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Implementation of the Bologna process in Electrical and Information Engineering in Europe: present situation and evolutions

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Abstract

The EIE-Surveyor ERASMUS thematic network ran from October 2005 to November 2008. The main topics dealt with in the disciplines of Electrical and Information Engineering (EIE) were competences, accreditation, quality and the Bologna process. The main outcomes of the project are three books which freely available to all parties interested. The books provide information on the existing curricula in EIE in Europe, on the implementation of the Bologna process, mobility aspects, on the current situation and on recommendations for accreditation in conjunction with a quality approach.

Content Page

* Due to their number, the other authors are listed at the end of the article.

1. Introduction

Bologna in EIE

The construction of the European Higher Education Area until 2010 is the aim of the Bologna process [1].

At present, the situation still presents a varied profile, since some countries have already adopted the Bologna declarations in full, whereas others are still discussing implementation.

An overview of the process permits the conclusion that a convergence of Higher Education Degrees has been attained at this level. The 3-cycle BMD system is used now in most European countries and the credit system ECTS is applied in all the countries that have signed the Bologna Declaration.

Work is now under way to refine the accreditation aspects, which are strongly connected to the implementation of the Bologna process, and which concern the recognition of courses passed elsewhere, as well as the wide recognition of diplomas [7, 8].

These are very important aspects which are now to be taken into account within the Life Long Learning Programme of the European Commission.

This programme combines both Higher education (academic) and vocational approaches, as far as accreditation and credit accumulation are concerned.

EIE-Surveyor Thematic Network

EIE-Surveyor is an ERASMUS thematic network which was funded by the European Commission for a three-year period from October 2005 until September 2008. Launched in response to a call from the European Commission, the aims of the project are to reflect upon and make concrete proposals regarding problems of mobility of students, readability of contents, and recognition of diplomas.

The project was organised in the form of four main tasks, each of which was related to a specific outcome of the project, including the different activities and dissemination strategies. A management team ensured the coordination of all these different activities.

The main objectives of the project were the following:

- 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, in order 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.

The content of the project includes a survey and proposals for competencies, accreditation procedures, curricula and multinational degrees.

Acting as a reference point for Electrical and Information Engineering in Europe, this project has been proposed and achieved under the aegis of the EAEEIE (European Association for Education in Electrical and Information Engineering, www.eaeeie.org).

Content of the paper

The paper is organised as follows: the next section presents the project and its context. Section 3 deals with the activities of the project. In order to illustrate the results achieved in implementing the Bologna process in Europe, section 4 proposes a case study which compares 2 higher education systems in Europe. Section 5 describes the results of the project and section 6 the dissemination strategy.

2. Presentation

Actions of the project

In order to encourage students mobility at the European level and the recognition of diplomas, and also in order to facilitate the readability of curricula and diplomas, the EIE-Surveyor thematic network *(EIE-Surveyor: Reference Point for Electrical and Information Engineering in Europe – Project Nr. 225997-CP-1-2005-1-FR-ERASMUS-TNPP)* ran from October 2005 until November 2008, in response to a call from the European Commission.

The thematic network was accepted for a three-year period. The activities of the project were the following:

- Reflection on generic **competences** and subject-specific competences in Electrical and Information Engineering (EIE) with application of the TUNING approach [4] [5] [6] [9],
- Implementation of **quality assessment** methodologies on some educational resources available in EIE [10],
- Reflection and proposition of a methodology for **accreditation**, in order to enhance comparability and common certification procedures [10],
- 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** [11, 12] and **doctoral** levels [13].

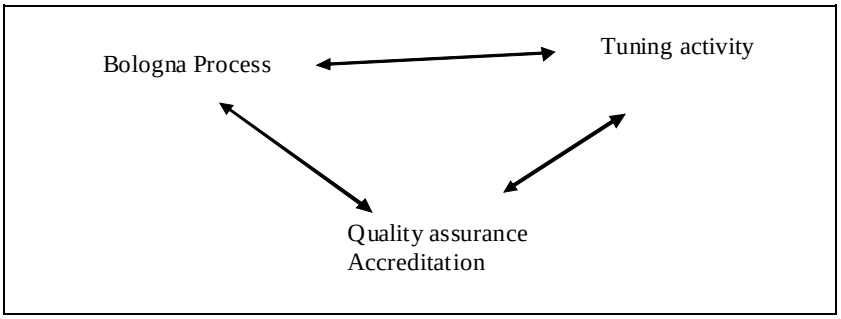


Fig. C 5.1-6-1 **Relationships between the main activities of the EIE-Surveyor Thematic Network**

The main activity deals with competences (TUNING approach) which are important elements to be taken into account for the accreditation procedures which aim at improving student mobility and diploma recognition, the Bologna process being the means to reach this goal (see figure C 5.1-6-1).

Consortium

29 eligible countries were represented in the consortium (see figure C 5.1-6-2):

- 26 countries of the European Union (except Luxembourg),
- Norway, Iceland, Turkey.

Two non- eligible countries were represented in the consortium: Ukraine and Lebanon.

