It can be a simple semester or a whole academic year with validation by the home institution. Many double diplomas are proposed.

- International co-operations
  The international co-operations between two institutions consist of student and teachers mobility. They generally precede the organisation of study abroad opportunities. They are often initiated by research activities.
- Foreign language requirements and education
  For non-English speaking people, a knowledge of the English language is very desirable.
- Subject or specific classes taught in foreign languages
  Many institutions propose some courses in English and a few have a full curriculum in English.

3. Questionnaire content

It was considered important that the questionnaire evaluated how the EUR-ACE criteria are considered by the institutions during the accreditation process. The goal was to have some complementary information specific to EIE field.

The questionnaire was constructed so that it could be completed in a quick and straight forward manner. It was sent to one partner in each participating country. Where a country has several accreditation bodies, several questionnaires were sent. The questions were divided into four sections.

3.1. Accreditation body
- Is accreditation compulsory to deliver engineering degrees in EIE?
- Is the accreditation awarded by the government, the university, a professional body or some other agency?
- Is the accreditation awarded to a programme, a department or the whole institution?
- Does the accreditation body include faculty, employers, engineers in industry?
- Does the accreditation process include quality assurance measures?

3.2. Parameters Measured
A number of different parameters can be considered during the accreditation process. For each of them the questionnaire asked whether it is evaluated and if documentation is provided in advance or during the visit. The parameters listed in the questionnaire were:
- Curricula
- Examination papers
- Student examination scripts
- Projects reports and thesis
- Students' performance
- Employment of graduates
- Academic staff
- Recruitment
- Research activities
- Collaboration with industry
- Facilities

3.3. Evaluation visit
In general the accreditation body sends a visiting panel in the institution to be reviewed. In order evaluate the visiting process, the following questions were asked:
- What is the frequency of the visits?
- What is the size of the visiting panel?

- What is the composition of the visiting panel (academics, industrial, others)?
- What is the duration of the visit?
- Whom does the panel meet during the visit?
        - students
        - academic staff
        - technical staff
        - administrative staff
        - employers
        - graduates

3.4. Conclusions

On the completion of the visit, the visiting panel in general gives a verbal presentation of their findings to the staff in the institution visited. Subsequently a report is written which includes a recommendation on the accreditation. In order to evaluate how the conclusions are processed the followed questions were asked.
- To whom do the review panel report (government, university, professional body, agency)?
- Who makes the final decision (government, university, professional body, agency)?
- What are the different possible decisions?
- full accreditation
- accreditation for reduced period of time
- no accreditation
- additional non-compulsory recommendations
At the end of the questionnaire, the participants were also invited to add any further comments they may wish to make.

4. Results

Twenty two completed questionnaires were received from partners in eighteen different countries. Some countries have several accreditation bodies – for example there are six different accreditation bodies in Germany and three in France. In the questionnaire many of the answers were not mutually exclusive so several answers were possible with the result that the total percentage may add to more than 100%.

64% of the respondents said that the accreditation is compulsory and in some cases accreditation can be given simultaneously by several entities. In 64% of the cases the government awards the accreditation while an independent agency does so in 45% of the cases. In the majority of cases (73%) the programme itself is accreditation and the whole institution is evaluated 56% of the time. The accreditation body is constituted by faculty (65%), member of specific accreditation bodies (59%) and employers (45%). Engineers in industry are present in only 14% of the accreditation bodies. The accreditation process includes quality assurance measures (77%).

The most important criteria that have been considered during the accreditation process are the curriculum (95%), the academic staff (91%), the collaboration with industry (86%), the facilities (86%), the research activities (82%) and the employment of graduates (77%). In most cases documentation related to these items was provided in advance. Other criteria evaluated include the projects reports and thesis (68%), the recruitment (59%) and the student examination scripts (45%). These items are generally evaluated during the visit. The examination papers are considered in only a minority of cases (32%).

On average, the frequency of the visits is 5 years and the size of the visiting panel is 4 persons. It

is mainly composed of academics (86%) and industrial representatives (55%). The visit lasts between 2 and 3 days. The panel meets mainly students (91%), academic staff (95%) and administrative staff (82%). Technical staff (50%), employers (36%) and graduates (41%) are interviewed less frequently.

The final report is sent to the government in (50%) of the cases, the university in (32%) and an independent agency in (41%). The final decision is made by the government (55%) of the time and an independent agency (36%) of the time. They decide on full accreditation or an accreditation for a reduced period of time or a non-accreditation. In 41% of the cases, additional non-compulsory recommendations can be given.

A first analysis shows that some countries have not yet introduced a formal accreditation process. These countries are generally in a transition situation in relation to introducing the Bologna process. The accreditation process, ECTS and the quality assurance measures will probably be introduced at the same time.

In some other countries several accreditation bodies exist depending on the region (in Germany according to the Länder) or the nature of the institution (in France between universities and Grandes Ecoles). It also appears that the accreditation for masters and PhD degrees is not yet compulsory everywhere.

Other issues regarding the accreditation process that are also being considered include the payment of the expenses in relation to the accreditation process. This point is important in the countries where the accreditation process is not paid by government. Also, the relation between the ECTS and the actual content and level of the courses is being considered. This issue is larger than the goal of this task, but it is a very important question for the mutual recognition of the curricula. Finally the issue of whether industrial placement is compulsory and for how long must it last is being reviewed.

5. Outcomes and dissemination

The results have been presented at three conferences.

5.1. 18th European Association for Education in Electrical and Information Engineering (EAEEIE) annual conference (Prague, Czech Republic, July 2-4, 2008)
The introduction of the Bologna Process is leading to changes in the process of accrediting engineering programmes and also the quality control mechanisms associated with these programmes. The EIESurveyor project is examining the various accreditation processes currently in use in Europe and existing accreditation systems in Germany, Ireland and Portugal have been reviewed in this paper. Developments relating to mutual accreditation by the professional engineering bodies have also been presented

5.1. 19th European Association for Education in Electrical and Information Engineering (EAEEIE) annual conference (Tallinn, Estonia, June 29 - July 2, 2008)
A communication has shown that, according to the answers, the accreditation processes may be classified by a statistical approach into three groups (group I: Ireland, France (CTI), Latvia, Norway, United Kingdom; group II: Bulgaria, Czech Republic, Estonia, France (except CTI), Poland, Portugal, Slovakia; group III: Finland, Germany, Greece, Hungary, Lithuania, Spain).

Classification into three groups might be a bit surprising. Indeed, differences between the accreditation processes are not as large as this classification suggests. However, to get objective criteria for assessing present differences, a "metric" had to be created. This metric was measuring the (weighted) deviations in the responses from the above mentioned questionnaires. Therefore, the formulation of the questions in the questionnaire and the decision what to answer had also an important influence on the outcome. This might be illustrated by an example.

One of the questions in the questionnaire was:
"Who makes the final decision?   government □ university □   professional body □

independent agency   □   international agency   □ "

In case of the German accreditation agency ASIIN, more than 95% of the final decisions (as of autumn 2008) are made by ASIIN alone, which is an independent agency. However, in cases of course programmes for teachers, an additional permission of the state authorities must be given that confirms compliance with state laws and directives. As a policy by ASIIN, it is also carefully observed whether the latter are met. Therefore, in the questionnaire, the response "independent agency" was given, since this is closest to reality, while for the mentioned cases "government" would also be correct. However, differences like these might have been the reason to classify the German system into one group or into another.

