Escuela Técnica Superior de Ingeniería del Diseño

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

VALENCIA GLOBAL 2014

19th to 20th June 2014 at ETSID

Conference Proceedings

Conference Proceedings

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INTRODUCTION

The School of Design Engineering (ETSID) – Universitat Politècnica de València, Spain, is organizing the International Meeting Valencia Global 2014 which will be held from 19th to 20th June 2014 at ETSID.

As in previous editions (Valencia Global 2002, 2006 and 2010), the main objective of this international meeting is to bring together our international partners, lecturers, researchers, staff and companies to provide an international forum to showcase innovation, share best practices and discuss new approaches in the field of International Cooperation and Exchanges in Engineering Education.

We would like to invite you to participate in our international meeting Valencia Global 2014. The list of topics that will be discussed in a series of round tables are, but not limited to, the following:

Internationalizing the engineering curriculum
Dual & double degrees
The Global Engineer
Quality Assurance and Accreditation
International Networking
Cooperation with industry & international placements
Employability across borders
Innovation in EE
Lifelong learning in EE
Green Engineering
Engineering Design
International Cooperation Programmes
Management of International Offices and Mobility
Bologna Process & New European Curricula
World financial crisis and EE
Gender & Diversity issues in engineering
Education and Research

We expect around 200 participants from 100 Universities. We sincerely invite you to join us and are looking forward to receiving your registration forms through the website (http://-vg2014.webs.upv.es/), where you will find further information. We would like you to feel free to share this invitation with other colleagues and partners who might be interested in Networking at Valencia Global 2010. In addition to the technical aspects, a social programme will give participants the opportunity for networking while at the same time relaxing in our beautiful city of Valencia and enjoying the surrounding areas.

Welcome to Valencia Global 2014!

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Luís Sánchez, Vice-Dean of International Relations

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PROGRAMME

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AJUNTAMENT DE VALENCIA

ITI

Thursday 19th June

08:30 – 9:00	Registration Hall ETSID and Poster placing
09:00 – 9:30	Openning Ceremony
09:30 – 10:15	Plenary Session "Internationalisation as a key element in university strategy. The UPV approach". Juan Miguel Martínez Rubio, Head Rector's Office. Introduced by Luis Sánchez, Vice Dean – ETSID International Office
10:15 – 11:00	Plenary Session "Quality and Excellence in European Engineering Education". Guy Haug European Expert, UPV Advisor, Past SEFI General Secretary. Introduced by Ana Gimeno, Professor – ETSID
11:00 – 11:30	Coffee Break / Poster Presentations
11:30 – 12:15	Plenary Session "PEGASUS, the roadmap for excellence in the formation of aerospace engineers". Franco Bernelli, Chairman of PEGASUS (Aeronautical Association). Introduced by Sergio Hoyas, Vice Dean – ETSID
12:15 – 13:15	Round table: three case studies. Mª Ángeles Martín Universidad de Sevilla – Vicepresidenta de Pegasus /Representative from Airbus Group /Antoine Lanthony Industrial and international relations Supmeca Chairman: Sergio Hoyas, Vice Dean – ETSID
13:15 – 14:15	Round table: International Experience Testimonial
14:15 – 15:15	Lunch
15:15 – 15:55	Round table Prof. Alvaro Escribano Vice-Chancellor of International Relations University Carlos III de Madrid (UC3M) / Prof. Junji Hirai Mie University Chairman: Ramón Blasco, Professor – ETSID
15:55 – 17:40	Parallel Sessions A B C
20:30	Dinner

PROGRAMME

Parallel Session A (classroom N02)

Attracting international students: a proposal for the School of Engineering of the Universty of Minho.

European Project Semester: Good practices for competence acquisition.

ETSIDI: a new internationalization style.

Teaching Innovation through International Staff Mobility at Universitat Politècnica de València.

Intercultural skills, key in the internationalization of engineering curricula.

Engineering Education for the Future. European Project Semester at Universitat Politécnica de Valencia, Spain, and Lodz University of Technology, Poland.

SHOWroom WebTV-Production - Project based Education and Research.

Parallel Session B (classroom N03)

International Collaboration in Teaching Physics in the ETSID.
Urban green thinking: implementing green technologies in a product of public use.
Economic feasibility of energy-efficient solutions: an Italian case study towards green engineering.
A case study: Research collaboration among UPV and two Indian universities through international cooperation programs.
Decision Making Framework in Life Cycle Assessment for Sustainable Packaging Design.
Determination of wind turbine far wake using actuator disk.

Parallel Session C (classroom N04)

Servipoli Foundation.
Self-directed learning of Physics in Engineering Degrees by means of Moodle quizzes.
Students perceptions of the methodological change in language teaching of a higher education institution in Spain.
An innovative approach for education in aircraft design engineering.
Cooperation with Industry and Work Placements at the University of Ruse.
Campus of Alcoy First European Double Degree in Mechanical Engineering.

The FSU program in Valencia.
Distance Exams as a HEI Service for Promoting the Participation of Students in International Exchange.

PROGRAMME

Friday 20th June

09:30 – 10:15	Plenary Session “SEFI@40 Driving Engineering Education to Meet Future Challenges”. Françoise Côme, SEFI – Secretary General Introduced by Luis Sánchez, Vice Dean – ETSID International Office
10:15 – 11:00	Plenary Session “The T.I.M.E. Association: Promoting International Cooperation, Recognition and Quality in Engineering Education”. Paul Crowther, Secretary General at T.I.M.E. Association. Introduced by Guy Haug, European Expert, UPV Advisor, Past SEFI General Secretary
11:00 – 11:45	Coffee Break / Poster Presentations
11:45 – 12:30	Round table: Universities Cristina Cuerno Rejado Vice Dean – International Relations Escuela Técnica Superior de Ingenieros Aeronáuticos – UPM / Layek Abdel-Malek, NJIT – American responsible from Umane Project
12:30 – 13:15	Round table: International Experience Testimonial by Aeronautical Engineers Chairman: Ramón Blasco, Professor – ETSID
13:15 – 14:00	Plenary Session “The digital learning experience in the post-MOOC era”Xavier Fouger, Senior Director – Global Academia Programs Dassault Systemes Introduced by Josep Tornero, Director of Institute of Design for Manu facturing and Automated Production – ETSID
14:00 – 14:15	Closing Ceremony
14:15 – 15:15	Lunch

FULL PAPERS

Plenary Sessions

Valencia Global 2014

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Internationalisation as a key element in university strategy

The UPV approach

Juan Miguel Martínez Rubio
June 2014

Objectives:

- Missions
- Context
- What universities should do
- UPV internationalisation from the past…
  … to the future: Present policies
- Quality education
- Doctoral school
- Global entrepreneurship

Missions of the University:

1. Teaching
2. R+D+i
3. Relationship with society
4. **internationalisation**

4 Mission

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Context:

- EEES
- Spanish University Strategy 2015: Plan for Internationalisation (2011)
- European Strategy 2020
- New generation of programs: Erasmus+, Horizon 2020
- EU Internationalisation Strategy of HE: “European Higher Education in the world”
- …

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International Students:

- Increase in the overall number
- QS World University Rankings 2012/13
  - Top-100: Increase of 10%
  - Top-700: 4% international students. More students are studying in more countries.
- OCDE:
  - 2000: 2,1 million students were studying abroad
  - 2010: 4 million
  - Forecast: 7 million in 2020.
- Total Higher Education students:
  - 2013: 99 million
  - 2030: 414 million

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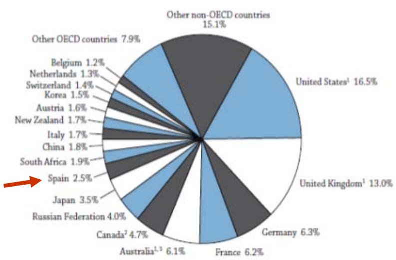
Top destinations:

- European Union (leader and target of 40% of international students)
  - United Kingdom (13%)
  - Germany (6,3%)
  - France (6,2%)
  - **Spain (2,5%)**
- United States (16,5%)
- Australia (6,1 7%).

Chart C4.2. Distribution of foreign students in tertiary education, by country of destination (2011)
Percentage of foreign tertiary students reported to the OECD who are enrolled in each country of destination



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- Factors that influence the choice of country destination:
  - Language in which the degree is taught
  - Quality in programs
  - Cost of studies
  - Immigration policy.
  - Etc

- Great increase of students coming from Asia.

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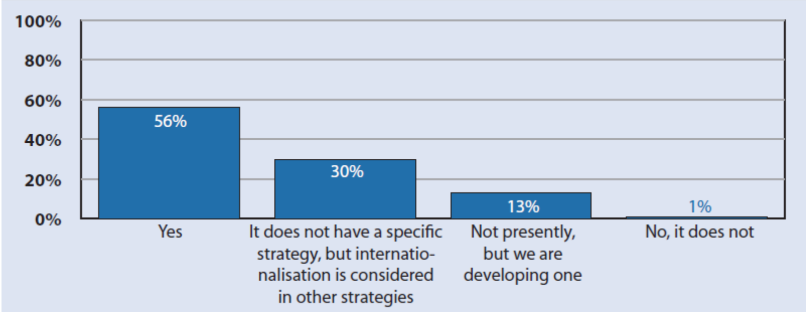
Figure 5: Existence of internationalisation strategy at institutions.



EUA 2013: Internationalisation in EHE: European policies, Institutional strategies and EUA support

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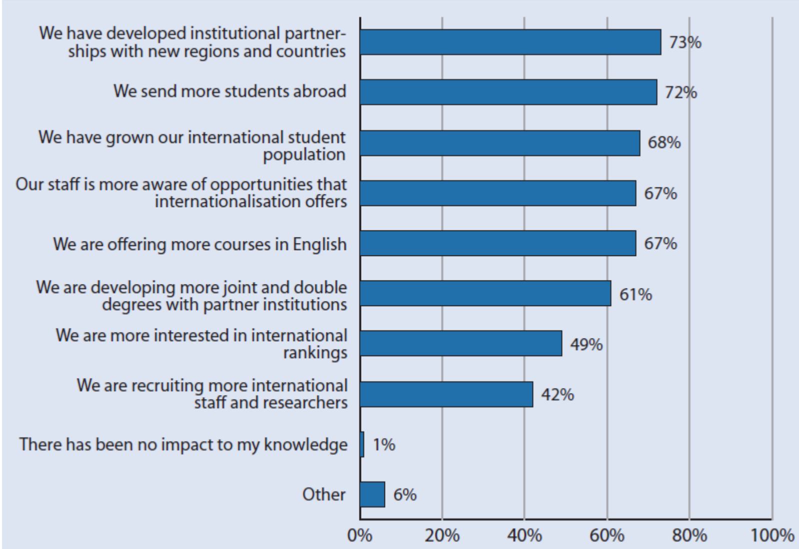
Figure 6: Impact of the internationalisation strategy at the respondent institutions.