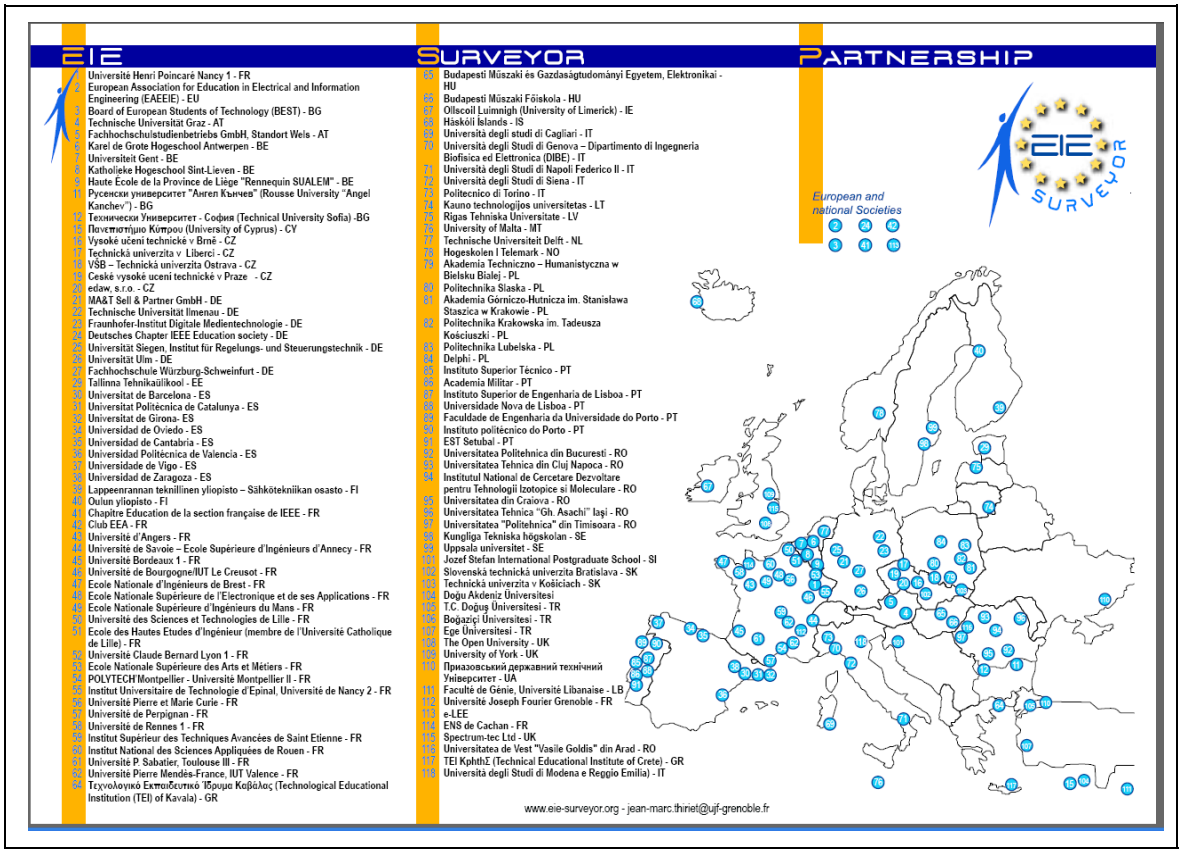


Fig. C 5.1-6-2 The EIE-Surveyor partnership

3. Activities of the project

EIE is actually the common substrate of all the most advanced technologies. So it is important to maintain an observatory on the implementation of the Bologna process in EIE: a tool for feedback, but also for colleagues. The aim of the project is to become a reference point in EIE. The general aim is also to enhance the attractiveness of ERA (European Research Area), the links with industry, as well as to participate in the continuous evolution of HE in Europe.

To answer to these needs, the main aims of this thematic network are:

1. to implement the "Tuning project" [4, 5, 6] approach in EIE, complementing the work done in other disciplines by the Tuning project itself and other thematic networks; the aim of this Tuning Approach is to identify and quantify the fields which have to be taught

Tuning approach

to a student, the generic competences (Line 1 of the tuning approach) as well as the subject-specific competences obtained (Line 2 of the Tuning approach): in other words, to identify the competences relevant to EIE. This should act as an instrument providing a correct definition of the learning outcomes of the programme developed in the European Union, in order to emphasise recognition and transferability.

Accreditation

2. to work towards a methodology of accreditation [7]: to this end, a preliminary study of the existing accreditation procedures was undertaken during the THEIERE project [8]. The purpose here is to go further and complete the study, in order to have a better view of the way accreditation is done in the various countries [3], this point is strategic if we wish to go further in the recognition of degrees and diplomas throughout Europe. The project aims to provide guidelines on good practices of accreditation, based on the required competences and learning outcomes, as well as on the needs of industry [14].

E-learning

3. to incorporate internet-based educational resources (e-learning) for EIE education [15, 16]. For this purpose it is necessary – first – to have access to specific web-based materials, covering the required EIE topics, and – second – to have computer-supported tools allowing these materials to be used in an appropriate manner for attaining specific learning objectives and permitting different learning strategies (project-based learning, collaborative / cooperative learning). This task concerns e-learning, for lifelong learning as well as for initial education. To achieve this aim we propose to set up a bank of pedagogical EIE resources available via the internet, to act as a census of existing resources. The aim is here to implement Quality in education in respect of the pedagogical resources in EIE available on the internet. On the one hand, this means selecting and classifying educational materials for EIE on the basis of the quality of content in relation to the concepts, models and competences required in EIE, as well as their potential effectiveness as teaching-learning tools for EIE education; at the same time, we will make them available to the EIE community. The work will be a continuation of some of the activities of the THEIERE project, which will be completed with the selected resources.

Bologna process implementation in EIE

4. to implement a survey of the Bologna process in EIE at Bachelor level, at Master level, and also at the PhD level [13]. The activities will conclude the updating of the maps of European undergraduate and postgraduate studies: a monograph was produced during the THEIERE project (2000-2003), but some countries remain to be completed; in addition, some information needs to be updated because the situation is always evolving.

4. Case study of the comparison of 2 HEIs systems in Europe

In order to illustrate the comparative analysis, we describe the situation of higher education in two countries. These were chosen between the various partners as case studies of two kinds of evolution.

One of the cases, that of HEIs in Slovakia, shows a great difference between the situation in 2001 and today. The second case refers to Ireland where the system of higher education operating in 2001 still prevails.

