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A Survey of the Evolution of the Bologna Process in EIE in Europe

M.J. Martins[1], J.-M. Thiriet[2], O. Bonnaud[3], M. Hoffmann[4], M. Robert[5], J. Benlloch[6], G. Jervan[7]

[1] *Instituto Superior Técnico, DEEC, AC- Telecomunicações*
Av. Rovisco Pais 1, 1049-001 Lisboa – Portugal
mariajoaomartins@ist.utl.pt

[2]*Grenoble Images Parole Signal Automatique (GIPSA-Lab/CNRS UMR 5216)*
Université Joseph Fourier Grenoble - Institut Universitaire de Technologie 1 de Grenoble, France
[3]*Groupe Microélectronique-IETRs,Université de Rennes 1, France*
[4]*Institut für Mikrowellentechnik, Universität Ulm, Germany*
[5]*Centre de Recherche en Automatique de Nancy (CRAN/CNRS UMR 7039)*
Université Henri Poincaré, Nancy 1; France
[6]*DISCA, Universidad Politécnica de Valencia, Valencia, Spain*
[7] *Department of Computer Engineering, Tallinn University of Technology, Estonia*

***Abstract*— The EIE-Surveyor project is a European Thematic Network funded by the European Commission for a three-year period until October 2008. Its partnership includes 110 European academic institutions, which aims at acting both as an observatory and a proposition force for the evolution in the inter-disciplinary fields of Electrical and Information Engineering (EIE), of engineering curricula through the implementation of the Bologna process. The content of the project includes a survey and proposition of competencies, accreditation procedures, curricula contents and multinational degrees. In this paper we describe the work developed and results obtained in Task 3.1-A Survey of the Bologna Process in EIE at the Bachelor, Master and PhD level. This paper presents the main objectives of the project, the methodologies used and activities developed in the task.**

A comparative analysis of the obtained data will allow a clear perspective of the evolution of the implementation of the Bologna process across Europe, concerning not only the bachelor and master's degrees but also the numbers of PhDs and their interplay with industry, and mobility at all levels in Europe.

I. Introduction

The constant and growing amount of exchanges amongst researchers and professors, the many joint projects undertaken by international groups and the increased mobility of undergraduate and graduate students, encouraged by the establishment of exchange programs such as Erasmus, demand for a new paradigm in higher education.

Innovative approaches to the internal functioning of higher education are implemented through two independent processes: curriculum reform and the use of information and communication technologies (ICT).

Regarding the first, common core structures of study programs, modularization and the adoption of a common credit system- European Credit Transfer System (ECTS), are emerging as the most important tools to achieve that goal. Besides, these tools have several potential benefits in terms of mobility of students, flexibility of higher education programs, and international recognition of studies and qualifications.

These considerations were the backbone of the Thematic Network (TN) EIE-Surveyor proposal.

The new thematic network was launched based on the results of the THEIERE project [1], [2] (www.eaeeie.org/theiere) during which an observatory on the implementation of the Bologna process [3] in EIE throughout Europe was established.

EIE-Surveyor: Reference Point for Electrical and Information Engineering in Europe (www.eie-surveyor.org) is a three-year European ERASMUS TN running since October 2005. The main objectives of this thematic network are:

- a reflection on generic competences and subject-specific competencies in Electrical and Information Engineering (EIE)
- an implementation of quality assessment methodologies on some educational resources available in EIE,
- a reflection and proposition of a methodology for accreditation, in order to enhance comparability and common certification procedures,
- 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.

II. The EIE-Surveyor Partnership

This TN comprises 110 European academic institutions representing 29 eligible countries (all the current EU countries except Luxembourg) plus Norway, Iceland, Turkey, and 2 non eligible countries (Ukraine and Lebanon). Besides the academic institutions some other organisations, such as:

industrial companies, research institutes and societies, are involved in the network: BEST (Board of European Students of Technology), EAEEIE, IEEE French and German chapters on Education and the French Club EEA.