EUA 2013: Internationalisation in EHE: European policies, Institutional strategies and EUA support

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What should Universities do?

- Have an Institutional internationalisation strategy
- Be attractive
- Be active in international mobility (student/staff)
- Be involved in the Internationalisation of R&D
- Have presence in international rankings
- Ensure curriculum internationalisation for all
- Provide double/joint degrees
- Have an International Alumni network

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What should Universities do?

- Languages: Teaching in English
- Provide excellence in teaching and research opportunities
- Form strategic alliances. Networks
- Provide online contents & tools: Digital learning
  - MOOCs (Massive Open Online Courses)
- Increase International student recruitment
- Have indicators to measure internationalisation
- Encourage international cultural activities

UPV internationalisation from the past…

- Erasmus: European presence, program sharing
- Latin America:
  - ✓ Doctoral programs
  - ✓ Institutional networking for collaboration
  - ✓ Talent recruiting
- Erasmus-Mundus, Alfa, Tempus, etc: World wide collaboration
  - ✓ Internationalisation of programs
  - ✓ Consortium development

… to the future: Present policies

- Graduate programs in English
- Financed talent recruiting
- Development of doctoral programs
- Strategical Networking for:
  - ✓ Research
  - ✓ Regional development
  - ✓ Joint programs
  - ✓ Lobbying
- Industrial collaboration
- International Campus of Excellence (VLC-Campus, Habitat 5U)

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Quality education

- International Accreditation
- Presence in Top Rankings
- Multimedia education
- Promote curricular development through excellence programs

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Doctoral school:

- Researchers contact and collaboration
- Joint excellence programs
- Industry collaboration
- Talent attraction

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Global Entrepreneurship:

- International collaboration on existing entrepreneurship experiences
- Global opportunities
- Applied research for industry and employment

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Quality and Excellence in European Engineering Education

Guy HAUG

1 Introduction

The presentation will try to illustrate a transition in progress in European Engineering Education: from national schemes mainly focused on guaranteeing a sufficient level of quality, the attention is shifting towards new approaches aimed at identifying and promoting “excellence” and establishing the credibility of degrees/programmes at the European/international level.

Hence, the presentation first reviews the main tools set in place for quality assurance in engineering assurance in the European Higher Education Area. Such tools consist mainly in internal quality assurance tools within universities, national accreditation agencies and national qualifications frameworks, together with their linkage at European level through networks of quality assurance agencies (ENQA and EQAR, but also ECA) and the European Qualification Frameworks (EQF).

By and large, these tools have been effective in guaranteeing a minimum level of quality and relevance in degree programmes, and in this way they have contributed to improving engineering education and providing some degree of comparability across institutions of higher education and across countries in the EHEA. Yet, expectations in society (students, industry, governments, society at large) have also been changing since the early days of the Bologna Process (1999) and the Lisbon Agenda of the EU (2002). Students as well as enterprises seek guidance about the <u>best</u> HEIs at a particular level in a particular area of specialization. Governments are increasingly anxious to secure a strong contribution from universities to growth, competitiveness, job creation, innovation, entrepreneurship and social inclusiveness. International university rankings have come as a cold shower to many universities and countries and in spite of their limitations and shortfalls, they have had a tremendous impact on universities, students and governments as well and they are bound to become a standing piece of the higher education landscape in the world. The presentation will therefore provide a summary review of rankings and their foreseeable impact on higher education institutions and policies.

These new needs/demands have been increasingly acknowledged over the past years and in response new tools have been developed, mainly in two directions: the identification and promotion of high quality or “excellence” at HEIs, and the development of European/international quality seals, notably in engineering education and informatics. The presentation will review some of these tools and provide a view about their impact and further development.

- National initiatives for the identification and promotion of “excellence” have flourished across a significant number of countries, partly in response to new European initiatives (European Research Council, European Institute of Technology and Innovation, ERASMUS Mundus and Marie-Curie programmes) and partly in acknowledgment of the strong challenges coming from new knowledge powers in Asia that have strong policies supporting excellence in science, technology and innovation, e.g. China, Singapore, Korea. Whether in Germany, the UK, Austria, Switzerland, France or the Nordic countries, these initiatives share in common a number of features that will be reviewed (role of external/international evaluations, role of doctoral schools, competition for talented teachers/researchers and students all over the world, etc.).

- International seals of quality are a relatively new feature in the worldwide landscape of higher education, including in engineering education. For decades some well-known US accreditation seals (such as AACSB in Management and ABET in Engineering) have served as a substitute to truly international quality seals. A move in the same direction has emerged recently in Europe, e.g. when European universities seek an accreditation seal from a (highly regarded) quality assurance agency based in another country. Some countries already accept QA reviews carried out by foreign agencies. In Engineering, agencies such as ASIIN (Germany) and CTI (France) are increasingly engaged in international accreditation and others are bound to follow suit. There are now also an increasing number of truly international quality seals. Two well-established schemes are meeting strong demand, including from outside Europe: EUA's Institutional Review Programme (IRP) and the EQUIS seal in the area of management; both are offered by organisations that have a strong basis in their respective area. The newest generation of European/international quality seals has emerged recently from thematic networks set up in the previous decade within the framework of the ERASMUS programme.

This is the case of the EUR-ACE “accreditation” in Engineering and the EURO-INF “accreditation” in Informatics, together with similar initiatives in e.g. Chemistry, Public Administration or Music Conservatories. EUR-ACE and EURO-INF have just become accessible to Spanish universities thanks to ANECA's new programme called “Acredita-Plus” and they should soon be available to interested HEIs in Latin America. Both are based on a set of generic, future-oriented graduate profile emphasizing the role of engineers/informatics in innovation and in society. These quality seals are still young, but growing and spreading fast. They are now linked to each other within the framework of the new European Alliance of Subject-Specific and Professional Accreditation (EASPA).

There are reasons to believe that international quality seals could become the still missing, but indispensable, second pillar of quality assurance in Europe, next to the earlier established nationally-based agencies. Some of these international agencies are knocking at the door of ENQA and EQAR and there is little doubt that they will succeed in the foreseeable future. The presentation will therefore terminate with an invitation to participants to put these news seals onto their mental map and consider the benefits they could contribute to their efforts to achieve international visibility and recognition.

PEGASUS

PEGASUS

Partnership of a European Group of Aeronautics and Space UniversitieS

THE ROADMAP FOR EXCELLENCE IN THE FORMATION OF AEROSPACE ENGINEERS

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PEGASUS

Outline

- *Presentation of PEGASUS network*
  - ***WHO*** is partner in PEGASUS
  - ***WHEN*** was PEGASUS created
  - ***WHY*** was PEGASUS created
  - ***WHAT*** are the PEGASUS achievements
  - ***WHERE*** is PEGASUS operating
  - ***HOW*** is PEGASUS operating
- *The PEGASUS view of excellence in aerospace education*

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PEGASUS

WHO is partner in PEGASUS

- PEGASUS partners are public and/or non-profit institutions of higher education in aeronautical / aerospace engineering located in the EU.
- 20 Founding Members in 1998
- Presently 25 member Institutions
- 10 European countries represented
- Yearly output: more than 2500 BAC+5 graduates in aerospace engineering from the whole network
- Website: www.pegasus-europe.org

- PEGASUS is open to all EU institutions providing a sufficiently qualified education in aerospace engineering.

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PEGASUS

WHO is partner in PEGASUS

- PEGASUS partners have a reputation for high quality research and a quality recognition in education and research.

- PEGASUS will welcome new partners, insofar as they support the objectives and match the quality criteria for admission.

- Admission to PEGASUS follows an assessment based on a small set of established criteria:
  - qualitative and quantitative criteria;
  - excellence as well as international co-operation are considered;
  - assessment regards only education and reputation

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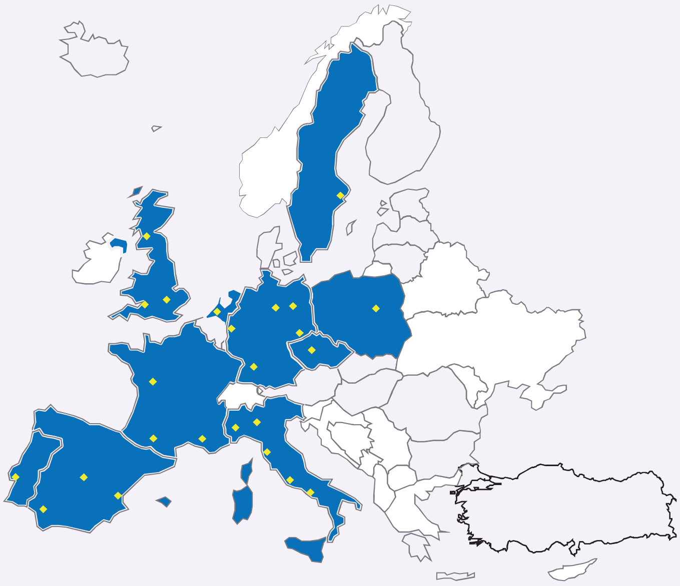
PEGASUS

WHO is partner in PEGASUS



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PEGASUS

WHO is partner in PEGASUS

Country	Institution	Country	Institution
	Politecnico di Milano Politecnico di Torino Università degli Studi di Napoli Università degli Studi di Pisa Università degli Studi di Roma		RWTH Aachen TU Berlin TU Braunschweig Universität Stuttgart TU Dresden
	Ecole-air de Salon de Provence ENAC Toulouse ENSMA Poitiers ISAE Toulouse		Cranfield University University of Bristol University of Glasgow
	TU Delft		KTH Stockholm
	UPM/ETSIA Madrid US/ESI Sevilla UPV/ETSID Valencia		CVUT Prague
	IST Lisboa		Politechnika Warszawska

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PEGASUS

WHO is partner in PEGASUS

Partners of the Pegasus Network are categorised as:

•**Full Partners**, who fulfil the conditions stipulated by the internal procedural regulations.

•**Probationary Partners**, who joined the Pegasus Network according to the Internal Procedural Regulations and have not yet been upgraded to the Full Partner status.

•**Associate Partners**, namely institutions not fulfilling all admission requirements but, nevertheless, in possession of a high reputation.

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PEGASUS

WHO is partner in PEGASUS

Associate Partners are not network members, however they are:

a) invited to participate to Council sessions;

b) entitled to participate to the events organized by PEGASUS;

c) regarded by the PEGASUS Members as privileged recipients of new proposals of student exchange agreements, research collaborations …

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PEGASUS

WHO is partner in PEGASUS

PEGASUS Associate Partners

Country	Institution
	Kazan State Technical University Ufa State Aviation Technical University Moscow Aviation Institute

Country	Institution
	Kharkiv Aviation Institute

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PEGASUS

WHEN was PEGASUS created

- Founded in 1998 in Toulouse, from initiative of Groupe des Ecoles Aéronautiques et Spatiales (GEA).
- Its objectives were outlined in a Letter of Intent for an 'European Thematic Network on Aerospace Engineering'.
- It was called 'Partnership of a European Group of Aeronautics and Space UniversitieS', abbreviated to PEGASUS, 1999, ENAC, Toulouse.
- The PEGASUS Council, approved a PEGASUS Partnership Agreement, including Internal Regulations, in Trondheim, 2001.