4.1 Higher education evolution in Slovakia

Example of Slovakia: important modifications for Bologna

In the figures below (Figure C 5.1-6-3, C 5.1-6-4) the situation of higher education in Slovakia in 2001 (Figure C 5.1-6-3) is shown in a diagram, where the transition process between the several degrees is also depicted. Figure C 5.1-6-4 shows the present situation.

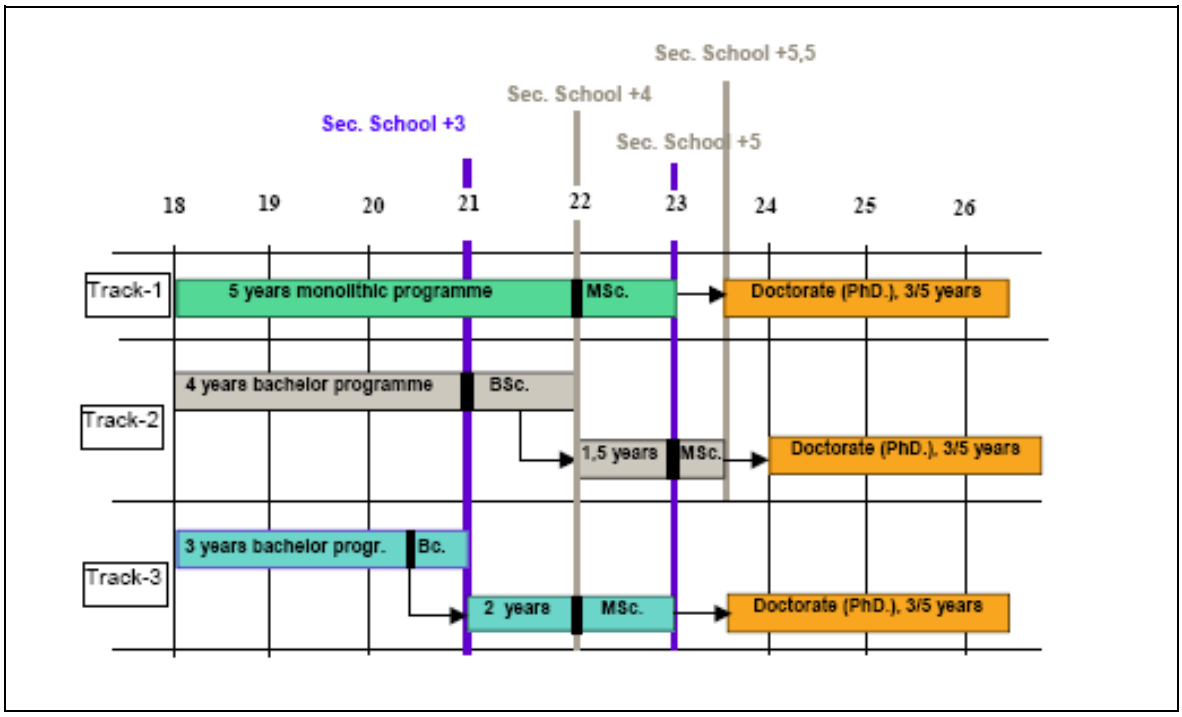


Fig. C 5.1-6-3 Slovakian higher education system in EIE disciplines in 2001

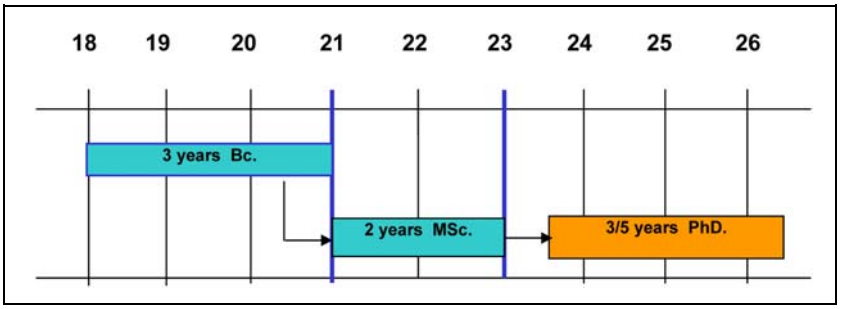


Fig. C 5.1-6-4 **Slovakian higher education system in EIE disciplines in 2008**

As can be inferred from the schematic representation, all the four tracks available in higher education prior to 2001 were merged into a single system, which complies with the Bologna model.

The new system was prescribed by HE law (No. 131/2002), which was passed in February 2002. Study programmes in the academic year 2007/8 are based on a new "system of study fields in HE" drawn up by the Ministry of Education of the Slovak Republic in December 2002 [18].

The **Bachelor** study programme, according to the HE law, can take three years at least and four years at most, but the standard length of first cycle study programmes is 3 years.

In EIE there exist only **Magister Engineer** (equivalent to MSc.) programmes. They require one year at least and three years at most, so that the standard length of study combining the Bachelor and the continuing second level study programme in the same or relatively similar field of study is in total five years at least.

The PhD. study programme has a normal full-time duration of three years at least. At present, the PhD. study is integrated into the 3-5-8 scheme as the third cycle , including the implementation of ECTS.

The general condition for admission to the first-degree programme is the secondary school-leaving certificate (**Vysvedčenie o maturitnej skúške**) issued after passing the secondary school-leaving examination taken upon completing 13, or exceptionally 12, years of study.

The general condition for admission to the second-degree programme is the successful completion of the first-degree programme in the same main field of study (specialisation) or a related one, as well as the successful completion of an entrance examination.

The general condition for the admission to the PhD. programme is the successful completion of an appropriate second-degree programme and the completion of an entrance examination.