Since accreditation systems are in a process of modification – in Germany, for example, it is planned to introduce "system accreditation" in addition to "programme accreditation" – differences and similarities between accreditation systems must be carefully observed in the future. It might even be necessary to refine classification into groups.

5.2. 36th Société Européenne pour la Formation des Ingénieurs (SEFI) annual conference (Aalborg, Denmark, July 2 – 5, 2008)

The main topics of this conference was quality, assessment, employability and innovation. The results shown above have been presented. This has been the opportunity to discuss with people involved in EUR-ACE and in French AERES (Research and Higher Education Evaluation Agency) who are interested in the final conclusions of the project.

6. Appendices

Appendix 1

18th European Association for Education in Electrical and Information Engineering (EAEEIE) annual conference (Prague, Czech Republic, July 2-4, 2007)

Accreditation of higher education in EIE in Europe

F. Maciel Barbosa[1], Cyril Burkley[2], Michael H.W. Hoffmann[3],
and Jean Marc Thiriet[4]

[1] Faculdade de Engenharia da Universidade do Porto, Portugal
Departamento de Engenharia Electrotécnica e de Computadores
R. Dr. Roberto Frias, 4200-465 Porto-Portugal
Tel. +351-22-508 1874 / 22-508 140 ; Fax. +351-22-508 1443/0; E-mail. fmb@fe.up.pt

[2] College of Informatics and Electronics (I & E), University of Limerick, Limerick, Ireland
Tel. +353-61202776 ; Fax. : +353-61202561; E-mail. cyril.burkley@ul.ie

[3]University of Ulm, Institute of Microwave Techniques
Albert-Einstein-Allee 41, D-89069 Ulm, Germany
Tel. +49-731-50-26352; Fax. +49-731-50-26359; E-mail. Michael.Hoffmann@uni-ulm.de

[4]Université Joseph Fourier, IUT 1, Dépt. RT, BP 67, 38 402 Saint Martin d'Hères cedex,
France
Tel. + +33 - 4 76 82 53 68; Fax. +33 - 4 76 82 44 95; E-mail. jean-marc.thiriet@ujf-grenoble.fr

Abstract

The introduction of the Bologna Process is leading to changes in the process of accrediting engineering programmes and also the quality control mechanisms associated with these programmes. The EIESurveyor project is examining the various accreditation processes currently in use in Europe and existing accreditation systems in Germany, Ireland and Portugal are reviewed in this paper. Developments relating to mutual accreditation by the professional engineering bodies are also presented.

1. Introduction

During the Bologna follow-up-conference in Prague, "Ministers recognized the vital role that quality assurance systems play in ensuring high quality standards and in facilitating the comparability of qualifications throughout Europe. They encouraged universities and other higher education institutions to disseminate examples of best practice and to design scenarios for mutual acceptance of evaluation and accreditation/certification mechanisms."

Therefore, national accreditation agencies have been installed in many countries. Though the intention was (and still is) to achieve comparability of degrees, accreditation processes in different countries are different.

In the EIESurveyor project, one of the working groups is collecting available material on the processes and procedures of accreditation.

Using the accreditation agencies of Germany, Ireland, and Portugal as examples, it will be shown that accreditation procedures differ in Europe.

2. Accreditation in Germany

Education is in the responsibility of the individual States in Germany. Prior to the reforms that came into effect after the Bologna declaration, quality control of higher education was, therefore, a matter of the ministers in charge of higher education. The legal aspects were handled by themselves.

Functional control in the field of electrical and information engineering (EIE) was executed by the German Council of University Departments of Electrical and Information Engineering (FTEI). Only those departments, that met the requirements of the FTEI, were recognised by FTEI. Students with degrees awarded by FTEI recognized departments were preferred by German industry. Therefore, all university departments of electrical and information engineering aimed at meeting the requirements. Thus, a very effective and cost-efficient system of quality control was set up.

Since this system was completely outside of political control, ministers wanted to get rid of it. They took the opportunity of harmonization in the framework of the Bologna process to change the laws in such a way that the new degrees must now be accredited by accreditation agencies. This was based on the concept that competition between agencies would improve the quality of accreditation process. In order to control the accreditation agencies, they installed an Accreditation Council [1], [2] as a foundation under public law in North-Rhine Westphalia, the latter being one of the states of the Federal Republic of Germany.

To date, the Accreditation Council has accredited six accreditation agencies. These are in alphabetical order:

ACQUIN (www.acquin.org),
AHPGS (www.ahpgs.de),
AQAS (www.aqas.de),
ASIIN (www.asiin.de),
FIBAA (www.fibaa.de),
ZEVA (www.zeva.uni-hannover.de).

Each of these agencies is different from the others [2], either by its legal form, or by an existing or missing specialisation to certain subjects, or by its funding, or by its additional tasks and dependencies.

Presently, each new bachelor- and master-course programme must be accredited in Germany during the next three years. Accreditation should then be renewed every five years.

Programme accreditation is described using the procedures of ASIIN as an example. Initially, the programme team prepares a self-evaluation report, following guidelines prepared by the accreditation agency. A review team, consisting of three to seven peers, for formal correctness, then analyzes this report. Questions to be answered concern the content of a study course programme and its coherence, its level and quality, whether or not there is a need for graduates from this programme in the job market, the quality and quantity of lecturers, whether there is adequate supervision of students, whether there are sufficient lecture rooms, whether these are equipped adequately, whether there is appropriate access to literature, etc.

If these questions are answered satisfactorily, the team of peers visits the faculty offering the program. They review the management team of the faculty, the staff and the students. The latter are also interviewed in absence of staff.

At the conclusion of the visit, the team of peers gives a provisional summary to the management team of the faculty. They write a final report with recommendations. A board of experts, who may add to or even change the final report, then discusses this report. The final decision about accreditation is then made by another, independent group of experts.

Accreditation might either be awarded without any conditions, or with conditions or recommendations that ought to be followed within one year, or it might be denied. In the latter case, the state might even forbid the faculty to run that programme. Therefore, it is to be expected that the vast majority of programmes will be set up in a way that makes them likely to be accredited.

Since there are about 15000 course programmes in Germany (including all technical and non-technical subjects), about 3000 accreditation procedures must be executed each year. Since one of these procedures costs about € 25000, politicians are beginning to discover that they have produced gigantic additional costs. The previous system was more efficient and cheaper by some orders of magnitude.

Unfortunately, educational politicians in Germany find it difficult to admit that they have made mistakes. Therefore, the Bologna reforms will be reformed gradually over the next few years. In relation to accreditation this process has already begun.

Presently there is a discussion about replacing the program accreditation by what is called "system accreditation". The idea is to install a quality assurance system at the Universities and Fachhochschulen. The new QA-system itself will be accredited every five years also. The QA-system will then accredit the individual programmes.

Again, this idea is flawed, since it is quite clear that the existence of a quality assurance system does not guarantee by itself that quality is maintained, let alone improved.