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WHY was PEGASUS created

The **network's goals** are the following:

- Contribute to the development of a quality system for the European higher education in Aerospace Engineering.
- Improve educational process and curricula to specifically serve the needs of the aerospace industry.
- Show similarities and differences of European curricula to the aerospace world.
- Co-operate with other groups and networks to fulfil the EU policy lines in higher education.
- Increase co-operation between partners and industry as well as national and European research agencies.
- Contribute to attract non-European students and engineers through competitive curricula and continuing educational services.

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WHY was PEGASUS created

PEGASUS aims to offer itself as the European portal for higher education services in aerospace, being recognised as the most efficient channel to get university inputs at the integrated EU level.

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PEGASUS

WHAT are the PEGASUS achievements

- Twenty founding institutions have signed an Agreement on the common objectives of PEGASUS.
- More institutions will be admitted on the basis of well specified criteria.
- Reciprocal recognition of common quality: the PEGASUS labels Certificate and A.W.A.R.D. in recognition of an individual student's multi-national experience.
- All partners have agreed on a specific curriculum description format, enabling an immediate understanding of the level of education provided by the partners. PEGASUS Course Catalogue, 2009.

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PEGASUS

WHAT are the PEGASUS achievements

- Definition of the status of Associate Partner.
- PEGASUS-AIAA student conference:

A forum for Pegasus Students and student members of the European Sections of AIAA to present technical papers in public competition in the graduate (masters candidates only) category.

- 1st edition 2005 in Toulouse
- 2nd edition 2006 in Munich
- 3rd edition 2007 in Naples
- 4th edition 2008 in Prague
- 5th edition 2009 in Toulouse
- 6th edition 2010 in Seville
- 7th edition 2011 in Torino
- 8th edition 2012 in Poitiers
- 9th edition 2013 in Milano
- 10th edition 2014 in Prague

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WHAT are the PEGASUS achievements

PEGASUS Foundation:

- Foundation is a Legal Body representing the Network.
- Signing of the Foundation Act on July 6, 2007.
- Registering by the Chamber of Commerce Rotterdam.
- All Foundation Board Members are members of the Network.
- The Foundation Board Members are elected by the Network (Council).
- Sharing of the Chairman (to be arranged by the Network)
- Annual Report of the Foundation to the Network.

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WHAT are the PEGASUS achievements

PEGASUS-Industry Alliance:

- The aerospace industrial community and the PEGASUS network are equally represented to discuss all issues relevant to this subject.
- The main objective of the PEGASUS-Industry Alliance is to contribute to reinforcement of the European academic and industrial relations for mutual benefits.
- The basic criteria for selecting the industrial partners are both the size of the company and the pan-European dimension of its activities.

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PEGASUS

WHAT are the PEGASUS achievements

PERSEUS label (PEGASUS European Recognition of Scientific Excellence of UniversitieS)

- PEGASUS agrees that a new European system for QA in Aerospace Engineering Education should be applied for on a voluntary basis and if possible should not duplicate existing accreditation systems.
- The new system should focus on the qualifications and skills of the graduates right after graduation. MÁM7
- PEGASUS, as the only European network of excellence in Aerospace Engineering education, is able to lay the foundation for a sort of European society for QA in Aerospace Engineering Education.
- PEGASUS, through PEGASUS-Industry Alliance, has established an entity for developing a quality/excellence label, PERSEUS, including peer reviews and site visits.

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Diapositiva 17

MÁM7 The new system should focus on the qualifications and skills of the graduates right after graduation, taking into account the requirements of the European aerospace sector.
María Ángeles Martín; 09/06/2014

PEGASUS

WHAT are the PEGASUS achievements

PERSEUS label (PEGASUS European Recognition of Scientific Excellence of UniversitieS)

PEGASUS will first focus its efforts on programmes in its own domain of excellence which is:

- Aerospace Engineering Programmes;
- At Master level (level 5 of Bologna process);
- Excellence (backed by research) and strong international cooperation.

First audits for PEGASUS programmes in 2012.

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PEGASUS

WHAT are the PEGASUS achievements

Other spontaneous achievements:

- Increased mobility among PEGASUS Partners.
- Cross breeding of curricula and new “crossed” engineering profiles generated by the EU student mobility.
- Cross-breeding of curricula is slowly taking place during the implementation of the Sorbonne – Bologna 3+2 scheme.
- Strong connection with laboratories to support the internship availability on top of industrial placements.
- Thanks to PEGASUS the members can strengthen collaborations between them and with industry

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PEGASUS

WHAT are the PEGASUS achievements

Further actions:

- Establishment of formal cooperation with EU research centres (like INTA, CIRA,... or EREA).
- Creation of a new PEGASUS Research Alliance.

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PEGASUS

WHERE is PEGASUS operating

- PEGASUS must operate with the minimum of costs. To this end, the following principles are agreed:
  - The structure should be as light as possible.
  - The costs in administering PEGASUS should be shared by all partners.
  - Necessary central responsibilities should be shared by implementing a rotating system.
- Permanent Administrative Office:
  c/o Politecnico di Milano – Italy
- PEGASUS foundation's registered offices:
  c/o TU Delft – The Netherlands
- PEGASUS Council meetings (2 per year) on a rotating basis
- PEGASUS student conference (1 per year) on a rotating basis

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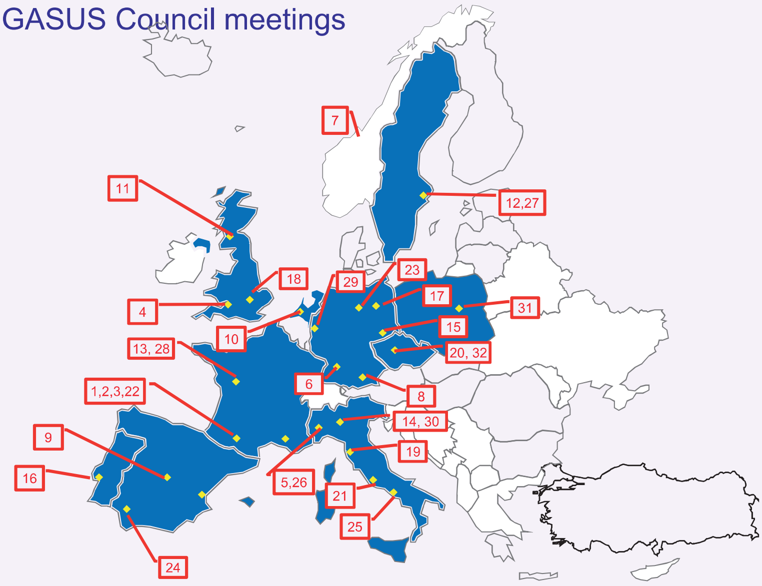
PEGASUS

WHERE is PEGASUS operating

PEGASUS Council meetings



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PEGASUS

WHERE is PEGASUS operating

PEGASUS Council in Rome, Oct. 2008

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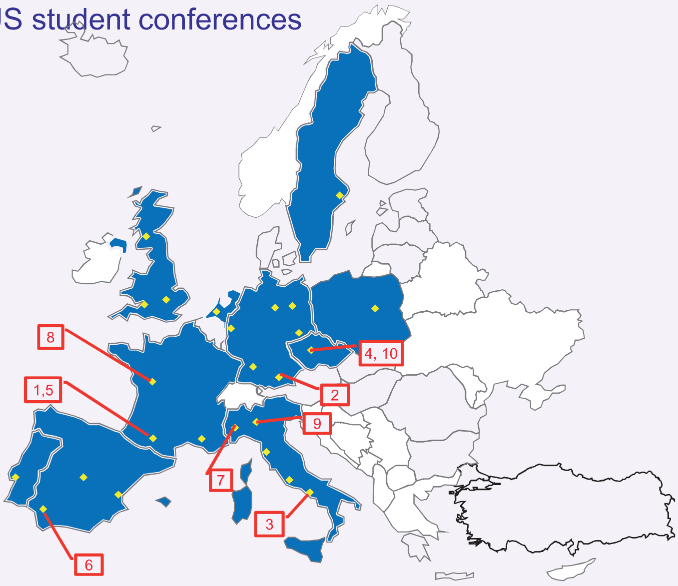
PEGASUS

WHERE is PEGASUS operating

PEGASUS student conferences



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PEGASUS

WHERE is PEGASUS operating

PEGASUS student conference in Seville, Apr. 2010

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PEGASUS

HOW is PEGASUS operating

- The bodies of Pegasus are:
  - the Council;
  - the Board;
  - the Chairman;
  - the Working Groups.
- The Council and the Board are permanent bodies.
- The Chairman is elected on a rotating basis.
- The Working Groups are non-permanent bodies, being modified according to the actual needs.

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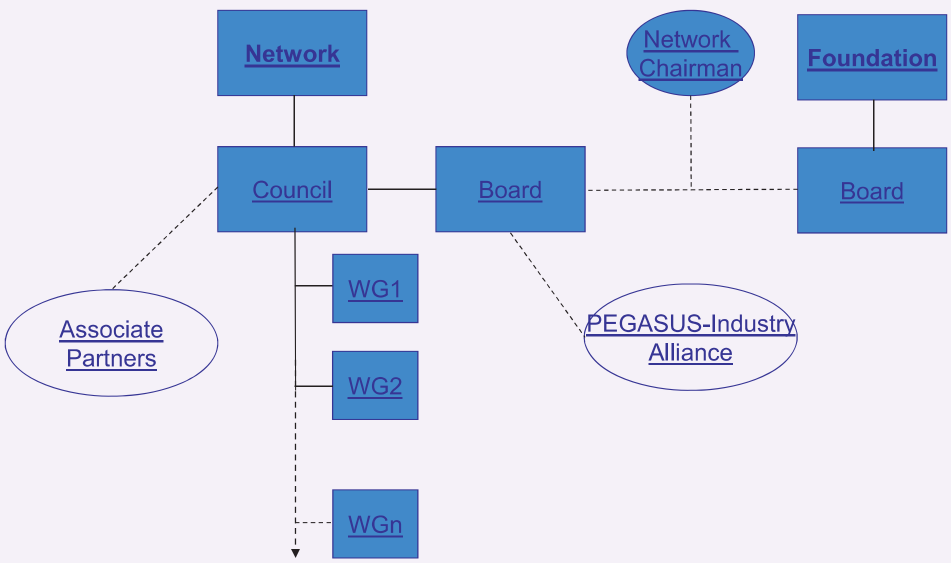
PEGASUS