The curricula of all HE study programmes are designed by the professors who are employed at the particular HE institutions that will offer the programme, in cooperation with the professionals from the industry at home and abroad. The process of the curricula design takes into account the internal HE institution quality assurance criteria. The final version of the program has to be approved by the Scientific Board of the HEI and is also discussed in the HEI's academic Senate. After that the program has to be accredited by the Accreditation Commission, that is the advisory body of the Slovak Government.

4.2 Higher education evolution in Ireland

Example of Ireland: slight modifications for Bologna

Figure C 5.1-6-5 below shows the situation of higher education in Ireland in 2001, as well as the transition process between the several degrees. The framework shown in this figure is still valid today.

Engineers Ireland, which is the professional engineering Association and also the accreditation body, has reviewed the Bologna Declaration and its impact on engineering education in Ireland and submitted its finding to the Government. Various other groups are still discussing the possible implications of moving towards the Bologna-BMD system.

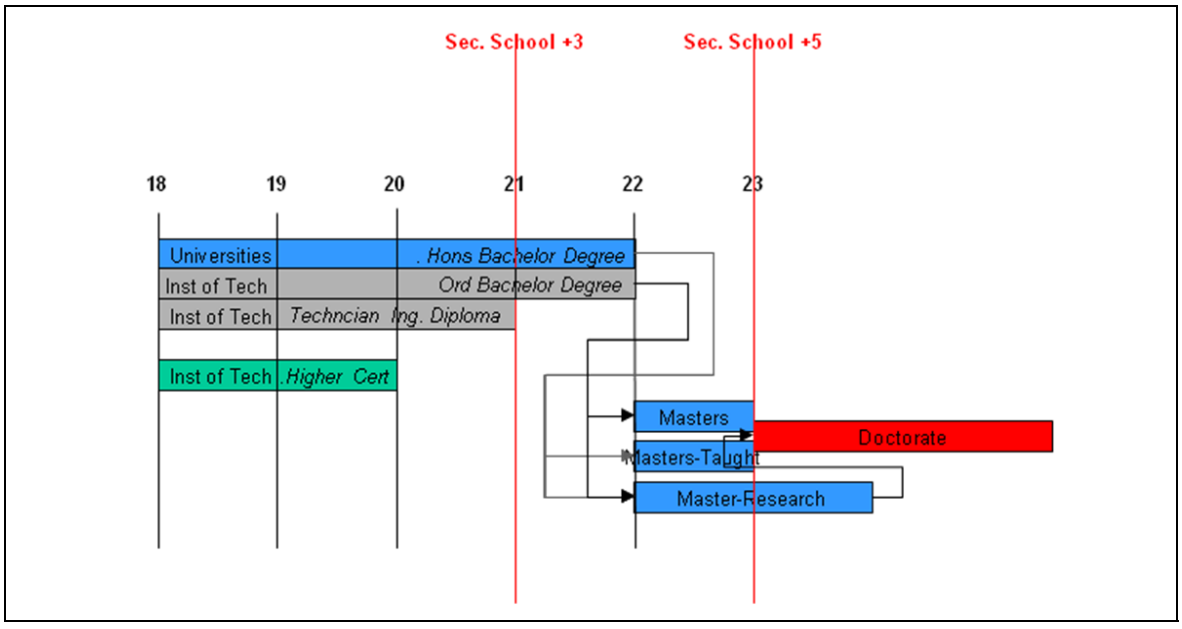


Fig. C 5.1-6-5 Irish higher education system in EIE disciplines

Meanwhile, all the Universities and Institutes of Technology have adopted the ECTS system and all the programmes and individual modules have been assigned the appropriate ECTS credit weighting.

The current Irish University education system is based on a four-year first degree. The current system is therefore one of 4-5-8. The universities are funded by the government; currently students taking first degrees pay no fees and for this reason changing the Irish system to a Bologna-BMD system presents problems.

Reducing the first degree to three years will significantly reduce the level achieved by the graduates, which will have a negative knock-on effect for employers in business and industry. It will also require the universities to redesign all of their existing programmes.

An alternative option is to increase the duration of the first degree to 5 years, but this would have major funding implications for the Government and therefore is a decision that would require much prior discussion.

4.3 Conclusions

Present situation of the Bologna process implementation

This study aims at showing that European countries are working to implement the Bologna process in their HEI systems. Nevertheless, the national viewpoint remains strong and the weight of the past should not be forgotten.

As a main conclusion of this study, not only regarding these two examples, but also throughout Europe, we might say that the main objective of introducing two-cycle basic training in EIE has been put into effect in most countries in Europe. The credit system is now for the most part based on ECTS, which facilitates the inter-institutions recognition of diplomas as well as student mobility.

However, in many Bologna signatory countries the implementation of ECTS does not reflect its transformation into a **E**uropean **C**redit and Accumulation **T**ransfer **S**ystem, where credits are exclusively based on the work load and not on other aspects such as face-to-face teaching hours, significance of the course unit in the curricula etc. This transformation is very important for the further development and implementation of LLL. It is a major challenge for the future tuning of the Bologna Process.

Doctoral studies have lagged behind and there is still a lot of controversy, particularly in respect of the weight of independent research work and the mandatory inclusion of seminars and courses also credited by ECTS.

5. Main results of the project

The main results of the project are available as three books, which have been published and disseminated to many target groups. The results of the project can also be downloaded from http://www.eie-surveyor.org/cd/.

Competences, Tuning approach

1. (Under the co-ordination of A.E. Ward) – "The alignment of Generic, Specific and Language Skills within the Electrical and Information Engineering discipline", Ed. EAEEIE, Nancy-Grenoble, September 2008, 188 pages, (ISBN 2-9516740-2-3).