The umbrella organization of the four councils of schools of engineering and of computer technology at German Universities, 4ING, is, therefore, concerned about the future of engineering programmes at German Universities. They have started an intensive discussion with the sixteen state ministers and with the federal minister in charge of higher education in Germany. The experts of 4ING believe that the Bologna process in general, and accreditation of its programmes in particular must be reformed to maintain high-level higher education programmes.

3. Accreditation in Ireland

In Ireland each University is responsible for both the awarding and quality control of its own degrees. In addition engineering programmes have been subjected to external accreditation by the professional engineering bodies for many years. Engineers Ireland (EI) is responsible for setting up and maintaining proper standards of professional and general education for the formation of chartered engineers and has formally accredited engineering degree programmes in Ireland since 1982.

The accreditation process [3] involves a periodic audit of the engineering education provided by a particular programme. It is essentially a peer review process with an independent panel comprising both academic staff and professional engineers from industry. Detailed self-assessment reports and documentation are submitted to the panel several weeks in advance of the visit. During the 2-day visit the panel meet with academic and support staff members,

18th EAEEIE conference, Praha, 2007

students, former students and employers. The panel also visits the various facilities (library, laboratories, etc.) and reviews student project work, examination papers and scripts and other assessed work. If the accreditation panel were satisfied completely with the standard of the programme, accreditation would be granted for a five-year period, at the end of which the programme would be invited to apply for re-accreditation. If the panel is not satisfied completely, accreditation for a reduced period, or, where there are serious deficiencies, no accreditation, is proposed.

In recent years, Engineers Ireland has revised its accreditation criteria, with the emphasis moving from inputs to outputs. Thus the new criteria are based on programme and learning outcomes [4].

4. Accreditation in Portugal

Prior to the introduction of the Bologna Process in Portugal, there were two accreditation and quality controls for the programmes at the Universities and Polytechnics with two different objectives.

The first was an accreditation process to control the scientific quality of the programmes and the adequacy of the staff, laboratories, programmes and the learning process quality. The responsibility for this process was a commission established by the Rectors of the Public Universities which was independent of the Government. The quality control was evaluated every five years, unless there were problems and in this case the period could be shortened to two or three years to check if the compulsory modifications had been introduced. The commission that evaluates the programmes is composed of academics, who prepare a report and propose a decision in relation to the programme quality, which is approved or not by the Quality Body.

The second was an accreditation process organized by the Professional Bodies to check if the standard of the programme was sufficiently high so that graduates from the programme would be able to practice as engineers and undertake the necessary responsibilities. The commission, which typically comprised three engineers and two academics, visited the institution offering the programme and undertook the evaluation. The Professional Body reviewed the report proposed by this commission.

For the two processes, which are independent, the Universities and Polytechnics prepare documentation on the administrative processes (information on teaching and administrative staff, subjects, programmes, laboratories, equipment, quality selection of students, student performance and subsequent employment information as well as questionnaires on the programme and teaching process.). During the visit, which generally lasts two days, the commission independently interviews the faculty, students, staff and alumni. After their visit, the commission writes a report, which is submitted to the board. The report makes a recommendation, and also gives guidelines for improving the quality of the programme

The implementation of the Bologna process started during the current academic year and is already being realized in most of the programmes being offered at the Universities and Polytechnics. The Portuguese Law, which defines the new structure of the programmes, was published in May 2006 and also defines the new accreditation quality control process. A new independent Accreditation Agency, which the Government will establish, taking into account the European Accreditation System guidelines, will be responsible for the overall quality control. This new Agency will include representatives from the European Agency or representatives from accreditation boards from other European countries. The Portuguese Law, which is going to define the accreditation process, has not yet been published.

5. The EUR-ACE Project

Under the auspices of FEANI, a group of national associations involved in accreditation [ASIIN (Germany), CTI (France), EC (UK), EI (Ireland), COPI (Italy), OE (Portugal), UAICR (Romania) and RAEE

18th EAEEIE conference, Praha, 2007

(Russia)] submitted a proposal to the European Commission to set up the EUR-ACE project [5] with the objectives of (i) ensuring consistency between existing national engineering accreditation systems, (ii) establish a European "quality label" for accredited programmes, (iii) assisting with the establishment of accreditation in European countries where it does not yet exist, thus improving the quality of engineering education, facilitating trans-national recognition and mobility of engineering graduates. Following the successful completion of the EUR-ACE project, the partners established ENAEE (European Network for Accreditation of Engineering Education) to establish policies and procedures whereby the professional accreditation agencies in Europe will be authorized to add the EUR-ACE label to their accreditations.

6. Conclusions

Degree programmes in Universities and other Institutes are subject to various accreditation, evaluation and quality control processes, which vary from country to country. These processes can be managed by the Government, the State or by the Institutes themselves. Engineering programmes in addition may be subjected to external accreditation by the professional engineering bodies. The Bologna process, with its focus on mobility, credit transfer and quality control is resulting in a review of current accreditation processes. In addition the professional engineering bodies are increasingly considering mutual accreditation, which is also leading to changes in the process. The EIESurveyor project is reviewing existing processes and procedures for accreditation across Europe with a view to proposing best practice for accreditation and quality control of EIE engineering programmes in Europe.

References

[1] Ländergemeinsame Strukturvorgaben gemäß § 9 Abs. 2 HRG für die Akkreditierung von Bachelor- und Masterstudiengängen (Beschluss der Kultusministerkonferenz vom 10.10.2003 i.d.F. vom 22.09.2005), [online]:
http://www.kmk.org/doc/beschl/Laendergemeinsame_Strukturvorgaben.pdf

[2] . Stiftung zur Akkreditierung von Studiengängen in Deutschland: Synopsis of accredited accrediation agencies in Germany, [online]:
http://www.akkreditierungsrat.de/SynopseGesamt.doc

[3] "Accreditation Criteria for Engineering Education Programmes". Engineers Ireland, November 2003.

[4] Cyril Burkley, "Accreditation of Engineering Programmes in Ireland – a New Approach" Proceedings of the 17th International EAEEIE Conference, Craoiva, Romania, 1st-2nd June 2006.

[5] EUR-ACE Project, details on the FEANI website, www.feani.org.