HOW is PEGASUS operating



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PEGASUS

PEGASUS view of aerospace education

Equation for excellence in aerospace engineering education

Strong scientific knowledge

+

Research laboratories

+

Industrial partners

+

National networking

+

International networking

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PEGASUS

Strong scientific knowledge

- Academic activities @ PoliMI

Bachelor in Aerospace Engineering

1st year
2nd year
3rd year

Year 1: fundamental sciences
Year 2: general engineering
Year 3: aerospace disciplines

Job

Bachelor
(Laurea)

Master in Aeronautical Engineering
1st semester: common core
2nd semester: common electives
3rd and 4th semester: specialisation
Aerodynamics
Flight mechanics and systems
Propulsion
Structures
Fixed wing
Rotary wing

Master in Space Engineering
Single track, with two electives
Focus on spacecraft design

Master
(Laurea Magistrale)
EUR-ACE accreditation in 2012

PhD in Aerospace Engineering

PhD (3 YEARS)

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PEGASUS

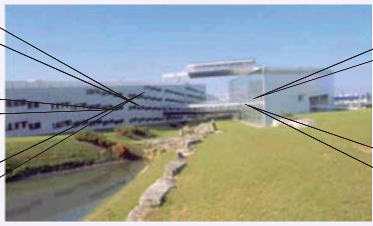
Research laboratories

- Research activities and facilities @ ENSMA : 5 laboratories

Aerodynamics **LEA**

Materials science and mechanics **LMPM**

Heat transfer **LET**



Combustion and detonics **LCD**

Staff : ≈260
- Permanent positions : ≈180
- PhD students : ≈80

Computer science applied to engineering **LISI**

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PEGASUS

Industrial partners - WHY

- To support specific education activities
- To provide complementary educational opportunities
- To provide special seminars or course modules
- To give advise on the educational offer of Universities

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PEGASUS

Industrial partners - HOW

- To support specific education activities

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PEGASUS

Industrial partners - HOW

- To provide complementary educational opportunities

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PEGASUS

Industrial partners - HOW

- To provide special seminars or course modules
  - At PoliMI, 4 modules (24 credits) in aerospace engineering are taught by industrial experts
  - At PoliMI, special seminars (e.g., tutorial on one particular software) are delivered on Saturday morning
  - At PoliMI, on average 10 special seminars per semester are included in the regular courses in aerospace engineering

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PEGASUS

Industrial partners - HOW

- To give advise on the educational offer of Universities

EUR-ACE Framework Standards for the Accreditation of Engineering Programmes 28/08/2008

Table: Criteria and Requirements for Programme Assessment

Guidelines for Accreditation	Criteria to be assessed	Requirements	What the Self-assessment Report (cf. Section 3.1) should give evidence of and the Accreditation Team should check
1. Needs, Objectives and Outcomes	1.1 Needs of the Interested Parties	Have the needs of the interested parties (such as students, industry, engineering associations, etc.) been identified?	Modes and periods of relationships with the interested parties. Needs identified for each of the identified interested parties.
	1.2 Educational Objectives	Are the programme educational objectives consistent with the mission of the Higher Education Institution (HEI) and with the needs of the interested parties (such as students, industry, engineering associations, etc.)?	Programme educational objectives vs. mission of the HEI and needs of the interested parties. Transparency and publicity of the programme educational objectives.

EUR-ACE Framework Standards for the Accreditation of Engineering Programmes 28/08/2008

Guidelines for Accreditation	Criteria to be assessed	Requirements	What the Self-assessment Report (cf. Section 3.1) should give evidence of and the Accreditation Team should check
		Do stakeholders (graduates, employers, etc.) confirm the achievement of the programme's educational objectives?	Graduates' opinions on the education received. Opinion of employers on the graduates' education.

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PEGASUS

National networking

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PEGASUS

International networking

THE PEGASUS ACHIEVEMENTS

- Reciprocal recognition of common quality: the PEGASUS labels Certificate and A.W.A.R.D. in recognition of an individual student's multi-national experience.
- All partners have agreed on a specific curriculum description format, enabling an immediate understanding of the level of education provided by the partners.
- Increased mobility among PEGASUS Partners.
- Cross breeding of curricula and new "crossed" engineering profiles generated by the EU student mobility.
- Cross-breeding of curricula is slowly taking place during the implementation of the Sorbonne – Bologna 3+2 scheme.

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PEGASUS

Conclusion

Equation for excellence in aerospace engineering education

Strong scientific knowledge
\+
Research laboratories
\+
Industrial partners
\+
National networking
\+
International networking
=
PEGASUS

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PEGASUS

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SEFI: Driving engineering education to meet future challenges

Françoise Côme, Secretary General, Société Européenne pour la Formation des Ingénieurs

European Society for Engineering Education
Europäische Gesellschaft für Ingenieur-Ausbildung
Société Européenne pour la Formation des Ingénieurs

Engineers, educated to create practical solutions to the challenges of mankind, need to work hard these days to stay on top of the developments in their field.
A career of lifelong learning is demanded from engineers more than in any other discipline. They have to constantly adapt to the new environments, societal and technological, in the general context of an increased mobility and in a climate of competition for the best students and the best universities.
Therefore, educational innovation and European and global cooperation in higher engineering education have gained in importance, now, more than ever.

In these areas, the European Society for Engineering Education – known with the French acronym "SEFI" (Société Européenne pour la Formation des Ingénieurs) – has developed a lot of experience over the last 41 years.
SEFI has the mission to contribute to the development and improvement of the engineering education in Europe, promoting information exchange between teachers, researchers and students in the various European countries. SEFI ensures cooperation between the higher engineering education institutions (research orientated institutions and practice orientated institutions) and also promotes cooperation with the enterprises, acting as a link between its members - 410 in 48 countries - and other scientific and international organisations. Through its membership, SEFI connects over 1 million students and 158000 academic staff members, in Europe and in the world.

SEFI supports the idea of the international dimension in higher engineering education and contributes to the visibility of the European engineering education in the world.
Its objectives are achieved through the activities of its working groups (*curriculum development, continuing education and lifelong learning, physics, mathematics, gender and diversity, attractiveness, accreditation and quality assurance, sustainability, engineering education research, ethics, new educational technologies*), ad hoc task forces (*engineering skills, university business cooperation, student cooperation, global cooperation*), through Annual Conferences and workshops. The 2014 Annual Conference (University of Birmingham, 15-19 September 2014) will be on the theme of "Educating engineers for global competitiveness". It will welcome a series of high rank keynote presentations and will be the occasion for several interactive workshops and parallel sessions (www.sefi2014.com).
SEFI also organise specific activities for the deans in engineering, such as the European Convention for engineering deans (ECED), the next one being organised in UP Valencia in March 2015, and is in charge of the European Engineering Deans Council (EEDC).

SEFI also participates in several European cooperation projects in the context of the EU education and research programmes, and it contributes to the dissemination of new insights on engineering education through its bi-monthly scientific journal, the European Journal of Engineering Education (EJEE) published by Taylor and Francis. Other publications such as a monthly electronic information newsletter, an annual report and a series of ad hoc documents and monographs are also published by SEFI.

These past years, SEFI regularly communicated the views of its members to the policy makers in charge of the Bologna process. In the last years position papers were published on the topic, but also on subjects such as the Doctorates in engineering education and the accreditation of engineering education. Considering the increasing importance of the question of the accreditation, SEFI contributed in the establishment of the EUR-ACE Label (*Accreditation of European Engineering Programmes and Graduates*) and is also a founding member of the European Network for the Accreditation of Engineering Education (ENAEE).
On a more global context, SEFI is founding member of the International Association for Continuing Engineering Education (IACEE), of the International Federation of Engineering Societies (IFEES) and of the International Institute for the Development of Engineering Academics (IIDEA).

Educating engineers in the perspective of the 2020 strategy, facing the challenges of the economical crisis, preparing global professionals, enhancing employability, reinforcing accreditation, promoting mobility and innovation, encouraging new learning and teaching methods, understanding better the engineering skills according to the national contexts , are all topics of concerns presently on the agenda of SEFI for the coming years.

Françoise Côme (B/F) is Secretary General of SEFI and of EEDC, Vice President for Europe of IFEES and of the Cartagena Network, former Vice President of ENAEE and European Secretary of IIDEA.
She has more than 25 years of experience in the field of higher education in general and engineering education in particular, starting her career at the European Cultural Foundation in Amsterdam (1986), joining SEFI in 1988, with a two-year WFEO Executive Director position (Paris, UNESCO) in 2004-2006.

T.I.M.E. Association

VALENCIA GLOBAL 2014

Universitat Politècnica de València
ETSID
Friday June 20th. 2014

T.I.M.E. Association

The T.I.M.E. ASSOCIATION

Promoting International Cooperation,
Recognition and Quality in
Engineering Education

Origins of T.I.M.E.

- Founded 1989 (France) (16 Institutions)
- European (10 EU countries represented)
- Charter (13.10.1989):
- "Dual cultural background .. indispensable"
- "Development of exchanges .. leading to dual diplomas recognised equally"
- "Freely agreed bilateral exchanges .. and the bilateral accreditation of degrees"

T.I.M.E. Today

- 53 Member Institutions in 20 countries on 4 continents. Increase in non-EU members
- Around 5,000 T.I.M.E. Double Degree Alumni with excellent international careers
- New T.I.M.E. Association Charter (2009)
- T.I.M.E. Quality Label Certificate (2010)
- T.I.M.E. International Doctorate Charter (2011)
- T.I.M.E. Alumni Association (2013)

T.I.M.E. Charter 2009: Values

- ".. multicultural background .. indispensable .."
- ".. education with a strong scientific base .."
- ".. exchanges .. leading to double degrees at .. Master level plus joint or double Doctorates."
- "360 ECTS-credit (or equivalent) curriculum .."
- ".. members may also cooperate multilaterally on joint programmes .."

What has Changed?

- International Education is globalised and has become more competitive. Cooperation?
- New learning approaches (E-learning, MOOC).
- Emergence of new, smaller, focused networks.
- ERASMUS has become a global "brand" and has led to ECTS and the Bologna Process.
- Programmes such as ERASMUS MUNDUS offer study abroad with funding and "brand image".

Values, Challenges, Responses (1)

1. T.I.M.E. values and promotes diversity:
- Harmonisation leads to more uniformity whilst not guaranteeing better quality.
- There is no single model and diversity is a source of improved quality of graduates.

2. T.I.M.E. promotes the Master-level engineer:
- In the 5-year qualification, the Bachelor is only a foundation for the Master cycle. "Vertical" mobility in this context means less coherence.

Values, Challenges, Responses (2)

3. T.I.M.E. believes cooperation is a necessary complement to competition:
- Higher education is not a zero-sum game. Our competitors are also our peers.

4. T.I.M.E. is a large, decentralised and open network:
- Competitive pressure has led to more closed, focused, centralised networks, sustainable or not, for economies of scale and visibility.