   This book proposes a list of EIE competences, implementing the European TUNING [4] [5] [6] transversal approach; this aspect is very important when considering accreditation and recognition at European level. The value of the Tuning Methodology and of the analyses carried out has been demonstrated by this project task and the specific findings point clearly to areas where more work can be undertaken.

Bologna process implementation in EIE

2. (Under the co-ordination of M.J. Martins & J.M. Thiriet) – "Overview of the Bologna Process – Implementation in Europe in Electrical and Information Engineering", Ed. EAEEIE, Nancy-Grenoble, September 2008, 538 pages, (ISBN – 2-9516740-3-1).

   This book proposes two reference papers on the implementation of the Bologna process at Bachelor, Master and at the doctoral levels. A study of mobility in EIE is also proposed.

   The second part of the book consists of a country-by-country presentation of the implementation of the Bologna process in EIE in Europe, with updated data, compared to the previous version of the book, published in 2003 [13].

Quality and accreditation

3. (Under the co-ordination of D. Pasquet and D. Deniz) – "Quality and Accreditation in Europe: implication in Electrical and Information Engineering", Ed. EAEEIE, Nancy-Grenoble, September 2008, 79 pages, (ISBN – 2-9516740-4-X).

   The book consists of two parts. The first part is dedicated to the Quality Assessment of Resources in EIE Available through the internet. The second part concerns an analysis of existing accreditation procedures and a proposed methodology.

The following sub-sections aim at presenting the main results of the sub-tasks of the project.

5.1 Alignment of Generic, Specific and Language Skills in Electrical and Information Engineering

The Electrical and Information Engineering discipline area is broad and somewhat ‘fuzzy’ as different institutions typically interpret it differently throughout Europe. The findings of the first cycle degree programme monograph show that there are many different academic programmes that clearly fall within a common understanding of the terms and many that lie at its boundary.

European vision on competences

For the purposes of the Surveyor project, the definition of EIE has been aligned with the monograph definition to be found in a set of degree programme titles. These embrace Electrical and Electronic Engineering as would be expected. They embrace Information Engineering, where it is of an electronic or computer science related nature, and Computer Science. This excludes information engineering when its main focus is on media information (news, television, etc.) Subjects such as Media Technology, Communications (again where electronic in nature), Control, Aerospace, Mechatronics, etc. are included where the electrical or electronic technical content predominates. Subjects such as Business Management are included where it is a minor component (typically 25% or less) of a technical degree."

How strong is the consensus? In the analysis no comparison was made between student groups studying different subjects within EIE. Only overall conclusions can therefore be commented at this stage.

The question regarding which skills are required is a very difficult one. Answers vary, depending if they are given by employers from large or small (typically) companies, and despite the public statements issued by top managers from large companies. One could conclude that what is required is the employer view in the results section and the full report shows these results and compares them with the views of both students and faculty.

How does it differ from other forms of engineering? One feels that the results related to generic competences would be very similar, but that specific competences would be a totally different set compared with those specific to EIE.

Is there a significant European Labour Market? For EIE this varies throughout Europe and is in part dependent on how well supported national industries are.

This aspect of the EIE-Surveyor project was dedicated to the application of the Tuning Methodology to the Electrical and Information Engineering discipline area. This report presents the approach taken to this application and an analysis of the results obtained from a pan-European survey of students, academics, graduates and employers. In

total 3,275 completed questionnaires have been received and entered into a single SPSS dataset.

The main stakeholders were asked to express their opinions concerning the importance of the generic and subject specific competences for finding the job at the labour market and the degree of development of these competences during the completion of a specific study program in the EIE area. The sets of these competences were accepted on the basis of a common agreement by all participants in the project. The following tables show these competences.

List of Generic Competences in EIE Skill/Competence	**List of Subject Specific Competences in EIE** Skill/Competence
1. Capacity for analysis and synthesis	*Fundamentals*
2. Capacity for applying knowledge in practice	1. Ability to demonstrate knowledge and understanding of scientific facts, concepts, theories, principles and methods necessary to underpin the engineering discipline
3. Planning and time management	2. Ability to demonstrate knowledge and understanding of mathematics principles and methods necessary to underpin the engineering discipline
4. Basic general technical knowledge of the profession of your work area	3. Ability to apply and integrate knowledge and understanding of other engineering disciplines
5. Grounding in basic knowledge of the profession of your work area	4. Ability to demonstrate an appreciation of the wider multidisciplinary engineering context and its underlying principles
6. Oral and written communication in your native language	5. Ability to understand and take into account social, environmental, ethical, economic and commercial considerations affecting the exercise of engineering judgement
7. Knowledge of a second language	*Engineering Analysis*
8. Elementary computing skills	6. Ability to apply appropriate quantitative mathematical, science and engineering methods and computer software to solve engineering problems
9. Research skills	7. Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques
10. Capacity to learn	8. Ability to apply a systems approach to engineering problems

List of Generic Competences in EIE Skill/Competence	**List of Subject Specific Competences in EIE** Skill/Competence
11. Information management skills (ability to retrieve and analyse information from different sources)	*Design*
12. Critical and self-critical abilities	9. Ability to investigate and define a problem and identify constraints including environmental and sustainability limitations, health and safety and risk assessment issues
13. Capacity to adapt to new situations	10. Ability to understand customer and user needs and the importance of considerations such as aesthetics in the design process
14. Capacity for generating new ideas (creativity)	11. Ability to identify and manage cost drivers in designs and projects
15. Problem solving	12. Ability to demonstrate creative and innovative ability in the synthesis of solutions and in formulating designs
16. Decision-making	13. Ability to undertake design activities and projects to ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal
17. Teamworking	14. Ability to manage the design process and evaluate outcomes
18. Interpersonal skills	*Economic, social and environmental context*
19. Leadership	15. Ability to demonstrate knowledge and understanding of the commercial and economic context
20. Ability to work in an interdisciplinary team	16. Ability to demonstrate knowledge of management techniques which may be used to achieve engineering objectives within the commercial and economic context
21. Ability to communicate with non-experts (in the field)	17. Ability to demonstrate understanding of the requirement for engineering activities to promote sustainable development
22. Appreciation of diversity and multiculturality	18. Ability to demonstrate awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues
23. Ability to work in an international context	19. Ability to demonstrate understanding of the need for a high level of professional and ethical conduct in engineering
24. Understanding of cultures and customs of other countries	20. Ability to demonstrate knowledge of characteristics of particular materials, equipment, processes, or products

