

DEVELOPMENT OF A REFERENCE MODEL FOR COMPARISON AND RECOGNITION OF ENGINEERING PROGRAMS. (MIRROR)

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Abstract: *This document is an abstract of the work done in the frame of the project “Development of a reference model for comparison and recognition of engineering programs” supported by the programs ALFA II of the European Community under the number AML/19.090/06/18414/II-0510-A. This project began on July 2007 and is now in the phase of analysis of the information gathered by the partners of each institution involved in the programs that are enrolled in the project. The main objective of the project is to develop a model, under the basis of a common agreement that can be used as a reference to all partners, institutions and shareholders related with engineering, to exchange students, researchers and professionals between institutions and countries. It will facilitate agreements between institutions and promote the collaboration among them. The main purpose is to evaluate the model under different environments, each one represented by the institutions partners of the network. The project is planned to be finished on July 2009.*

Key words: *Engineering, Quality, Evaluation, Accreditation.*

1. INTRODUCTION.

In the frame of the globalization of superior studies, one of the main tasks of the Bologna process for the European universities is to increase the attraction of international students. Latin American universities need to build a space in this globalization process and want to participate more actively of it.

On both regions, most of the institutions want to modernize their curricula and the teaching and learning process, particularly on the engineering programs, mainly for their strategic impact on the social and economic development.

On this project the partners are working on engineering, an area of great interest for both regions. The purpose is that the academic authorities can obtain benefits of the experiences on curricular reforms and the constant improvement of quality programs existing now. To take advantage of the local, national or European mechanisms (VI Frame Program, Marie Curie

Scholarships, ALFA, Alban,...), to obtain a better valorization of the programs taken by the students and a simplification of the process for admission to other universities.

In this sense the institution included on the project has recognize the previous experiences on evaluation, taking in consideration the new tendencies on curricular and evaluation design of academic programs, and it wants to build an European and Latin American (EULA) common space for superior education on engineering, from the curricular convergence of the Bologna declaration an the regional and sub regional process on Latin America (Ex: MERCOSUR).

The institutions enrolled on the project are:

Latin America: Universidad Nacional de la Plata (Argentina), Universidad Nacional de San Juan (Argentina), ABENGE (Brasil), Universidad Federal de San Marcos (Brasil), Universidad Federal de Pernambuco (Brasil), Universidad Estatal de Campinas (Brasil), Universidad Católica de Valparaíso (Chile), Universidad de Talca (Chile), Universidad Nacional de Colombia, Universidad de Costa Rica, Instituto Tecnológico de Estudios Superiores (México), Universidad Iberoamericana (México), Universidad Católica del Perú, Instituto Tecnológico de Sonoro (México).

Europe: Technische Univesität Braunschweig (Alemania), Universidad Politécnica de Madrid (España), Universidad Politécnica de Valencia (España), Asociación Columbus (Francia), Universidad Politécnica de Torino (Italia), Universidad de Aveiro (Portugal), Universidad Técnica de Lisboa (Portugal).

The criteria used to evaluate the programs are based on the following facts:

- Professional competencies: knowledge and learning outcomes obtained by the student.
- The coherency between the professional competencies and the roles of the professional exercise.
- The process of curricular design, implementation and review.

The partners want to develop a common language, identify the documented evidences that satisfy these criteria, integrate those criteria on a reference model for comparison purposes and eventually the evaluation/accreditation of curricula. They also want to validate the model experimentally by applying it to the partner institutions and stimulate the reflection among the partners about the process of learning and the competencies obtained by the graduates.

Other objectives of the project are to create academic collaboration agreements between the institutions, increase the mobility of students between the partner institutions and create reference documents with de model validated and the bases to be applied by other institutions.

The programs to be analysed are: Chemical Engineering, Mechanical Engineering and Electronics Engineering. Each institution has to choose one of those programs to collect the information requested by the model.