T.I.M.E. Association

TOP INDUSTRIAL MANAGERS EUROPE

Summary: The T.I.M.E. Perspective

- International cooperation is a complement to competition. It promotes quality / relevance.
- The qualities fostered by international study (adaptability, mobility, human awareness) are crucial to students' personal development
- Collective action promotes professional and academic recognition for ambitious students.

T.I.M.E. Association

TOP INDUSTRIAL MANAGERS EUROPE

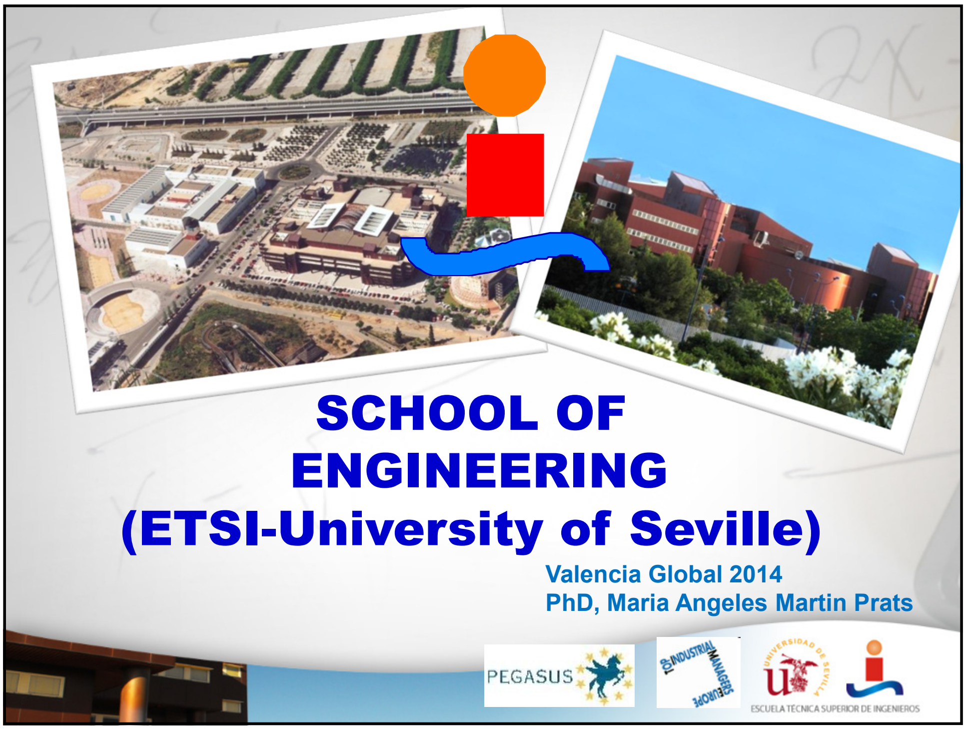
Thank You!

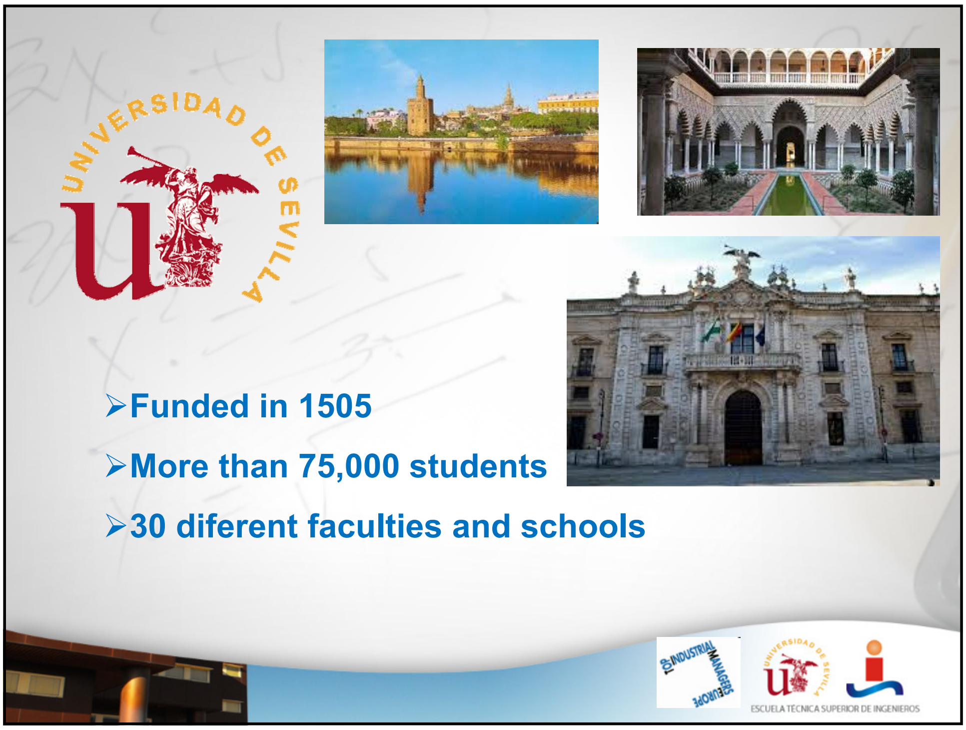
Further Information:

www.time-association.org

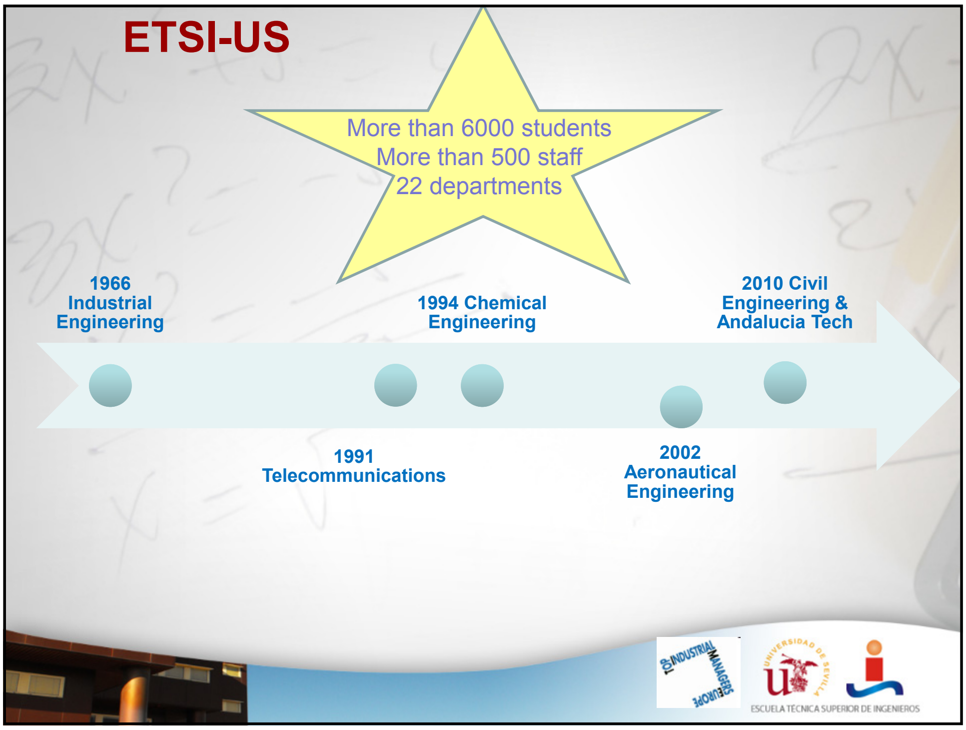
crowther@time-association.org

Round Tables


SCHOOL OF
ENGINEERING
(ETSI-University of Seville)
Valencia Global 2014
PhD, Maria Angeles Martin Prats
PEGASUS
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS


UNIVERSIDAD DE SEVILLA
➢Funded in 1505
➢More than 75,000 students
➢30 diferent faculties and schools
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS


ESCUELA SUPERIOR DE
INGENIERIA
➢ Created in 1963
➢ Located at Reina Mercedes until 1997
➢ Currently is located in Cartuja
50 ANIVERSARIO
ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA DE SEVILLA
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS


ETSI-US
More than 6000 students
More than 500 staff
22 departments
1966 Industrial Engineering
1991 Telecommunications
1994 Chemical Engineering
2002 Aeronautical Engineering
2010 Civil Engineering & Andalucia Tech
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

INGENIERÍA INDUSTRIAL
Degree Industrial Engineering Technologies

Specialization in 11 areas:

Mechanics of Machinery, Mechanics of Construction, Electricity, Chemistry, Electronics, Automation, Energy, Materials, Organization, Production and the Environment.

+ Master in Industrial Engineering

INGENIERÍA EN TELECOMUNICACIÓN
Telecommunications Engineering Technology

Specialization in 4 areas:

- **Telecommunication Systems**
- **Electronic Systems**
- **Telematics**
- **Sound and Image**

+ Master in Telecommunications Engineering

INGENIERÍA QUÍMICA
Degree in Chemical Engineering

Specialization in 3 areas:

- Chemical Processes
- Environmental Engineering
- Industrial Technology

+ Master in Chemical Engineering

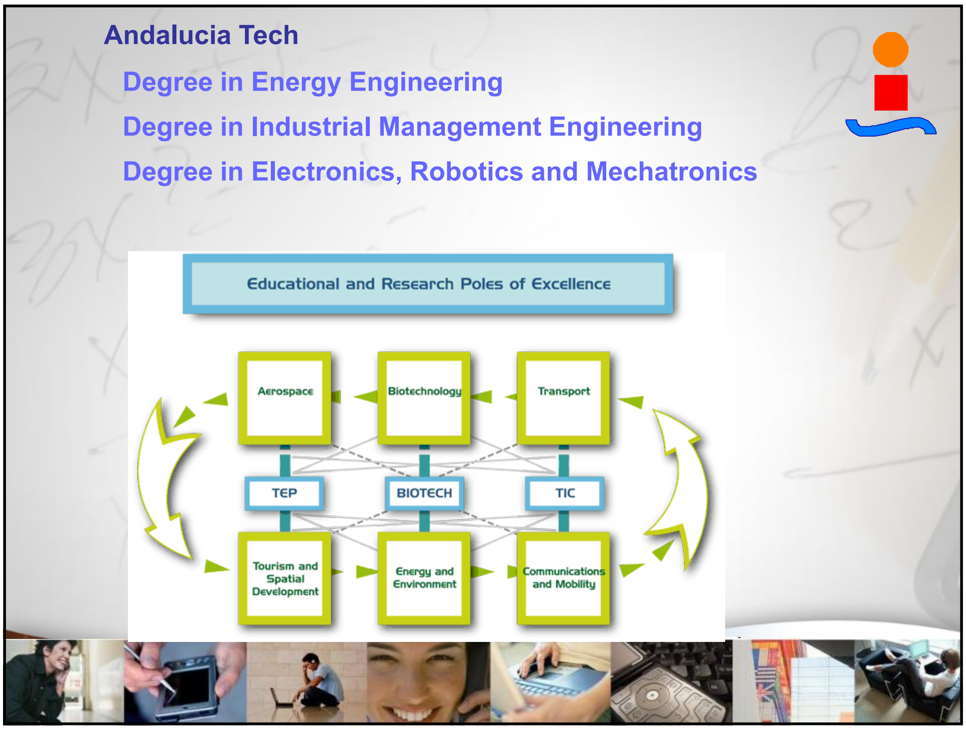
INGENIERÍA AEROESPACIAL
Degree in Aerospace Engineering