List of Generic Competences in EIE Skill/Competence	**List of Subject Specific Competences in EIE** Skill/Competence
25. Ability to work autonomously	21. Ability to demonstrate practical engineering skills.
26. Project design and management	22. Ability to demonstrate understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc)
27. Initiative and entrepreneurial spirit	23. Ability to demonstrate understanding of the use of technical literature and other information sources
28. Appreciation of ethical issues	24. Ability to demonstrate awareness of the nature of intellectual property and contractual issues
29. Concern for quality	25. Ability to demonstrate understanding of appropriate codes of practice and industry standards
30. Will to succeed	26. Ability to demonstrate awareness of quality issues
31. Patents and Intellectual Property Rights	27. Ability to work with technical uncertainty
32. International Relations and Collaborations	28. Ability to work in a group on a major project

Table C 5.1-6-1 Competences in Electrical and Information Engineering

Analysis of the data on competences

The responses have enabled analyses to be carried out in a number of different ways, including comparisons by gender, academic study level, country and competence, both individually and in the groups formed through the application of standard statistical data reduction techniques. Attention has been paid to the clarification of the scope of the EIE area, as the boundaries between technical degrees and broader arts degrees are blurred in places.

The project has confirmed the appropriateness of the Tuning Methodology to the discipline area and, in line with other Tuning studies, has shown that the results differ between countries and that clustering of countries occurs in some analyses.

The analysis shows that, in terms of employability, academics typically over-rate while students generally under-rate how well students are prepared for employment. This perhaps reflects the general optimism of academics and the pessimism of students where future employment is concerned. In general, employers and academics rate competences higher in importance than students and graduates, even allowing for the unevenness in the average responses of these different stakeholders. The most important generic competence is problem-solving, followed by elementary computing skills and knowledge of a second language. A number of differences between the rated impor-

tance and the level of development of the competences emerge, providing evidence that the adjustment of curricula would be beneficial. Finally, the analysis shows that the English language is the only second language that is rated as anything more than marginally important. All stakeholder groups share this view.

The value of the Tuning Methodology and of the analyses carried out has been demonstrated by this project task and the specific findings point clearly to areas where more work can be undertaken. There are gaps in the data for some countries and for some stakeholder groups within some countries. It is recommended that attempts be made to fill these gaps, so that the analysis can be extended to be more representative of the whole of Europe. The issue of clustering needs to be examined in more detail and a focused study in this area may reveal some interesting European country clusters or some regional differences.

This book is composed of 198 pages and is downloadable from http://www.eie-surveyor.org/cd/.

5.2 Accreditation and Quality

Accreditation in the European countries

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 [7].

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*). Not all competing accreditation agencies of a country offer accreditations for all subjects (e.g., ASIIN in Germany offers accreditations of subjects in engineering, informatics, mathematics, and natural sciences), and some agencies have more customers in particular parts of a country (e.g., ACQUIN in the southern part of Germany, ZEvA in the northern part of Germany). It also appears that the accreditation of Master and PhD degrees is not yet compulsory everywhere. The doctorate, for instance, is normally not accredited in Germany, since it is not considered to be a part of studies, but a first part of a particular professional career.

Other issues regarding the accreditation process that are also being considered include the payment of the costs of the accreditation process. This point is important in the countries where the accreditation process is not paid for by government. Also, the relation between ECTS and the actual content and level of the courses is being considered. This issue is wider than the objective of this study, 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.

Quality on e-resources

The following advances have been made on the issue of quality of e-resources available over the internet [15] :

- 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 assessment methodology, containing both the e-Cat and the e-Surv sites, will be maintained under the umbrella of a professional organisation, such as the EAEEIE, beyond the lifetime of the project.

This book is composed of 76 pages and is downloadable from http://www.eie-surveyor.org/cd/.

5.3 Bologna Process implementation in Europe

Analysis of the Bologna process implementation

The construction of the European Higher Education Area by 2010 is the aim of the Bologna process. Since then follow-up conferences in Prague (May 2001) and Berlin (September 2003), have reviewed some of the initial objectives.

A three-cycle system has been established, with a common credit transfer system – ECTS – which should be extended towards an accreditation system in a LLL context.

Bachelor and master

The first cycle, the Bachelor, should not last more than 4 years, with a number of credits varying between 180-240. The second cycle, the Master, following the first degree, should require 90-120 credits (300

credits for the Bachelor + Master combined). The third cycle, the Doctorate, should not last longer than 3 years [2].

The true revolution of the Bologna process, also known as the BMD (Bachelor-Master-Doctorate) process, is that the teaching-learning process is focused on learning outcomes, rather than on syllabus, with the learners as the focal point of the educational strategy.

The use of learning outcomes to define the syllabuses means that the content of a specific course is expressed as knowledge, competences and skills acquired, rather than as information delivered. ECTS credits are based on workload rather than on face-to-face class hours [3]. Three initiatives have defined a framework for the establishment and development of the educational process and qualification system – the Dublin Descriptors, the Tuning project in the European Higher Education Area (EHEA) and the European Qualifications Framework.