19th European Association for Education in Electrical and Information Engineering (EAEEIE) annual conference (Tallinn, Estonia, June 29 - July 2, 2008)

Clustering Analysis on Questionnaire Data for Program Accreditation

George Papadourakis[#1], Fernando Maciel Barbosa[*2], Cyril Burkley*[3], Michael Hoffmann[##4],
Daniel Pasquet**[5], Georgios Tsiriotis**[6], Ioannis Kiriakides[#7]

Department of Applied Informatics and Multimedia, Technological Educational Institute of Crete

Heraklion, Crete, Greece

[1]`papadour@cs.teicrete.gr`

[7]`kyriakidis@teicrete.gr`

* *Faculdade de Engenharia da Universidade do Porto, INESC Porto, Porto, Portugal*

[2]`fmb@fe.up.pt`

**University of Limerick, Ireland*

[3]`cyril.burkley@ul.ie`

Universität Ulm, 89069 Ulm, Germany

[4]`michael.hoffmann@uni-ulm.de`

***ENSEA, 95014 Cergy, France*

[5]`Daniel.Pasquet@ensea.fr`

***Electrical Engineering Department, Technological Educational Institute of Kavala*

Agios Loukas, 654 04, Kavala, Greece

[6]`tsirigo@teikav.edu.gr`

Abstract—**The aim of the SOCRATES EIE-Surveyor project is to be a reference point for Electrical and Information Engineering in Europe, bringing together representatives from 27 out of 31 eligible countries. One of the tasks of the project is the evaluation of the accreditation processes in the participating countries. A questionnaire about the accreditation process was developed and sent to project partners in each participating country. The main areas investigated the nature of the accreditation body, the criteria, which are evaluated, the structure of the visit and the decision formulation. The results of the questionnaire, will be analyzed using clustering analysis and more precisely hierarchical, in order to compare the answers in 17 European countries and to find similarities among them. As distance measures the Euclidian metric and the City block distance will be used. Average linkage, and Ward clustering algorithms will be utilized.**

Index Terms— **accreditation, evaluation, clustering**

I. Introduction

The first moves towards formal engineering education in Europe began around the middle of the 18th century initially in France, but within a short space of time engineering schools were established in much of Europe [1]. In due course universities across the world established engineering programmes based on the European models. In mainland Europe, the duration and structure of engineering programmes were based on a programme of studies of four or five years duration and firmly grounded in mathematics and the sciences. Initially in the UK and Ireland programmes were generally of three years duration. The structure in the UK has evolved into a four years Masters of Engineering degree programme, while in Ireland, a four year Bachelor degree has been in place for nearly 50 years.

In June 1999 the Bologna Declaration [2] was published and its overall objective was the establishment of a European area of higher education in which student mobility would be facilitated and enabled. A follow-up conference in Prague [3] highlighted the important role that quality assurance systems play in ensuring high quality standards and in facilitating the comparability of qualifications throughout Europe. Prior to this the recognition or accreditation of qualifications was done largely on a national basis and, within individual countries, recognition or accreditation of programmes of study could take place at either institutional, national or the professional level. However, since the Bologna Declaration, the need for European wide recognition and accreditation of higher education programmes and their relationship to quality assurance are at present the subject of many discussions and

76

activities in Europe [4].

Under the auspices of FEANI, the European Federation of National Engineering Associations, a group of national associations involved in accreditation submitted a proposal to the European Commission to set up the EUR-ACE (EURopean ACcredited Engineer) project with the objectives of ensuring consistency between existing national engineering accreditation systems and establishing a European "quality label" for accredited programmes [5]. Following the successful completion of the EUR-ACE project, the partners established ENAEE (European Network for Accreditation of Engineering Education) to develop policies and procedures whereby professional accreditation agencies in Europe will be authorised to add the EUR-ACE label to their accreditation [6].

An earlier Thematic Network project THEIERE [7], conducted a preliminary study of existing accreditation procedures in the field of electrical and information engineering across a range of universities in Europe. This work has been extended in the EIE Surveyor Thematic Network project [8], which by means of a questionnaire has collected material on the existing accreditation processes and procedures in Europe. Some early results of this work have already been presented [9] and this paper presents a detailed analysis of the Questionnaire Data obtained.

II. QUESTIONNAIRE

A. Context of the questionnaire

The starting point of the accreditation task in Surveyor project was the EUR-ACE project (European accreditation of European Engineering and graduates) [5], which was a consortium of 14 partners, supported by the European Commission. The objectives of the EUR-ACE project were (i) to ensure consistency between existing national engineering accreditation systems, (ii) establish a European "quality label" for accredited programmes and (iii) assist with the establishment of accreditation in European countries where it does not yet exist, thus improving the quality of engineering education, facilitating transnational recognition and mobility of engineering graduates.

The aim of the EIE Surveyor task was to see how the EUR-ACE results could apply to the field of electrical and communication engineering.

The EUR-ACE project evaluated the various factors that should be taken into consideration when assessing an engineering programme. These have been used as the guideline for constructing the questionnaire. They are gathered into six domains.

1) General information and curriculum
The general points concerning the curriculum are:
- Identification of educational goals
- Profile of the programme
- Duration, workload, ECTS

A difference must be made between the duration of courses, tutorials and practical works and the actual workload which includes the personal unsupervised study time of the students.
- Teaching methods
- Programme structure
- Programme content
- Number and duration of internships or workplacements

The internships may be in academic laboratories or in industry.

2) Professors and academic staff
- Teaching staff (number, specialisation, qualification)

The ratio between professors and other academic staff is considered.
- Academic staff – student ratio
- Technical and support staff
- Research activities of staff
- Professional activities and consultancy

3) Admission and educational standards
- Admission requirements

Students may be admitted to the programme on the basis of a general national or state examination or by a selective entrance examination.
- Assessments of demand for the programme
- Assessments of student performance
- Student performance

The performance must be evaluated according to ECTS criteria. The distributions of the results among the different grades may be evaluated.
- Graduate employment opportunities

4) Quality assurance measures and development
- Quality assurance measures
- Plans for the future development of the programme

5) Institutional context
- General requirements (organizing, management,…)
- Cooperation with Higher Educational Institutions
- Industry cooperation
- Finances
- Facilities

6) Internationalisation
- Study abroad opportunities
- International co-operations

The international co-operations between two institutions consist of student and teachers mobility.
- Foreign language requirements and education
- Subject or specific classes taught in foreign languages

Many institutions propose some courses in English and a few have a full curriculum in English.

B. Questionnaire content

It was considered important that the questionnaire evaluated how the EUR-ACE criteria are considered by the institutions during the accreditation process. The goal was to have some complementary information specific to EIE field.

The questionnaire was constructed so that it could be completed in a quick and straight forward manner. It was sent to one partner in each participating country. Where a country has several accreditation bodies, several questionnaires were sent. The questions were divided into four sections.

1) Accreditation body

- Is accreditation compulsory to deliver engineering degrees in EIE?

- Is the accreditation awarded by the government, the university, a professional body or some other agency?

- Is the accreditation awarded to a programme, a department or the whole institution?

- Does the accreditation body include faculty, employers, engineers in industry?

- Does the accreditation process include quality assurance measures?

2) Parameters measured

A number of different parameters can be considered during the accreditation process. For each of them the questionnaire asked whether it is evaluated and if documentation is provided in advance or during the visit. The parameters listed in the questionnaire were:

- Curricula
- Examination papers
- Student examination scripts
- Projects reports and thesis
- Students' performance
- Employment of graduates
- Academic staff
- Recruitment
- Research activities
- Collaboration with industry
- Facilities

3) Evaluation visit

In general the accreditation body sends a visiting panel in the institution to be reviewed. In order evaluate the visiting process, the following questions were asked:

- What is the frequency of the visits?
- What is the size of the visiting panel?
- What is the composition of the visiting panel (academics, industrial, others)?
- What is the duration of the visit?
- Whom does the panel meet during the visit?
  - students
  - academic staff
  - technical staff
  - administrative staff
  - employers
  - graduates

4) Conclusions

On the completion of the visit, the visiting panel in general gives a verbal presentation of their findings to the staff in the institution visited. Subsequently a report is written which includes a recommendation on the accreditation. In order to evaluate how the conclusions are processed the followed questions were asked.