Specialization in 3 areas:

Aerospace Vehicles
Air Navigation
Airports and Air Transportation

+ Master in Aeronautical Engineering


INGENIERÍA DE CAMINOS, CANALES Y PUERTOS
Civil Engineering
Specialization in 3 areas:
• Civil Construction
• Hydrology
• Transportation and Urban Services
+ Master in Civil Engineering


Andalucia Tech
Degree in Energy Engineering
Degree in Industrial Management Engineering
Degree in Electronics, Robotics and Mechatronics
Educational and Research Poles of Excellence
Aerospace
Biotechnology
Transport
TEP
BIOTECH
TIC
Tourism and Spatial Development
Energy and Environment
Communications and Mobility

Master programmes (PhD Studies)

Master in Electronics, Signal Processing and Communications

Master in Electric Power Systems

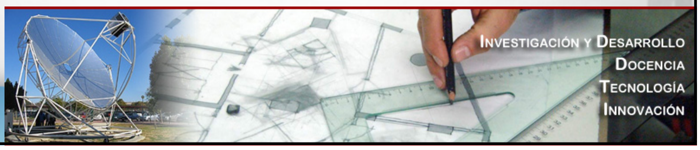
Master in Automation, Robotics and Telematics

Master in Advanced Mechanical Engineering Design

Masters in Industrial Organization and Management

Master in Environmental Engineering

Master's Degree in Thermal Power Systems



Master: Global Supply Chain and Aeronautical Industry Operation

Fifth Edition

Two courses of expert of University:

- On Aeronautical Industry Operation
- On Global Supply Chain

AIRBUS EUROCOPTER CASSIDIAN ASTRIUM

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Liasons with the industry

- Agreements with more than **100** companies.
- **400** internships per year in national companies.

Agreement MAI (Montreal Aerospace Institute) - ETSI

- June 2006, started collaboration.
- Internships of students and exchange with Canada since 2007.
- Agreement signed on November 2010

FRAMEWORK AGREEMENT BETWEEN Montreal MAI AND Sevilla AICIA

En Sevilla, a 1st de Noviembre de 2010

BETWEEN

D. HANY MOUSTAPHA, as President and Chairman of the "Montreal Aerospace Institute" (MAI)

D. CARLOS BORDONS ALBA, as General Manager of the "Asociación de Investigación y Cooperación Industrial de Andalucía" (AICIA), acting as the office for investigation transfer of the School of Engineering of Sevilla

Both parties mutually recognize legal capacity to adopt this Framework Convention.

EXPOSED

That MAI is an umbrella organization promoting and coordinating the training of undergraduate students for Concordia Institute for Aerospace Design and Innovation (CIADI), Institut de Conception Innovation Aerospatiale ETS (ICIA), Institut Innovation Conception a Poly (ICAP) and McGill Institute for Aerospace Engineering (MIAE)

AICIA is an association that exclusively pretends public interest without profit aim and whose purpose is to impel, orientate, and develop the industrial investigation, making special emphasis in publication and diffusion of its results in order to favor the technological advance in Andalusia and to collaborate for a better capacity of the engineers.

CLAUSES

FIRST- This convention has the character of Framework Agreement between MAI and AICIA to coordinate the following activities in the area of exchange of students in Aerospace Engineering

SECOND- Each organization will be responsible for the selection of their Aerospace Engineering students, to be sent to the other organization.

THIRD- Each organization will be responsible for the selection of the local aerospace companies who will host and provide a job for the students of the other organization.

Página 1 de 2

FOURTH- Each organization will be responsible for providing funding to the students selected by the other organization.

FITH- The number of students, their remuneration and the duration of the exchange will be pact in an specific agreement, for each year.

SIXTH- To ensure implementation of this Framework Agreement and the specific agreements, a joint commission formed by at least one representative from each of AICIA and MAI will be created. The Commission shall establish its own rules.
Until further notice, those responsible for ensuring the effectiveness of the agreement are Dr. Hany Moustapha for MAI and Dra. Maria Angeles Martin Prats for Escuela Técnica Superior de Ingeniería/Universidad de Sevilla. Both parties will consult with each other whenever it is deemed necessary and will review and evaluate their common activities once a year, if posible.

SEVENTH- This Agreement shall enter into force upon signature and will initially be valid for three years, which means extended for equal periods of time unless appropriate charges against either party by notifying the other party reliable, with at least three months before the date desired effect the termination of the Agreement.

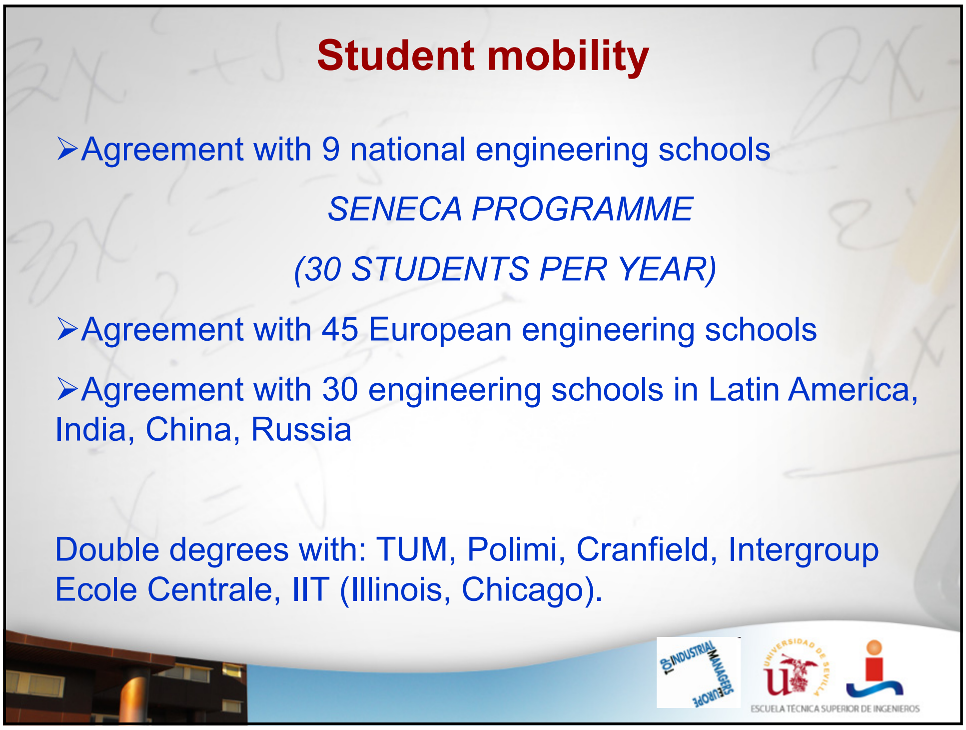
And as proof of compliance and faithful implementation of the agreement, this Agreement is signed cooperation framework in the place and date indicated above

November 1st, 2010

MAI'S PRESIDENT | **AICIA'S GENERAL MANAGER**

D. HANY MOUSTAPHA | D. Carlos Bordons Alba


Company Chairs
APPLUS
Applus
Cátedra Applus+3 de eficiencia energética en la edificación.
INERCO
INERCO
Cátedra deRiesgos Ambientales y Seguridad.
ENDESA
endesa
Cátedra Red de Innovación Energética.
FUNDACIÓN VALENTÍN DE MADARIAGA
MP
Cátedra Corporación MP.
HOLCIM
Holcim
Cátedra de Desarrollo Sostenible.
CÁTEDRA EADS
EADS
Cátedra EADS de Estudios Aeronáuticos.
CÁTEDRA IAT
Cátedra IAT
Ingeniería y Gestión del Conocimiento
Cátedra IAT de Ingeniería y Gestión del Conocimiento.
CÁTEDRA PRL
Cátedra PRL
Prevención de Riesgos Laborales
Cátedra de Prevención de Riesgos Laborales.
CÁTEDRA CEPSA
CEPSA
Cátedra Cepsa Energía.
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS


Student mobility
➢Agreement with 9 national engineering schools
SENECA PROGRAMME
(30 STUDENTS PER YEAR)
➢Agreement with 45 European engineering schools
➢Agreement with 30 engineering schools in Latin America, India, China, Russia
Double degrees with: TUM, Polimi, Cranfield, Intergroup Ecole Centrale, IIT (Illinois, Chicago).
TOP INDUSTRIAL MANAGERS FOR EUROPE
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Offer and demand of studies

Course 2013-2014

Degres and Masters	Offer	Cutting marks
Ingeniería Aeroespacial	130	12,3
Ingeniería Civil	80	9,6
Ingeniería de Tecnologías Industriales	260	10,3
Ingeniería de las Tecnologías de Telecomunicación	170	7,9
Ingeniería Química	80	7,1
Ingeniería de la Energía	65	10,1
Ingeniería de Organización Industrial	65	8,8
Ingeniería Electrónica, Robótica y Mecatrónica	65	10,4

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Destinations for Industrial engineering students (2013-2014)

Rheinisch-Westfalische Technische Hochschule Aachen
Ruhr-Universität Bochum
Technische Universität Berlin
Technische Universität Braunschweig
Technische Universität Darmstadt
Technische Universitat Munchen
Technische Universitat Munchen
Universität Stuttgart
Technische Universität Graz
Katholieke Universiteit Leuven
Université Libre de Bruxelles - Ulb
Fundaçao Universidade Do Estado de Santa Catarina
Universidad Federal Do Ceará
Universidad Federal Do Río Grande Do Sul
Universidade de Sao Paulo-Escola de Engenharia de Sao Carlos
École de Technologie Supérieure-Montreal
POLITECHNIQUE MONTREAL
Universidad de Chile
Lappeenrata University Of Technology
Centrale Marseille
Centrale Marseille
École Central de Lyon
École Central de Lyon
Ecole Centrale de Lille
École Centrale de Nantes
École Centrale de Nantes
École Centrale Des Arts Et Manufactures
École Nationale Superieure D' Arts et Metiers
Ecole Superieure D' Electricité
Technische Universiteit Delft
Dublin Institute of Technology - DIT
Technion-Israel Institute Of Technology
Politecnico di Milano
Università Degli Studi di Padova
Università Degli Studi di Roma "La Sapienza"
THE UNIVERSITY OF JORDAN
Norwegian University of Science And Technology
Politechnika Wroclauska-Wroclaw University Of Technology
The Agh University Of Science And Tecnology
Instituto Politecnico do Porto
University Of Cranfield
Lulea University Of Technology