At present, the situation still presents a varied profile, since some countries have already adopted the Bologna recommendations in full, whereas others are still discussing the implementation.

An overview of the process allows the conclusion that a convergence of Higher Education degrees has been attained at this level. The 3-cycle BMD system is used now in most European countries and the crediting system ECTS is applied in all the countries that have signed the declaration. However, a major challenge for the majority universities engaged in the Bologna process remains the final transformation of ECTS into a "ECT and Accumulation System" that is exclusively based on the workload of students. This would as well be very important for the further development of LLL.

Doctorate level

The Doctorate level is the one that is still under revision and presents more changes between the old and the new framework. The London Communiqué stipulates that different pathways to the doctorate will be possible in the future.

While the implementation of the Bachelor and Master degrees began in 2000, the consideration of doctoral studies arose only in 2003, since access to this third cycle required a successful completion of the second cycle. This topic is being discussed now.

A previous study [11] showed that there were wide differences in the doctorate in Europe, concerning duration, financial support and activities, for example the complementary classes and seminars that are compulsory in some countries and non-existent in others, or with respect to lecturers' duties.

The Bologna-follow-up conference in London in May 2007 was an important step in the evolution of doctoral studies. The main objective

is to promote a closer alignment of the European Higher Education Area (EHEA) with the European Research Area (ERA), with the aim of improving the quality and competitiveness of European higher education.

An overview of doctoral studies shows that there is a recent trend to include, besides the thesis research work, additional lectures, seminars, summer-schools, etc. that are particularly oriented to the needs of doctoral candidates [18]. Some ECTS credits are awarded for attending these events. The total workload of these events during the doctoral phase might be 50 to 150 hours on average. It must not exceed this time, in order not to put at risk successful research work.

It would be impossible to summarise a complex situation such as the evolution of European Higher Education in a short paper. For deeper information on the subject, please refer to the EIE project website (http://www.eie-surveyor.org). A new publication on the evolution of EIE syllabus evolution in Europe was published in September 2008 [13]. A detailed country-by-country analysis is available in that publication.

In conclusion, we can say that the main objective of introducing a two-cycle basic training in EIE has been put in place by most countries in Europe. The credit system is now for the most part based on ECTS, which facilitates the inter-institutions recognition of diplomas, as well as student mobility. However its transformation into a credit "transfer and accumulation" system is necessary.

Doctoral studies have lagged behind and there is still a lot of controversy, particularly regarding the weight of independent research work and the mandatory inclusion of seminars and courses also credited by ECTS.

This book is composed of 556 pages and is downloadable from http://www.eie-surveyor.org/cd/.

6. Dissemination strategy

Dissemination of the results of the project

The dissemination of the project is a key issue. EIE (Electrical and Information Engineering) is the targeted thematic field, as well as applications based on these disciplines.

The targets of the project are:

- teachers and researchers in HEIs. The project should encourage the definition of new study programmes in our disciplines,
- students, direct users of the courses,
- employers, as recipients of the students, in Europe and outside Europe,
- professional bodies, for their knowledge of the evolution in the HE landscape in Europe and their participation in accreditation.

Particular target groups are associations such as French *SEE (Société de l'Electricité, de l'Electronique et des Technologies de l'Information et de la Communication)*, British IET (Institute of Electrical Engineers), American IEEE (Institute of Electrical and Electronics Engineers), Portuguese *Ordem dos Engenheiros*, French *CNISF (Comité National des Scientifiques Français)*, French *Club EEA (Club des Enseignants et des Chercheurs en Electronique, Electrotechnique et Automatique)*, German *VDI (Verein Deutscher Ingenieure*, German *VDE (Verein Deutscher Elektrotechniker)*… as well as student associations in various countries and at European level (BEST, Board of European Students of Technology).

The last stage of the project has been reached, which consists in disseminating the outcomes. Three main actions were achieved during the project: participation of partners in conferences and meetings and presentation of EIE-Surveyor, use of the project website and disseminating the results of the project, as a CD, to around 1500 institutions.

6.1 Participation to conferences

During the 3 years of the project, more than 150 papers have been presented to international conferences. Some specific dedicated sessions have been organised, in particular in the previous EAEEIE Conferences in 2006, 2007 and 2008. Several national actions, such as the actions achieved within the French Club EEA (www.clubeea.org) working groups, allows the sharing of the activity of the project at a national level with other institutions, even if they are not partners in the consortium. The EIE-Surveyor project was also presented each

year during the Club EEA Annual congress, which attracts between 100 and 200 participants, in order for the French national community to become aware of the project. Similar actions were undertaken in other countries.