- To whom do the review panel report (government, university, professional body, agency)?

- Who makes the final decision (government, university, professional body, agency)?

- What are the different possible decisions?
  - full accreditation

- accreditation for reduced period of time
- no accreditation
- additional non-compulsory recommendations

At the end of the questionnaire, the participants were also invited to add any further comments they may wish to make.

C. First analysis

A first analysis shows that some countries have not yet introduced a formal accreditation process. These countries are generally in a transition situation in relation to introducing the Bologna process. The accreditation process, ECTS and the quality assurance measures will probably be introduced at the same time.

In some other countries several accreditation bodies exist depending on the region (in Germany according to the Länder) or the nature of the institution (in France between universities and Grandes Ecoles). It also appears that the accreditation for masters and PhD degrees is not yet compulsory everywhere.

Other issues regarding the accreditation process that are also being considered include the payment of the expenses in relation to the accreditation process. This point is important in the countries where the accreditation process is not paid by government. Finally the issue of whether industrial placement is compulsory and for how long must it last is being reviewed.

III. CLUSTERING AND DATA ENCODING

Cluster analysis or clustering is the classification of objects (patterns) into different groups, or more precisely, the partitioning of a data set into subsets (clusters), so that the data in each subset are similar according to some defined distance measure. Central to all of the goals of cluster analysis is the notion of degree of similarity (or dissimilarity) between the individual patterns being clustered. Data clustering is a common technique for statistical data analysis. The patterns are given in the form of feature vectors containing elements that describe in numeric form objects or events.

In this study the objective is to discover similarities among countries so each questionnaire answered is a distinct pattern. The feature vector for each questionnaire is formed by encoding numerically the answers to the questionnaire using various techniques.

TABLE 1
ENCODING OF QUESTIONNAIRE

		Desciption	Encoding					Inputs
1		**The accreditation body**						
	a	yes	1					1
		no	0					
	b	Government	1	0	0	0	0	5
		University	0	1	0	0	0	
		Professional body	0	0	1	0	0	
		Independent body	0	0	0	1	0	
		International agency	0	0	0	0	1	
	c	a programme	0,2					1
		a department	0,5					
		the whole institution	1					
	d							
	e	faculty	1	0	0	0	0	5
		employers	0	1	0	0	0	
		engineers in industry	0	0	1	0	0	
		accreditation body	0	0	0	1	0	
		Others	0	0	0	0	1	
	f	yes	1					1
		no	0					
	g	International	1	0	0			3
		European	0	1	0			
		EUR-ACE	0	0	1			
	h	Yes	1					1
		No	0					
2		**The Criteria**						
	a	11 choices accumulated In 3 columns (0-1)						3
3		**The evaluation visit**						
	a	2 years	0.25					1
		5 years	0.63					
		Other (normalized 8 y=1)						
	b	1	0.14					1
		2	0.29					
		3	0.43					
		Other (normalized 7=1)						
	c	Academics	1	0	0			3
		Industrial	0	1	0			
		Other	0	0	1			
	d	1 day	0.25					1
		2 days	0.50					
		3 days	0.75					
		longer	1.00					
	e	6 choices accumulated(0-1)						1
4		**The conclusion**						
	a	Government	1	0	0	0	0	5
		University	0	1	0	0	0	
		Professional body	0	0	1	0	0	
		Independent body	0	0	0	1	0	
		International agency	0	0	0	0	1	
	b	Government	1	0	0	0	0	5
		University	0	1	0	0	0	
		Professional body	0	0	1	0	0	
		Independent body	0	0	0	1	0	
		International agency	0	0	0	0	1	
	c	full accreditation	1.00					1
		reduced accreditation	0.50					
		no accreditation	0.00					
		additional non-compulsory recommendations	0.70					

Table 1 illustrates the encoding utilized. Each multiple choice question is encoded as a binary input or a real number between 0-1. In most cases, for example questions 1b), 1g) etc, the use 1-of-C coding is utilized. The number of input is determined by the possible choices of a question. Each choice is given the value zero except for the one corresponding to the correct one, which is given the value one. In other cases, such as questions 1c), 3a), 3b) a real number between 0-1 can represent the answer, and only 1 input is needed. Finally, in multiple choice questions, where the answers could be several categories, such as questions 2a) and 3 e) the total number of the selected categories is accumulated and normalized between 0-1. There was one question 1d) where the encoding was not possible and it was not used as input. In total, as shown in Table 1, 38 inputs formed the feature vector for each questionnaire.

Using the above encoding scheme the feature vector of each questionnaire was formed. However, there were several problems encountered with missing answers in the questionnaires. According to the nature of the question different strategies were used to resolve the problem. One of the most common problems encountered was the missing answers to a yes, no question, such as 1a), 1f), etc. In this case the value 0.5 was used. In questions such as 1c), 3a), 3b) where a real number between 0-1 can represent the answer, and only 1 input is needed, the value 0 is reserved for no answer.

Finally, analyzing the answers to al the questionnaires, in question 4a) nobody choose "international agency", so this input was eliminated. Similarly, in question 4b) the inputs for choices "University" and "International Agency" were eliminated.

Data clustering algorithms can be hierarchical or partitional [10]. Hierarchical algorithms find successive clusters using previously established clusters, whereas partitional algorithms determine all clusters at once. Hierarchical algorithms can be agglomerative ("bottom-up") or divisive ("top-down"). Agglomerative algorithms begin with each element as a separate cluster and merge them into successively larger clusters. Divisive algorithms begin with the whole set and proceed to divide it into successively smaller clusters. Hierarchical clustering may be represented by a two dimensional diagram known as dendrogram which illustrates the fusions or divisions made at each successive stage of analysis. An example of such a dendrogram is shown in Fig. 1.

An important step in any clustering is to select a distance measure, which will determine how the similarity of two elements is calculated. The most common distance measure, which will be used in this paper, is the Euclidean distance. The Euclidean distance between feature vectors $\underline{x}$ and $\underline{y}$ is given by:

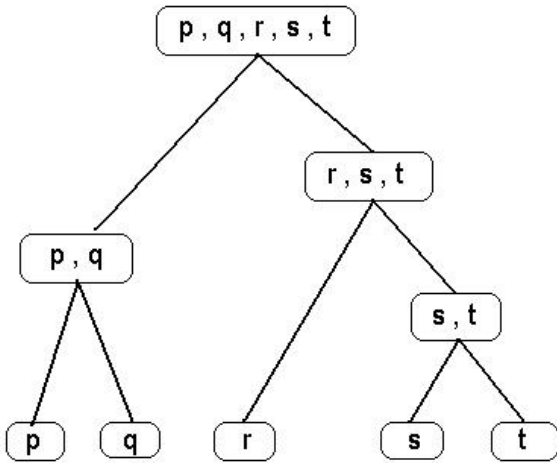$$d_E\left(\underline{x},\underline{y}\right) = \sqrt{\sum_i \left(x_i - y_i\right)^2} \qquad (1)$$

79

Fig. 1. Example of dendogram

Another popular distance measure, which is utilized on integer values, and suitable to the data presented in this paper, is the City block distance also known as Manhatan distance or Taxi distance. The City block distance between feature vectors $\underline{x}$ and $\underline{y}$ is given by:

$$D_C\left(\underline{x},\underline{y}\right) = \sum_i |x_i - y_i| \qquad (2)$$

In this paper agglomerative hierarchical clustering is utilized using the Euclidean and City block distance. At each particular stage the method joins together the two clusters which are closest together (most similar). Differences between methods arise because of the different ways of defining distance (or similarity) between clusters.