III. Project's Activities

EIE is actually the common substrate of all the most advanced technologies. The goal of the project is to become a reference point in EIE and, at the same time, to enhance the attractiveness of the European Research Area (ERA), the links with industry, and to participate in the continuous evolution of higher education in Europe. To answer these needs, the ongoing activities of the project, as identified in the contract, are:

- the setting up of common definitions about the competencies to define the paths of the students, during their studies,
- the analysis of accreditation procedures and methodologies all over Europe (and also in third world countries) in order to make some propositions for a common or shared approach, throughout Europe, in order to enhance comparability of curricula and recognition of diplomas,
- the setting of quality assessment of some pedagogical resources available in EIE in Europe,
- the state of the art of the implementation of the Bologna process in EIE in Europe, the various curricula available, at the Bachelor, Master and PhD levels,
- the existence of international curricula .

IV. Description of task 3.1.

(A survey of the Bologna process in EIE at the bachelor, master and PhD levels)

The activities in this task are the finalisation and update of the maps of European undergraduate and postgraduate studies. As mentioned previously, a monograph (Collective, 2003) [4] has been published during the THEIERE project (2000-2003), but some countries are still to be completed and some information needs to be updated because the situation is still evolving. Another monograph issued during the THEIERE-DISS project (2004-2005) [5], concerning an overview of PhD studies must be completed, together with the identification of the existing links between masters and PhDs, taking into account the master courses which will prepare the students for PhD studies. The completion and update of the information in the portal (see the prototype at www.eaeeie.org/theiere) will be achieved at the same time. This portal aims at allowing a student or a teacher (in the case of a search for partners for example) to find a requested curriculum (for example: bachelor in Computer Engineering in Lisbon, master in Automatic Control in Tallinn,…) either as a function of weighted keywords, or by using a known curriculum in the country of origin as a reference [6].

The main outputs of this action will be an update and completion of this monographs and the portal.

V. Comparative Analysis

The construction of the European Higher education Area until 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 was established, with a common accreditation system – ECTS.

The first cycle, entitled **Bachelor** should not last more than 4 years, with a number of credits varying from 180-240 credits. The second cycle – **Master**, after the first degree, should require 90-120 credits. The third cycle- **Doctorate**, should not last longer than 3 years.

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 programmes means that the content of a specific course is expressed as knowledge, competences and skills acquired, rather than on information delivered. ECTS are based on workload rather than on presential class hours. Two initiatives have defined a framework for the establishment and development of the educational process and qualification system - the Dublin Descriptors and the Tuning project.

At present, the situation still presents a varied profile, since some countries have already applied in full the Bologna recommendations 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.

The Doctorate level is the one that is still under revision and presents more changes between the old and the new framework.

While the implementation of the Bachelor and Master's degrees according to the Bologna process, began in 2000, the situation of doctoral studies only arose in 2003, since access to this third cycle required a successful completion of the second cycle.

A previous study [5] showed that there were big differences in the doctorate in Europe, concerning duration, financial supports and duties, as for example complementary classes and seminars that are compulsory in some countries and non-existing in others, or with respect to duties as lecturers.

The Bologna-follow-up conference in London in May 2007, was an important step towards the reflection of the evolution in 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 at the needs of doctoral candidates [7]. 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 in the average. It must not exceed this time in order not to put at risk successful research work.

VI. Case Studies

In order to illustrate the comparative analysis, we will 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 HEI 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.

A. Higher education evolution in Slovakia

In the figures below (Figure 1, 2) the situation of higher education in Slovakia in 2001 (Figure 1) is shown in a diagram where the transition process between the several degrees is also depicted. Figure 2 shows the present situation.