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Destinations for Aerospace engineering students (2013-2014)

- Rheinisch-Westfalische Technische Hochschule Aachen
- Technische Universitat Munchen
- POLITECHNIQUE MONTREAL
- Ecole Nationale De L' Aviation Civile (ENAC)
- Ecole Nationale Superieure. D' Ingenieurs de Construction
- Ecole Nationale Supérieure de Mécanique Et D"Aérotechnique – Ensma
- Politecnico di Milano
- Politecnico di Torino
- Università Degli Studi di Pisa
- Università Degli Studi Federico II di Napoli
- UNIVERSIDADE DE LISBOA
- Istanbul Teknik Üniversitesi
- University Of Cranfield
- Ecoles …

Most of them members of PEGASUS

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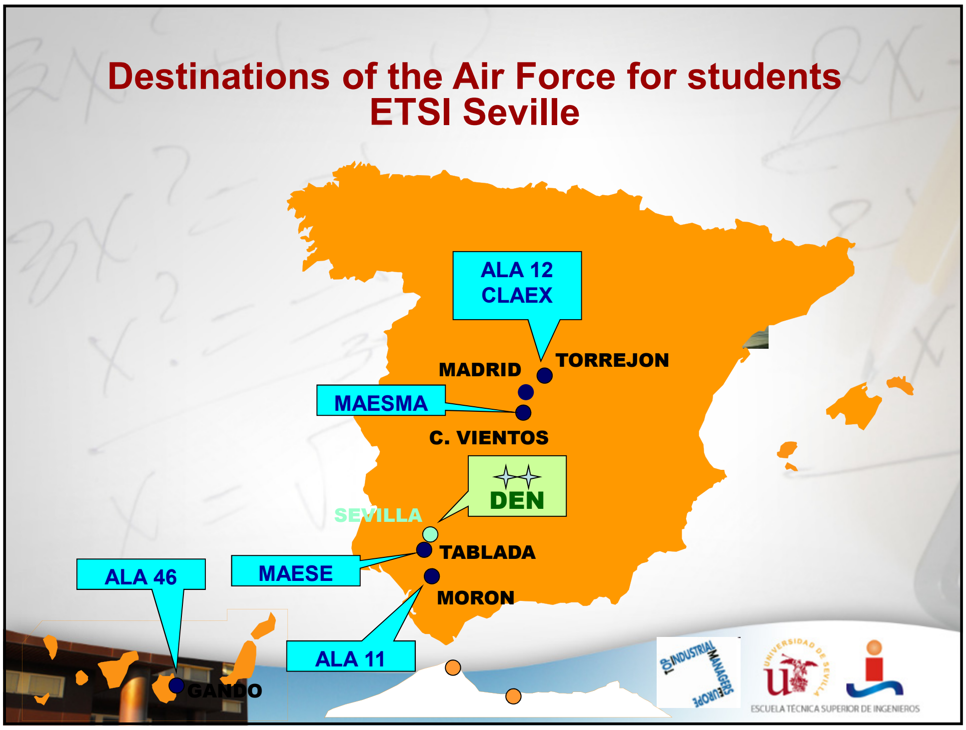
DIRECCIÓN DE ENSEÑANZA
EJERCITO DEL AIRE
Summer internships for students of ETSI


Destinations of the Air Force for students ETSI Seville
ALA 12
CLAEX
TORREJON
MADRID
MAESMA
C. VIENTOS
DEN
SEVILLA
TABLADA
MAESE
ALA 46
MORON
ALA 11
ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Aicrafts in the offered Air Miliatry Bases

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Practical case
PEGASUS – ETSI (University of Seville)

- 2008, ETSI Probationary member.
- April 2010, VI PEGASUS student conference, council and board meetings in Seville.
- October 2010, ETSI full member PEGASUS network.
- April 2011, member of the Board.
- March 2013, ETSI-US received PERSEUS Label.
- April 2013, PhD., Maria A. Martin Prats, Vice-President of PEGASUS.

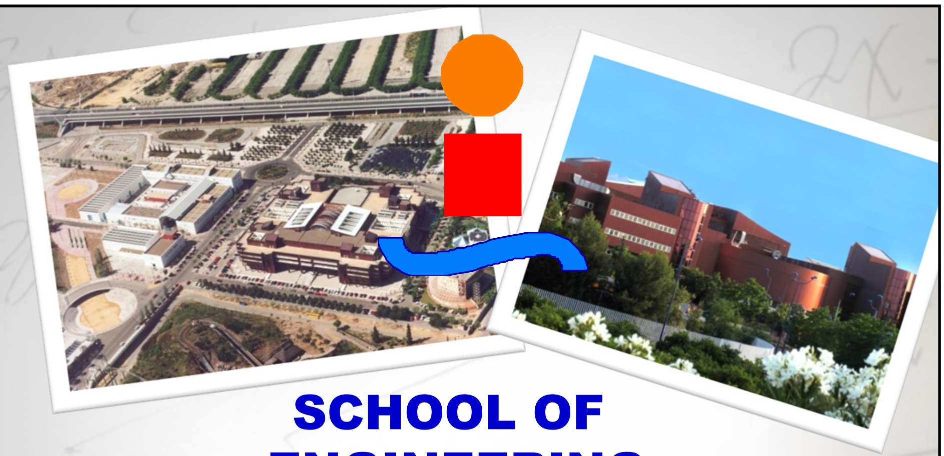
http://www.pegasus-europe.org/

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

Practical case
PEGASUS – ETSI (University of Seville)

- ✓ PEGASUS strengthens collaboration beetween Universities, rearch institutions and companies.
- ✓ Promote the exchange of students, researchers and professors.
- ✓ Active participation in working groups.
- ✓ Participation in academics and reseach projects.
- ✓ Presence in the European Commission.
- ✓ Participation in the definition of the European accreditation procedure, H2020,…
- ✓ Exchange of ideas, culture.

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS



SCHOOL OF ENGINEERING (ETSI-University of Seville)

Valencia Global 2014
PhD, Maria Angeles Martin Prats

PEGASUS

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS

PLACIS

COLLEGIUM ÎLE-DE-FRANCE

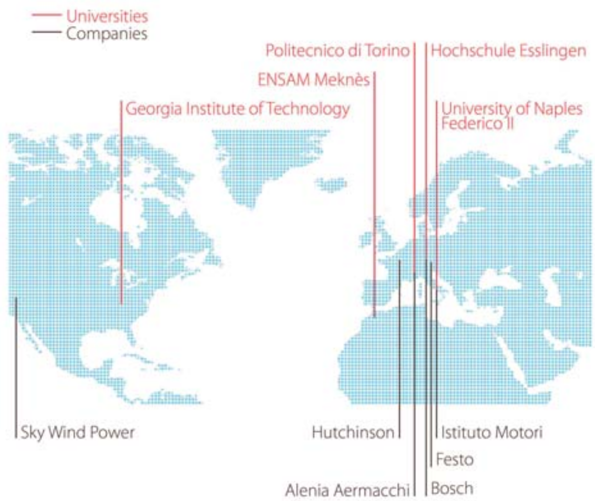
PLACIS projects are industrial, international and at-a-distance collaborative projects for students. They are managed by the Collegium Ile-de-France (SUPMECA, EISTI, ENSEA) and involve foreign academic partners as well as French and foreign industrial partners.

Projects in the framework of PLACIS

- PLACIS projects are based on a subject given by an industrial company.
- They are carried out by teams composed of students from two universities in two countries.
- They are a pedagogical tool of choice to train system engineers, through active learning.

Participative students :

- Use the most novel tools for collaborative & systems engineering,
- Are prepared to the conditions now prevailing in the industrial world, thanks to the multicultural & multidisciplinary experience they gain.



Main results

- 8 projects,
- New projects in an « incubator » phase,
- More than 200 students, 20 academic & industrial tutors already involved,
- Academic partners from Europe, Africa & America (Politecnico di Torino, Hochschule Esslingen, Georgia Tech…),
- Industrial partners from Europe & America

Main benefits

- Knowledge sharing between students,
- A unique experience of international industrial & multidisciplinary projects for the students,
- A first hand assessment on potential interns & employees for the companies,
- A unique experience on the most advanced tools for all stakeholders,
- An opportunity to create new ties abroad for all stakeholders.

Ongoing developments

- New 3.0 adaptive, collaborative, semantic & social platform,
- New projects to be developed with new academic & industrial partners,
- Enlargement of the project to other years/semesters of the engineering curriculum,
- Proposed Erasmus+ project more focused on teachers' role & adding new partners.

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Valencia Global 2014
Valencia, Spain

The PLACIS project is managed by the French National Agency for Research under the "Investments for the future" program with the reference ANR-11-IDFI-0029.

INTERNATIONAL EXPERIENCE: Exchange Student inside Erasmus's Programme.

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Conference Key Areas: Education, Exchange, Student.
Keywords: Academic exchange, international experience, foreign language.

Abstract

Nowadays the world is becoming more globalized day by day and international mobility is usual in the daily life of people. From the point of view of education and international experience, academic exchange is one of the factors known in this globalized or "internationalized" world. In order to know the international exchange from a more practical point of view, it has been presented a personal experience of a student involved in the Erasmus program. This document attempts to explain not only the academic life of the student, but also its adaptation to a new environment that will prepare him to understand area hitherto unknown to him.

1 Introduction

For university students, the possibility of study in another country has become an usual option. The international mobility programs promoted by the European Union, such as the ERASMUS Program, enable the student to consider the mobility as a possibility at the time of completing his studies. Although not all Universities of Europe participate in programs like ERASMUS, a large majority have a fairly broad mobility offer, which facilitates that the student can leave their country to complete a part of their studies abroad. The creation of inter-country academic exchange programs between members of the European Union has made possible that more than 3,000,000 students have carried out part of their studies abroad or carry out a period of practices in a foreign company [1], since its creation in 1987, thereby improving their chances to find a job.

2 Decide to study abroad

Studying during a period of time at a University in a foreign country opens up a range of possibilities that was non-existent if the student completes all training within their own University.

Nowadays, due to the economic crisis plaguing Europe, in countries such as Spain, students live with uncertainty for future employment. For this reason, the possibility of studying abroad attracts them, since it is a way to complete their training and open up a gap in the international world of work.

The number of students who participated in the Erasmus program since the 1994/95 academic year to 2010/11 course has increased 10547 students a 36.183 [2], as we see in Figure 1.

The main reasons why a student decides to study abroad are [3][4][5]:

- Learning a foreign language
- Chances for self-development
- Wish to gain academic learning experience in another country
- wish to improve career prospects

- Wish to improve understanding of the host country
- Wish to travel
- Wish for a break from usual surroundings

Personally, I decided to study outside of Spain because I had doubts about what I wanted to do after completing my studies. I thought that the right choice was to finish training in another country, improve my English and learn another language, which would facilitate the employment. Another key factor was also the chance for personal growing, since many colleagues who had gone abroad for to finishing their studies recommended it.