One of the most common agglomerative hierarchical clustering methods is **Average linkage**. The distance between two clusters is defined as the average distances between a point in one cluster and a point in the other cluster.

Ward's hierarchical clustering method minimizes the loss associated with each cluster. At each step in the analysis, among all pairs of clusters, it merges the pair that produces the smallest **squared error** for the resulting set of clusters, resulting in minimum increase in information loss. Information loss is defined by Ward in terms of an error squared error criterion. The squared error for a cluster is the sum of the squared distances in each element from the cluster mean. The squared error is thus equal to the total variance of the cluster times the number of elements in the cluster. The squared error for a set of clusters is defined to be the sum of squared errors for the individual clusters.

Each agglomeration occurs at a greater distance between clusters than the previous agglomeration, and one can decide to stop clustering either when the clusters are too far apart to be merged (distance criterion) or when there is a sufficiently small number of clusters (number criterion).

IV. CLUSTERING RESULTS

Hierarchical clustering was performed on the encoded data of the questionnaires in order to discover similarities among countries concerning accreditation procedures. The best results, in the Mean Square Error Sense, were the average linkage algorithm and the Ward's algorithm utilizing either Euclidean or City block distance.

The results of clustering using the average linkage algorithm and City block distance are shown in Fig. 2.
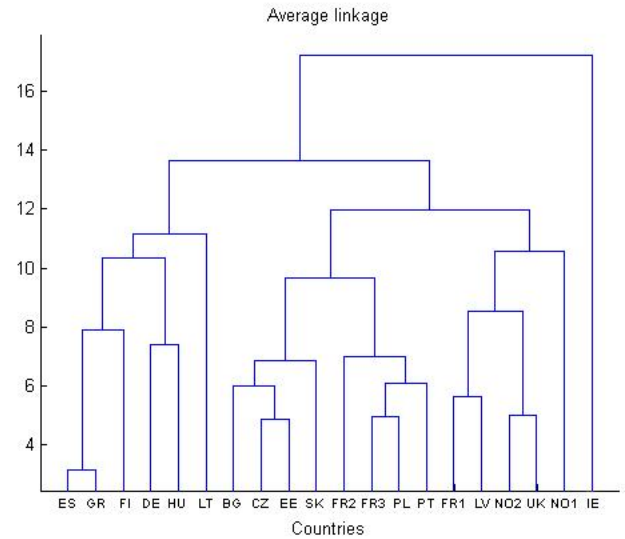

Fig. 2. Results of average linkage algorithm using City block distance

The results of clustering using the average linkage algorithm and Euclidean distance are shown in Fig. 3.

The results of clustering using Ward's algorithm and City block distance are shown in Fig. 4.

The results of clustering using Ward's algorithm and Euclidean distance are shown in Fig. 5.
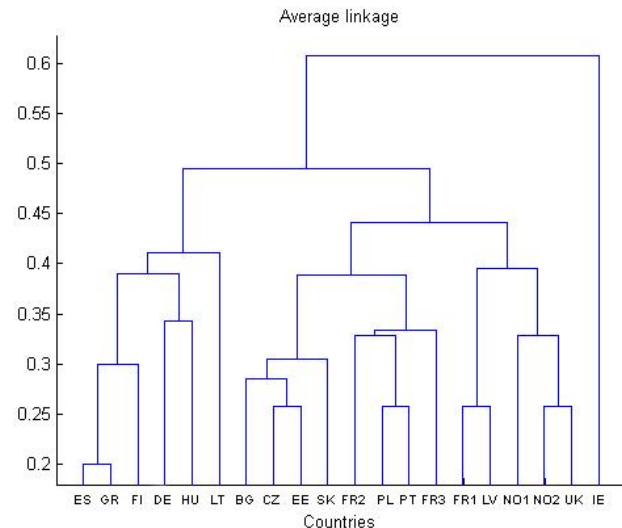

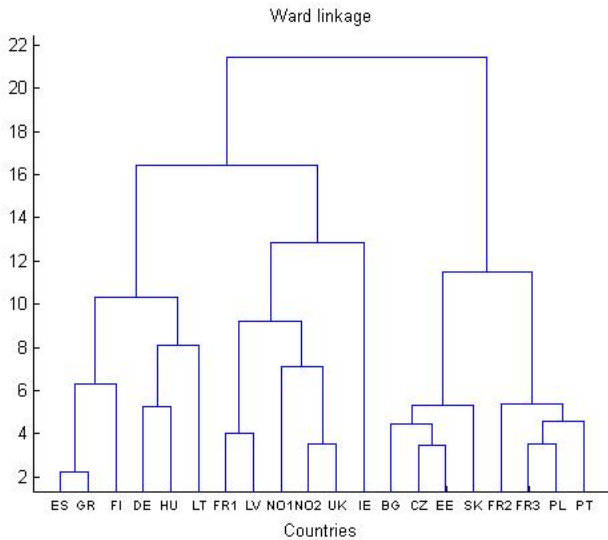Fig. 3. Results of average linkage algorithm using Euclidean distance.

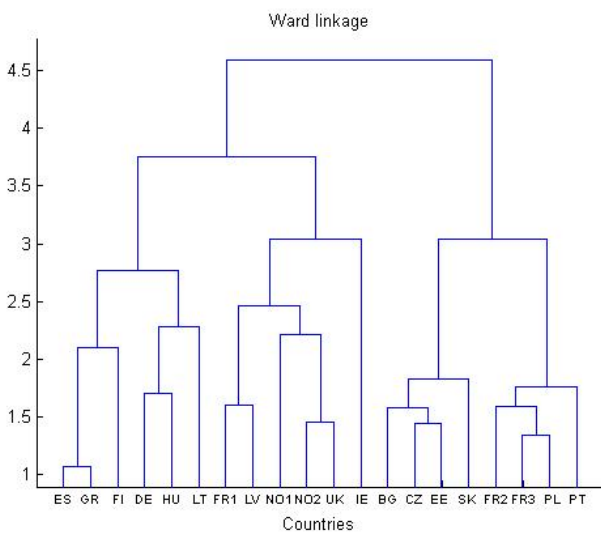Fig. 4. Results of Ward's algorithm using City block distance.

Fig. 5. Results of Ward's algorithm using Euclidean distance.

Analyzing the results we can see that results were similar in all cases and we note the formation of three clusters:

- Spain, Greece, Finland, Germany, Hungary and Lithuania.
- Bulgaria, Czech Republic, Estonia, Slovakia, France(2 and 3), Poland and Portugal.
- France(1), Latvia, Norway(1 and 2), United Kingdom and Ireland.