2. GENERAL DESCRIPTION OF THE PROJECT.

The central idea of the MIRROR project is to promote a comparative evaluation process between engineering degree programs based on a agreed criteria, which is essential to

characterize an academic program and to evaluate its quality. There is no simple definition of quality in education. Criteria may vary according to the approaches and the disciplines. This network recognizes **four essential central factors** analyze and compare academic programs:

1. **The extent to which the degree program matches external expectations** (professionals, institutions, potential employers and labor market). It requires the specification of the main **professional roles** of the graduates in a language understandable to the stakeholders, and the statement of the necessary **competencies** to fulfil those roles. (*For the aims of this project, competencies are designed as a set of knowledge and skills applied in a work context*).
2. **The development of the academic program in congruence with those expectations in an efficient and sustainable form.** It requires the transcription of the degree programs in terms of learning outcomes, analyzing them through the professional competencies obtained by the graduates, taking into account the duration of studies and the academic workload expressed in terms of educational credits.
3. **The real availability of resources allowing the creation of an adequate learning environment.** It requires the verification of the faculty, administrative staff, infrastructure and equipment availability.
4. **The verification of learning outcomes achieved by the student.** It requires the specification of the assessment methods necessary to determine if and to what extent the educational goals have in fact been turned into learning outcomes.

The analysis of these four factors will be done at the academic program and course levels:

- For each academic program: description of the general structure and contents, including the balance between the different elements (compulsory or elective courses, projects, practical training, etc.); balance between basic contents, specialized contents and skills; and balance between teaching-learning methods.
- For each course: description of the prerequisites, objectives, contents, methodology, course hours and assessment procedures.

For the analysis of the processes it is enough to verify their existence and efficiency related to the desired objectives (fitness for purpose), limiting the number of them (to diminish costs) to the most significant ones. On the other hand, the results analysis requires a large consensus about what are considered to be acceptable values or standards (fitness for purpose/benchmarks).

The work will follow 4 stages:

- Development of the methodology and agreement about the criteria to evaluate the design and implementation of academic programs; identification of the necessary evidence to evaluate their fulfillment(**development of the reference model**).
- Work at each institution to collect the necessary information according to the agreed criteria (**informative dossier**)
- Reciprocal external visits from two representatives of other universities participating in the network, to verify the consistency of the collected information and the applicability of the model. This visit will end with a brief report by the external peers, establishing if the information fulfils or not the established criteria (**informative dossier audit**).

- Final work with conclusions and recommendations for the improvement of academic programs within participant institutions and others potentially interested (**validation of the model**).

Through this process, an informed judgement concerning the degree programs goals and outcomes will be reached, facilitating its academic and professional recognition. Such information will also ensure that the qualifications obtained by the student are comprehensible in other educational contexts, making them easier to appraise and improving graduates employability in their home countries and abroad.

The developed model will be available on the Web and its synthetic character will facilitate its applicability and sustainability beyond the project duration. The informative dossier based on the model may be compiled and updated in a relatively economic way (compared to a self-evaluation process), becoming thus an enabler for the participant institutions to improve their quality and via external validation - enabling wider transparency and recognition of their academic programs.

Nowadays, the project is in the phase of summarize the final collected information of the programs. All the partners had completed the tabular data and the next task will be summarize that information on one model and verify the data collected by each institution, by visits and documents review doing by external pairs, one from Europe and one from Latin America.

3. GENERAL DESCRIPTION OF THE MODEL.

The information is collected in tables. In general terms the tables contain information with the competencies (interaction with the stakeholders, external requirements, intended learning outcomes and associated activities and courses), program studies (curricular content, profile of entry, hours of exposition and contact), resources of the program, the advance of the student and review of the program (input profile, progression of the student and analysis and review of the program). On the annexes are the courses description.

The tables are divided on five sets. The following is a description of each one.

A.- Front page. Historical Background. Presentation of the Program.

B.- External requirements and learning outcomes.