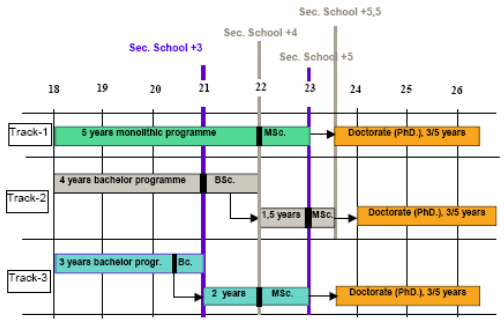

Figure1- Slovakian higher education system in EIE disciplines in 2001

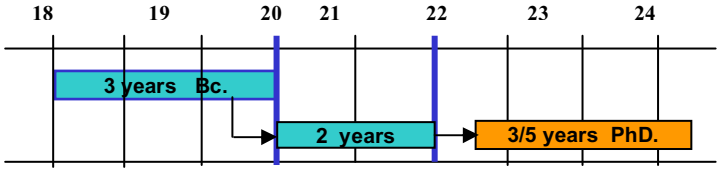

Figure 2- Slovakian higher education system in EIE disciplines in 2008

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

This new system was prescribed by the new HE law (No. 131/2002) passed in February 2002. Study programmes in the academic year 2007/8, are based on a new "system of study fields in HE" issued by the Ministry of Education of the Slovak Republic in December 2002 (see http://www.minedu.sk/index.php?lang=sk&rootId=413)

The **Bachelor's** study programme which according to the HE law can take three years at least and four years at most. But really the standard length of first cycle study program is 3 years.

In EIE there are only **Magister's, Engineer's** (equivalent to MSc.) Engineer's programs. The study takes one year at least and three years at most so that the standard length of study according to the Bachelor's study programme and the continuing second level study programme in the same or relative main field of study, is in total five years at least.

The PhD. study programme. The standard length in full-time form is three years at least.

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

The general condition for the admission to the second-degree program is the successful completion of the first-degree programme in the same main field of study (specialization) or a related one and the successful completion of the programme 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 the programme entrance examination.

The curricula of all HE study programs 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 from 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 HE institution and is also discussed in the HE institution Academic Senate. After that the program has to be accredited by the Accreditation Commission that is the advisory body of the Slovak Government.

B. Higher education evolution in Ireland

In the figure below (Figure 3) the situation of higher education in Ireland in 2001 is shown in a diagram where the transition process between the several degrees is also depicted. The framework shown in figure 3 is still valid nowadays.

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.

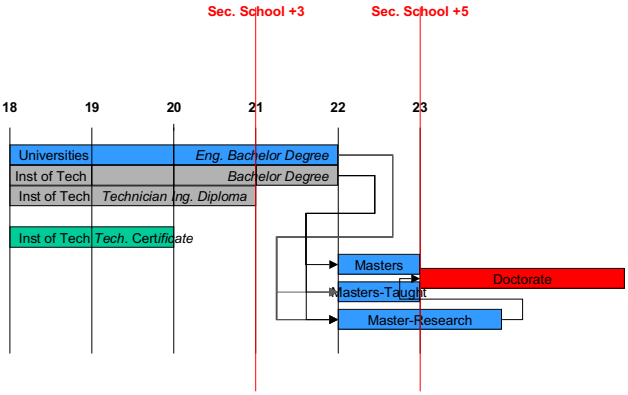

Figure 3- Irish higher education system in EIE disciplines

Meanwhile all the Universities and Institutes of Technology have adopted the ECTS credit 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. Therefore the current systems is a 4-5-8 system. The Universities are funded by the Government and currently students taking primary degrees pay no fees and therefore changing the Irish system to a Bologna-BMD system presents problems.

Reducing the primary 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 would also require the Universities to redesign all of their existing programmes.

An alternative option is to increase the duration of the primary 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.

VII. CONCLUSIONS

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

As a conclusion we might say that the main objective of introducing a two cycle basic formation in EIE has been applied in most countries in Europe. The crediting system is now for the most part based on ECTS, which facilitates the inter-institutions recognition of diplomas and student mobility.

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

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