The algorithms utilized, Average and Ward's, gave the same results for both distance measures, City block and Euclidean. The only difference between the two algorithms is the assignment of Ireland. The average algorithm shows that Ireland is different from all the other countries while Ward's algorithm assigns Ireland to cluster 3. One final notice is that the clustering results show the questionnaires in France to belong to two different clusters. This result can be explained by the fact that accreditation in France is done by different agencies and the results reflect the different approach to accreditation among these agencies.

V. CONCLUSION

In this paper the analysis of a survey about the accreditation process in 17 European countries was performed.

A first analysis shows that some countries have not yet introduced a formal accreditation process. These countries are generally in a transition situation in relation to introducing the Bologna process. The accreditation process, ECTS and the quality assurance measures will probably be introduced at the same time.

In some other countries several accreditation bodies exist depending on the region (in Germany according to the Länder) or the nature of the institution (in France between universities and Grandes Ecoles).

Cluster analysis showed the formation of three groups:

- Spain, Greece, Finland, Germany, Hungary and Lithuania.
- Bulgaria, Czech Republic, Estonia, Slovakia, France(2 and 3), Poland and Portugal.
- France(1), Latvia, Norway(1 and 2), United Kingdom and Ireland.

REFERENCES

[1] James Dooge, "Engineering Education and Training", Ronald Cox (ed) p.36, Engineering Ireland, Cork, Collins Press, 2006.

[2] "The European Higher Education Area", Joint Declaration of the European Ministers of Education, Bologna, June 1999.

[3] Conference of the European Ministers for Education, Prague 2001.

[4] Giuliano Augusti "Accreditation of Engineering programmes: European perspectives and challenges in a global context", European Journal of Engineering education, Vol. 32, No. 3, pp.1-11, June 2007.

[5] EUR-ACE Project 2004, details on the FEANI website, www.feani.org/EUR_ACE.

[6] Giuliano Augusti "Bologna Process, quality and accreditation of engineering educational programmes in Europe: the EUR-ACE label, the ENAEE network", JABEE Symposium/Workshop "Global Trend and Perspectives on the Quality Assurance of Engineering Education", Tokyo, Japan, December 2006.

[7] THEIERE Project 2002-4, details on EAEEIE website, www.eaeeie.org/theiere.

[8] EIE Surveyor Project 2005-8, details on EAEEIE website, www.eaeeie.org/EIESurveyor.

[9] FM Barbosa, C Burkley, M Hoffmann and JM Thiriet, "Accreditation of higher education in EIE in Europe", 18th International EAEEIE Conference, Prague, July 2007.

[10] E. Gose, R. Johnsonbaught, S. Jost, Pattern recognition and image analysis, Prentice Hall, 1996.

<div align="center">

Appendix 3

</div>

36th Société Européenne pour la Formation des Ingénieurs (SEFI) annual conference (Aalborg, Denmark, July 2 – 5, 2008)

<div align="center">

Accreditation processes in Electronic and Information Engineering

</div>

<div align="center">

Fernando Maciel Barbosa[1], Cyril Burkley[2], Michael Hoffmann[3], Daniel Pasquet[4]

</div>

[1]Universidade do Porto, 4200-465 Porto, Portugal
[2]University of Limerick, Ireland
[3]Universität Ulm, 89069 Ulm, Germany
[4]ENSEA, 95014 Cergy, France (pasquet@ensea.fr)

Abstract

The aim of the SOCRATES EIE-Surveyor project is to be a reference point for Electrical and Information Engineering in Europe. The project brings together representatives from 27 out of 31 eligible countries. One of the tasks of the project is the evaluation of the accreditation processes in the participating countries. A questionnaire about the accreditation process was developed and sent to project partners in each participating country. The main areas investigated the nature of the accreditation body, the criteria, which are evaluated, the structure of the visit and the decision formulation.

A first analysis shows that some countries have not yet introduced a formal accreditation process. These countries are generally in a transition situation in relation to introducing the Bologna process. In some other countries several accreditation bodies exist depending on the region or the nature of the institution. It also appears that the accreditation for masters degrees is not yet compulsory everywhere.

Other issues regarding the accreditation process that are also being considered relate to who pays the expenses in relation to the accreditation process, what is the relationship between the ECTS and the actual content and level of the courses and whether or not industrial placement is a compulsory component of the programme.

Keywords: accreditation, evaluation, electrical engineering

1. INTRODUCTION

EIE-Surveyor is a SOCRATES project whose objectives are:
- Identification of the generic competences and subject-specific competences in Electrical and Information Engineering (EIE).
- Implementation of quality assessment methodologies on some educational resources available in EIE.
- Evaluation of the existing accreditation processes and the proposition of a standard methodology for accreditation, in order to enhance comparability and common certification procedures.
- Compilation of the existing curricula in EIE in Europe, the multinational degrees, and the situation of the implementation of Bologna process in EIE, at the bachelor, master and PhD levels.

The main activities of the project are:
- The application of the tuning methodology to EIE to identify competences.
- The compilation of a list of the degrees available in EIE in Europe, and the state of the implementation of the Bologna process.
- The quality assessment of some resources in EIE available through the Internet.
- The analysis of existing accreditation procedures and the proposition of a standard accreditation methodology.

The expected outputs are:
- The update of a monograph on the degrees and international degrees in EIE in Europe that was published in a previous project (THEIERE project).
- Guidelines for the generic competences and subject specific competences content in EIE programmes
- Proposal for a standard accreditation methodology, together with a census on existing accreditation boards and methodologies.

- Library of selected pedagogical resources available in EIE with a quality assessment.

The project involves 94 partners from 27 countries (out of 31 eligible countries). This reports on the accreditation task of the project.

The starting point of the accreditation task in Surveyor project was the EUR-ACE project (European accreditation of European Engineering and graduates) [1], which was a consortium of 14 partners, supported by the European Commission. The objectives of the EUR-ACE project were (i) to ensure consistency between existing national engineering accreditation systems, (ii) establish a European "quality label" for accreditated programmes and (iii) assist with the establishment of accreditation in European countries where it does not yet exist, thus improving the quality of engineering education, facilitating transnational recognition and mobility of engineering graduates.

The aim of the EIE Surveyor task was to see how the EUR-ACE results could apply to the field of electrical and communication engineering.

2. MAIN POINTS TO BE CONSIDERED
The EUR-ACE project evaluated the various factors that should be taken into consideration when assessing an engineering programme. These have been used as the guideline for constructing the questionnaire. They are gathered into six domains.

2.1. General information and curriculum
The general points concerning the curriculum are:
- Identification of educational goals
- Profile of the programme
- Duration, workload, ECTS
    A difference must be made between the duration of courses, tutorials and practical works and the actual workload which includes the personal unsupervised study time of the students.
- Teaching methods
- Programme structure
- Programme content
- Number and duration of internships or workplacements
    The internships may be in academic laboratories or in industry.