Tables A1: interaction with external shareholders: This table provides the bases for a systematic, open approach to determining the educational requirements of prospective employers. It identifies the party or parties who promote consultation, the external stakeholders involved, and the type and frequency of interactions. Hypertext links to documents on record are also provided.

Table A2: External requirements. Specifies the professional roles for which the degree program is designed to prepare graduates. These roles are described in terms of the functions exercised in them and the competencies required in order to fulfil them.

Table A3: Intended learning outcomes and associated course work. The knowledge, understanding and skills expected of the student are shown in relation to the course

work and other educational activities whereby they are developed. The table thus details how teaching activities are organized in order to achieve the intended learning outcomes on several different level (knowing and understanding, knowing how to act, ability to make judgments, communication skills, self learning skills, knowing how to be).

C.- Teaching, learning and assessment.

Table B1a: Entry qualifications (selective admissions) – Table TB1b: Entry qualifications (for orientation): Attention to the overall quality of the educational process also centers on enter qualifications, distinguishing between the qualifications that students are required to have in cases where admission to the degree program is restricted or selective, and those that are recommended for orientation purposes, i.e. will help students make informed decisions based on their own aptitudes.

Table B2: Curricular content- Table B3: Contact hours. These tables provide the information needed to organize resources and manage time. The first gives details of course titles and the number of teaching hours involved, while the second provides direct access to class schedules.

D.- Resources.

Table C1: Material resources and equipment: Provides details for the facilities and equipment used for teaching activities.

E.- Monitoring, analysis and review.

Table D1: Student enrolment and progression data.

Table D2: Further information: Contains additional information compiled at the discretion of each degree program concerning student background and achievement, faculty stability, etc.

Table D3: Degree program analysis, monitoring and review: Summarizes the processes carried out as part of continual degree program improvement, detailing motivations, actions, and responsibilities for changes made to the program.

This tables complete the quality assurance framework matrix. The matrix has three levels:

- Design level.
- Implementation level.
- Quality assurance mechanisms.

On the **design level** are the references roles and the target competencies as a list of scholarly or professional roles for which the program is specifically designed to prepare graduates; is a broad declaration of competencies (Table A2) and the subject areas and learning outcomes in accordance with stated competencies.(table A3): knowledge, understanding and skills the student is expected to gain, and which are needed to develop professional competencies.

On the **implementation level** are interaction with external stakeholders (academic body or person representing the institution and the external stakeholders) (Table A1), the external requirements (expected characteristic of the student enrolment, the entry qualifications)

(Table B1a), perspectives and opportunities for graduates at local or national or international level (Table B1b). Those evidence complete de reference roles and target competencies on this level. The subject areas are completed by teaching, learning and assessment: the overall structure of program, deployment of subject areas in course modules (Table A3) and description: contents, teaching materials and methods, student assessment, methods. (Table B2), resources and services: faculty qualifications, technical and administrative support, infrastructure (classrooms, labs, libraries, facilities, equipment, etc.) (Table C1) and student guidance and support (Table D2).

On the **quality assurance mechanism** are established who, when and how will do: organization of interactions, determination of professional roles, course implementation, resource, infrastructure control and data collection.

The feedback will be done with the monitoring and analysis of the program, the student enrolment and progression data (Table D1) and student, graduate, employer, satisfaction. With the data collected it could be possible do periodic assessment of the program adequacy and effectiveness (Table D3), to improve the intended learning outcome, the locations and the curricular content.

Some general criteria are the following:

The program must be designed over the base of external needs competencies target that must be in accord with needs of the employers and the labor market.

The program must be implemented taking in account the of intended learning outcomes, that must be in accord with the target competencies.

The program must expose the students to a proper learning with state of the art equipment.

The program must certify that the learning outcomes has been reached and the proofs and other activities did by the student have a certified value.

4. FINAL CONSIDERATIONS.

It is possible to develop a model useful for comparison and recognition programs of engineering, that allow and promote the mobility of professionals and student on engineering and improve the collaboration between institutions of Europe and Latin America.