6.2 Website of the project

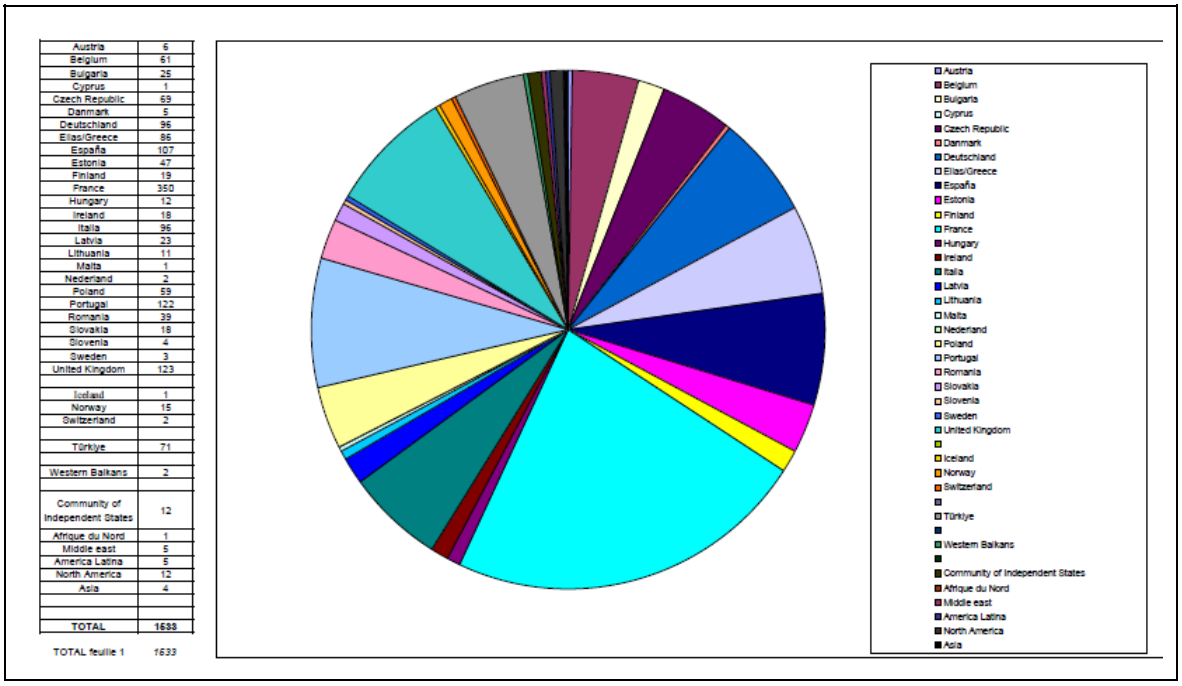
The EIE-Surveyor website (www.eie-surveyor.org) was used as a working website during the lifetime of the project. It has now been transformed into a dissemination website, which means that it is outcomes-oriented. Interested parties can find all the documents of the project on this website and everything is freely downloadable.

6.3 Dissemination of the results over 1500 institutions

Taking the opportunity of the size of the project consortium (110 partners), we decided to disseminate the results to higher education institutions, government institutions and ministries, economic partners (companies, newspapers...).

CDs containing the outcomes of the project together with flyers describing the projects were disseminated this way.

Some CDs and flyers were also distributed during conferences, meetings of other projects, or informal meetings. As a whole, 3000 CDs and 10000 flyers have been distributed, mainly in Europe, but also outside Europe.



Austria	6
Belgium	61
Bulgaria	25
Cyprus	1
Czech Republic	69
Danmark	5
Deutschland	96
Ellas/Greece	86
España	107
Estonia	47
Finland	19
France	350
Hungary	12
Ireland	18
Italia	96
Latvia	23
Lithuania	11
Malta	1
Nederland	2
Poland	59
Portugal	122
Romania	39
Slovakia	18
Slovenia	4
Sweden	3
United Kingdom	123
Iceland	1
Norway	15
Switzerland	2
Türkiye	71
Western Balkans	2
Community of Independent States	12
Afrique du Nord	1
Middle east	5
America Latina	5
North America	12
Asia	4
TOTAL	1638
TOTAL feuille 1	1633

Fig. C 5.1-6-6 **Dissemination among institutions**

7. Conclusion

Before concluding, we should point out that consideration has also been given within the project to attracting students to scientific study (particularly in EIE) and also to attracting women, since women are less present in our disciplines. Contacts have been established with TNs dedicated to these aspects.

From the strategic point of view, we can say this project has proved to be very important, since it makes a contribution to the second stage of a unified HE landscape in Europe. After the ERASMUS-ECTS tools invented by the European Commission in order to help universities to facilitate student mobility, the next stage is to go further in the improvement of the visibility and comparability of our degrees and curricula, in order to allow mobility, to attract foreign students and to facilitate the recognition of qualifications on a global basis…

As a whole, this three-year period was an exciting experience, working as a group of more than 100 institutions (the number of active partners about 60), trying to analyse the evolving situation regarding higher institutions in Europe, and trying to make recommendations concerning the future of HE in Europe.

Mobility of students and workers

Despite a policy dating back 20 years, encouraging mobility of students and the cross-recognition of degrees and diplomas, and despite the strong encouragement of the European Commission – not to converge, but to focus on a more easily readable format of study (the Bologna process), we can observe that much has been achieved but also that much remains to be done.
It is now more or less broadly accepted (except from some reluctant colleagues!) that it is good for a student to spend at least one semester abroad during her/his studies, in order to widen the experience of the future European citizen both at a professional level and in the human dimension.

The studies undertaken in the course of the EIE-Surveyor project reveal some remaining difficulties:

- The non-direct compatibility of the new Bologna-based curricula organised in Europe (for instance Bachelors with 180, 210 or 240 ECTS).

- The fact that on-course mobility is not so easy, in spite of ERASMUS. The recognition of courses spent abroad by a student should be prepared and validated for each student, which means a lot of energy expended, in some cases without success… In some universities it is simply impossible (except in the case of some projects), because each mobility must be explicitly part of the accreditation process, which is not practically achievable…

- The widespread non-recognition of qualifications: the diploma remains a national affair, with national accreditation bodies and procedures, and it is almost impossible to have a diploma well recognised in a first country to go and work in another one. Likewise, it is not easy to have a Bachelor recognised in one country in order to go for a Master course in another one.

What is missing in order to actually succeed in this mobility-based model is the existence of a European accreditation body, which would give the HEIs the possibility of delivering diplomas, according to well publicised rules. The European accreditation board should accredit each HEI in Europe. In this situation, single or joint multiple diplomas would be facilitated by accreditation at European level …

In the accreditation procedures, the mobility should be encouraged and an open process should be implemented in order to facilitate mobility.

The books [9] [10] [13] are the main outcomes of the project. The sustainability of the project is ensured, thanks to EAEEIE and thanks to the approval by the European Commission of a new ELLEIEC (www.elleiec.eu) project.

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