2.2. Professors and academic staff
- Teaching staff (number, specialisation, qualification)
    The ratio between professors and other academic staff is considered. Their area of specialisation must be close to the topic of the curriculum.
- Academic staff – student ratio
- Technical and support staff
    Qualifications of the technical and support staff are also important.
- Research activities of staff
    The research activity should inform the development of the curricula.
- Professional activities and consultancy

2.3. Admission and educational standards
- Admission requirements
    Students may be admitted to the programme on the basis of a general national or state examination or by a selective entrance examination.
- Assessments of demand for the programme
- Assessments of student performance
    This relates to the different ways of assessing the student performances (grading, oral assessment, practical results of a device).
- Student performance
    The performance must be evaluated according to ECTS criteria. The distributions of the results among the different grades may be evaluated.

- Graduate employment opportunities

2.4. Quality assurance measures and development
- Quality assurance measures
- Plans for the future development of the programme

2.5. Institutional context
- General requirements (organizing, management,…)
   This point relates to how the institution operates and is managed.
- Cooperation with Higher Educational Institutions
- Industry cooperation
   The industrial cooperation is important for technical fields. It can be at different levels (internships, Teaching engineers, facilities)
- Finances
- Facilities
   Many facilities are required for technical fields (laboratories, computers) but also for general needs (library, duplicated notes,…)

2.6. Internationalisation
- Study abroad opportunities
   Most of institutions propose studies abroad for their students. It can be a simple semester or a whole academic year with validation by the home institution. Many double diplomas are proposed.
- International co-operations
   The international co-operations between two institutions consist of student and teachers mobility. They generally precede the organisation of study abroad opportunities. They are often initiated by research activities.
- Foreign language requirements and education
   For non-English speaking people, a knowledge of the English language is very desirable.
- Subject or specific classes taught in foreign languages
   Many institutions propose some courses in English and a few have a full curriculum in English.

3. QUESTIONNAIRE
It was considered important that the questionnaire evaluated how the EUR-ACE criteria are considered by the institutions during the accreditation process. The goal was to have some complementary information specific to EIE field.

The questionnaire was constructed so that it could be completed in a quick and straight forward manner. It was sent to one partner in each participating country. Where a country has several accreditation bodies, several questionnaires were sent. The questions were divided into four sections.

3.1. Accreditation body
- Is accreditation compulsory to deliver engineering degrees in EIE?
- Is the accreditation awarded by the government, the university, a professional body or some other agency?
- Is the accreditation awarded to a programme, a department or the whole institution?
- Does the accreditation body include faculty, employers, engineers in industry?
- Does the accreditation process include quality assurance measures?

3.2. Parameters Measured
A number of different parameters can be considered during the accreditation process. For each of them the questionnaire asked whether it is evaluated and if documentation is provided in advance or during the visit. The parameters listed in the questionnaire were:
- Curricula
- Examination papers
- Student examination scripts
- Projects reports and thesis

- Students' performance
- Employment of graduates
- Academic staff
- Recruitment
- Research activities
- Collaboration with industry
- Facilities

3.3. Evaluation visit
In general the accreditation body sends a visiting panel in the institution to be reviewed. In order evaluate the visiting process, the following questions were asked:
- What is the frequency of the visits?
- What is the size of the visiting panel?
- What is the composition of the visiting panel (academics, industrial, others)?
- What is the duration of the visit?
- Whom does the panel meet during the visit?
>   - students
>   - academic staff
>   - technical staff
>   - administrative staff
>   - employers
>   - graduates

3.4. Conclusions
On the completion of the visit, the visiting panel in general gives a verbal presentation of their findings to the staff in the institution visited. Subsequently a report is written which includes a recommendation on the accreditation. In order to evaluate how the conclusions are processed the followed questions were asked.
- To whom do the review panel report (government, university, professional body, agency)?
- Who makes the final decision (government, university, professional body, agency)?
- What are the different possible decisions?
>   - full accreditation
>   - accreditation for reduced period of time
>   - no accreditation
>   - additional non-compulsory recommendations

At the end of the questionnaire, the participants were also invited to add any further comments they may wish to make.

4. RESULTS
Twenty two completed questionnaires were received from partners in eighteen different countries. Some countries have several accreditation bodies – for example there are six different accreditation bodies in Germany and three in France. In the questionnaire many of the answers were not mutually exclusive so several answers were possible with the result that the total percentage may add to more than 100%.

64% of the respondents said that the accreditation is compulsory and in some cases accreditation can be given simultaneously by several entities. In 64% of the cases the government awards the accreditation while an independent agency does so in 45% of the cases. In the majority of cases (73%) the programme itself is accreditation and the whole institution is evaluated 56% of the time. The accreditation body is constituted by faculty (65%), member of specific accreditation bodies (59%) and employers (45%). Engineers in industry are present in only 14% of the accreditation bodies. The accreditation process includes quality assurance measures (77%).

The most important criteria that have been considered during the accreditation process are the curriculum (95%), the academic staff (91%), the collaboration with industry (86%), the facilities (86%), the research activities (82%) and the employment of graduates (77%). In most cases documentation related to these items was provided in advance. Other criteria evaluated include the projects reports and thesis (68%), the recruitment (59%) and the student examination scripts (45%). These items are generally evaluated during the visit. The examination papers are considered in only a minority of cases (32%).

On average, the frequency of the visits is 5 years and the size of the visiting panel is 4 persons. It is mainly composed of academics (86%) and industrial representatives (55%). The visit lasts between 2 and 3 days. The panel meets mainly students (91%), academic staff (95%) and administrative staff (82%). Technical staff (50%), employers (36%) and graduates (41%) are interviewed less frequently.

The final report is sent to the government in (50%) of the cases, the university in (32%) and an independent agency in (41%). The final decision is made by the government (55%) of the time and an independent agency (36%) of the time. They decide on full accreditation or an accreditation for a reduced period of time or a non-accreditation. In 41% of the cases, additional non-compulsory recommendations can be given.

5. CONCLUSION

A first analysis shows that some countries have not yet introduced a formal accreditation process. These countries are generally in a transition situation in relation to introducing the Bologna process. The accreditation process, ECTS and the quality assurance measures will probably be introduced at the same time.

In some other countries several accreditation bodies exist depending on the region (in Germany according to the Länder) or the nature of the institution (in France between universities and Grandes Ecoles). It also appears that the accreditation for masters and PhD degrees is not yet compulsory everywhere.

Other issues regarding the accreditation process that are also being considered include the payment of the expenses in relation to the accreditation process. This point is important in the countries where the accreditation process is not paid by government. Also, the relation between the ECTS and the actual content and level of the courses is being considered. This issue is larger than the goal of this task, but it is a very important question for the mutual recognition of the curricula. Finally the issue of whether industrial placement is compulsory and for how long must it last is being reviewed.

Reference
[1] http://www.feani.org/EUR_ACE/EUR_ACE1_Main_Page.htm

This report has been written during the academic years 2005-2008 by a consortium composed of 107 universities, which are members of the EIE-Surveyor Thematic Network, with the cooperation of the EAEEIE (European Association for Education in Electrical and Information Engineering, http://www. eaeeie.org).

This report has been published in the summer of 2008 and therefore the available information corresponds to the situation in higher education institutions in Europe at this time.

The report consists of two parts:

> The first part is dedicated to the Quality Assessment of Resources in EIE Available through the Internet.

> The second concerns an analysis of the existing accreditation procedures, and proposition of a methodology.

.