The model will be supported by criteria mutually accepted by all the partner of the network.

The general model will be validated on different environments, related each one by the institutions working together.

This model is an instrument oriented to the output (learning outcomes) that allows locates the different activities of the engineering program in a well way to produce the better results on the learning process.

It allow to review the requirements over which the program is designed and the media through it is offered.

The instrument is designed over an “on line” base and not as periodic reports base. Its maintenance must be done inner to the departments.

The information included on the model could be the base for an inner review process or could be used by a accreditation/evaluation external panel.

The model could be used by other institutions to evaluate their own programs or to design a new engineering program.

It could be used by the stakeholders to review the program.

5.- ACKNOWLEDGEMENT.

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www.fing.ucr.ac.cr/redmirror

Bologna Related Web Sites

(see also the list attached to the paper “From Berlin to Bergen, the EU Contribution)

Conference of European Ministers responsible for Higher Education 18 - 19 September 2003
<http://www.bologna-berlin2003.de/>

From Berlin to Bergen
<http://www.bologna-bergen2005.no/>

Lisbon Convention - Convention on the Recognition of Qualifications concerning Higher Education in the European Region
www.bologna-berlin2003.de/pdf/Lisbon_convention.pdf

Sorbonne Declaration - Joint declaration on harmonisation of the architecture of the European higher education system
www.bologna-berlin2003.de/pdf/Sorbonne_declaration.pdf

Bologna Declaration - Joint declaration of the European Ministers of Education
www.bologna-berlin2003.de/pdf/bologna_declaration.pdf

Salamanca Convention - Message from the Salamanca Convention of European higher education institutions - Shaping the European Higher Education Area
www.bologna-berlin2003.de/pdf/salamanca_convention.pdf

Prague Communiqué - ‘Towards the European Higher Education Area’ Communiqué of the meeting of European Ministers in charge of Higher Education in Prague on May 19th 2001
www.bologna-berlin2003.de/pdf/Prague_communicuTheta.pdf

Berlin Communiqué - “Realising the European Higher Education Area” Communiqué of the Conference of Ministers responsible for Higher Education in Berlin on 19 September 2003
www.bologna-berlin2003.de/pdf/Communique1.pdf

Trends 1 - Project Report: Trends in Learning Structures in Higher Education (7 June 1999)
www.bologna-berlin2003.de/pdf/trend_II.pdf

Trends 2 - Towards the European higher education area: survey of main reforms from Bologna to Prague. Review of structures and trends in the countries not covered in 1999 in the Trends 1 report
www.bologna-berlin2003.de/pdf/trend_II.pdf

Trends 3 - Progress towards the European Higher Education Area. Bologna four years after: Steps toward sustainable reform of higher education in Europe (July 2003)
www.bologna-berlin2003.de/pdf/Trends_III_neu.pdf

Lourtie Report - Furthering the Bologna Process. Report to the Ministers of Education of the signatory countries in Prague May 2001.
www.bologna-berlin2003.de/pdf/Lourtie_report.pdf

Zgaga Report - Bologna Process between Prague and Berlin. Report to the ministers of Education of the signatory countries in Berlin September 2003.

www.bologna-berlin2003.de/pdf/Zgaga.pdf

Student documents ESIB - Student Göteborg Declaration on 25 March 2001

www.bologna-berlin2003.de/pdf/Student_documents_ESIB.pdf

National reports to the Bologna Process

www.bologna-berlin2003.de/en/main_documents/index.htm

Survey on Master Degrees and Joint Degrees in Europe – EUA Survey on Master Degrees and Joint Degrees in Europe (September 2002).

www.bologna-berlin2003.de/pdf/Survey_Master_Joint_degrees.pdf

Bologna Seminar on Master degrees. 14-15 March 2003 in Helsinki

www.aic.lv/ace/bologna/Prg_berl/2003/Hels_mast.rtf

Presidency Conclusions – Barcelona European Council. 15-16 March 2002

http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/71025.pdf