3 Final decisions to study abroad

When the decision of study abroad finally is chosen, factors [3][4][5] that students take into account to choose a destination are:

- practical matters concerning living
- studying in the host country
- foreign language proficiency
- the culture and society of the host country

My favorite destinations were the countries of Eastern Europe, because they have good reputation in terms of quality of education, also I wanted to look for a country with a different culture from the Spain. My first choice was the University CTU of Prague, in the Czech Republic, the following Slovakia and then several destinations in Germany.

4 Obtain a place at host University

When the student decides to carry out part of their studies in a foreign land, they should choose a place in a University abroad, and compete with the rest of the students that wants the same scholarship. The University and in particular, the origin Faculty selects candidates, each one has its own requirements [6][7], but is normally made on the basis of academic achievement, foreign languages proficiency, the interest in studies abroad and the personality of the student. The student decides a destination and if meets the requirements enters in a vacancy auction. More students receiving and sending countries are Spain, France and Germany, reflected in Table 1.

Moreover, in the Erasmus Program, we found a lot of Spanish Institutions in the list of major European institutions that more exchange student's receivers [8], as can be seen in Table 2.

In my case, only three places were offered for Electrical Engineering students at CTU in Prague, and there were many students that wanted this destination. Finally I got a place and there started my international experience.

5 Information and application

When we talk about mobility, some of the most complicated stages in the process are application and admission due to the time that is inverted and the management of proceedings by institutions. To obtain the place the following documents must be delivered:

- Letter of motivation
- Learning agreement
- Application form
- Academic record

One of the problems is the International Office at Universities, lots of students have problems in this stage due to lack of resources, because of the bureaucracy, the process is very slow and it seems that workers are overloaded.

In my experience as an Erasmus student this was the worst stage, which took a long time and with an unexpected ending. After sending all requests and all the documents to the University of Prague, Learning Agreement, Application form, CTU University refused my place at the end of June. From the International Office ETSID they offered me a place for nine months at Instituto Superior Técnico de Lisboa (IST), Portugal, the nearest country Spain and the most Western European country, completely opposite to what I desired. The idea did not amaze me but I decided to accept. I had to re-fill and deliver all documents in a short time because it was late June and the deadline was close.

6 Settling abroad

The arrival to the host country and first days are so important in the international exchange experience. Factors [3][4][5][9] influencing students to settle in the new country are:

- Language
- Economic sum
- Accommodation
- Host institution (university, company...)

6.1 Language

One of the first factors we found when we arrive to a new country is the language barrier [10]. English is essential to be able to settle anywhere, but there are situations where you have more problems, because not everyone speaks English. There are some areas where there are no problems, such as University, but day-to-day tasks, like shopping, language can be an important barrier.

It's recommended to do a language course before students arrive to the host country [10]. There is a possibility of study the language course in the host University, in some cases courses are free, but if there are not, normally are not expensive.

Evolution of the total numbers of mobility students for higher education institutions from Spain that training an Erasmus Intensive Language Course (EILC) [11] has increased over the years. As we can see in Graph 2 that shows the evolution of participants since 2001/02 academic year to 2010/11.

According to statistics from the International Exchange Programmes Office (OPII) from UPV [12], based on 1195 surveys done, the command of the language from host country, before and after exchange period varies in most cases. The variation depends on the previous command of the language, how it's shown on Graph 3. At the beginning of the stay, about 44% of the students had no knowledge of the language, at the end of the stay only 5% of these students had no knowledge; i.e. 39% of students learn anything about the language of the country. The increase for a poor command of the language is 2%, 15% for a good knowledge, 19% for very good and finally a 7% excellent. We note in this graph the command of the language various more in people who had no knowledge and people who had a good or very good knowledge.

In my own experience, I studied two intensive language courses, one per semester. Each one cost €50 and I received a B2 certificated as Portuguese as foreign language, on the Common European Framework of Reference for Languages. Later, once in Spain, I did an official language exam, receiving the official certificate that 'Faculdade das Letras da Universidade de Lisboa' offers.

Living with Portuguese helped me a lot; my roommates came from different areas in Portugal so I would be able to listen to different accents. One of the best experiences of my Exchange period was learning the official language of the hot country, because it is a way to understand the culture and people who lives there.

6.2 Economic sum

Economic sum it's a key factor during the time you are abroad, the money students receive come from different institutions, in most cases the amount of the grant is not enough to finance all study period, students tend to rely on their families and their savings to survive.

It is received a grant paid by Europe that normally has the same quantity for everybody [2]; what's more Spanish Government gives to some students another quantity of money, which depends on the family income. Finally, some Autonomous Regions gives a grant too.

As indicated, we can see big differences between students of different countries, and in our case it's a significantly difference, according to the origin of the students will have more or less economic sum. On Graph 4 it's shown the year variation about the economic sum and founding institution [2].

In my case I received an aid of €237 per month. In addition to the amount, the problem of the grant is the form that is sent to the student: several fractionated payments, which are not constant in time and in amount. All this makes that the amount that does not come from the institutions, personal savings and family help, facilitate the student sustain abroad. Personally, between my savings and the support of my family I could live for 9 months decently.

6.3 Accommodation

Regards accommodation, according to the destination there is more or less difficulty finding where to live. There are students looking for accommodation before arriving the country and students who look for when arrive there. Also you have to choose between living in a residence or in a shared flat. In Lisbon, for almost all Exchange students lived in shared flats, the average individual rental was around €250 per month, in some cases included additional costs (such as internet, water, electricity...) and in other cases these costs were not included. In Lisbon, a rental price it is high with respect to the standard of living of the country.

6.4 Host institution

The host institution is essential for the stay abroad. It is one of the first places that students go when they arrive and it is the first place where you go if you have any problem. Universities have an International Office where all documents as Learning Agreement and its changes are handed. In addition, most Universities have own students that help exchange students with difficulties, such as language, university tuition and the search for accommodation. I think that staff and students from host University are fundamental in the process of academic exchange.

In my own experience, the ‘Instituto Superior Técnico’ has an excellent staff in the management of student mobility in their International Office; make any process fast and efficient. At the beginning of the academic year they did a Welcome Week where greeted all foreign students and gave them the first guidelines about the University. Later, in the International Coffee, they met with all exchange students and presented the University and all activities that would be carried out during the course.

7 Studies in a foreign language

Lessons offered in the host country generally take place in English but sometimes are realized in the own language in the country [3][4][5]. Usually exchange students can study together with the local students instead of having specific courses designed for them [4][5], which does not offers the opportunity to know conditions about typical studies and provisions of the host country.

Generally at the IST, teachers and students speak English. Classes are given in Portuguese for are Bachelor lessons and English lessons are offered for Master studies. Almost every subject I conducted was taught in English because I was taking subjects of Master level. Only one subject was taught in Portuguese, I remember the first day at University I didn’t understand absolutely nothing and teacher asked me, I answered in English and teachers said the class would be taught in Portuguese and if I had any doubts or problem he could help me.

8 Academic experience

When a student realized an exchange period, usually studies similar subjects on the host country than in the home country. As far as the methods and areas of study, have most often been chosen subjects that gain knowledge, change specialty or know new specialty areas.

In many cases, all subjects that a student plans to take at the beginning cannot be taken, due to a lack of information, schedules and language. In some cases, study less stringent subjects or less study load is recommended, to soften the problem of the language barrier [3][4][5].

Problems encountered by students during their academic experience abroad are [4][5]: high academic level, different teaching and learning methods from their home universities. Concerning bureaucracy problems, appear in Learning Agreement, sometimes the student don’t know if all subjects will be accepted by his home university until the end of the academic exchange, and this contributed to created uncertainty.

In my case, I carried out during the nine months of stay, 3 subjects, 2 language courses and my Final Degree Project. The subjects I chose were fields that I had not done in Valencia, I did them to improve my CV and later in Valencia these subjects were validated as Free Choice Subjects. Academic level at IST is very high and both teachers and students are so strict. One of the problems that I found was difficulty of Master studies, because I came from a Bachelor course and I have to spend many study hours to pass subjects.

In several occasions, the University community thinks that exchange students tend not to study or they have more facilities to pass exams, it is possible that in some cases this belief can be true [4], but in IST Erasmus student were as Portuguese student and we had to work hardly to pass our exams. As an anecdote, some Sunday students went to laboratories to finish our weekly work and when my family or friends contacted me, could not believe that I was working on Sunday, but it was completely true.

The biggest difficulty I had on my exchange was the agreement with my Final Degree Project. In the first Learning Agreement did not appear that I was going to do my Final Project, when I could solve that, the teacher did not want to accept me because there realized Master Thesis and I had not qualification for this. After much effort, two teachers from Lisbon helped me with a smaller project, similar to a Final Degree Project; it was co-coordinated by another teacher from Valencia. I wrote my Project in English and Spanish, later I defended it in Portuguese, that experience makes me learn a lot and I realized that I had acquired skills not previously had with languages. Thanks to the selfless help of these three teachers I could finish my degree in Lisbon.

9 Life outside academic scope

Extracurricular experiences in a life of an exchange student are very important and varied, from reading news on the host country to feel more integrated, to go to the theater, movies and museums, participate in lectures and discussions with students and teachers in the host country, play sports and other leisure activities with people of the country and people from other countries.

Normally the Erasmus students feel well integrated in the social life of the host country as well as in the academic life of the host institution. Although, sometimes appear some problems, as integrated into the life of the students of the country. Adapt to the climate and food, which often differ from those of the home country. In my case, the year that happens in Lisbon was the rainiest year in history, and I was not used to rain, but as the food was similar to our food, there was no problem in this area.

Life beyond academic experience, better known as the term Erasmus Life, is what makes the student grow as an independent person, being out of his usual environment, family and friends. When a student arrives to the host country has to create his own place and that is why students, roommates, people you find become your family. This is done not only at parties, which is what most people think, but in all areas where students are located, at university, in stores, on the street.

It should be noted that not only you engage with people from the host country, also with people from all parts of Europe and the world. This experience is difficult to live it in the home University and it's enriching, see the 'internationalization' in a meeting, where everyone can understand perfectly leaving aside cultural differences, forming global links. From my point of view, it is an experience which people open their mind and stops thinking in an individual shape, which there is only the environment where resided regularly, and try to find a new environment in another place where you can create your own place with other people from different cultures.

10 Conclusions

For a student, to study abroad not only is a means of academic improvement, as the student moves to another country even if the education quality is not better than the quality of their institution home. The student improves their abilities because you have to adapt to a new environment to get academic achievements and to understand other cultures and people, with this we can say that today the mobility of the student ceases to be vertical to horizontal.

Cooperation between universities enables students to internationalize their academic CV and their personality, improving its value. Recognition of the study achievement by European credits (ECTS) makes that a student may stay a year away from their home university and you do not lose any academic year when returns, in this way student see mobility is no longer a possibility to be a fact.

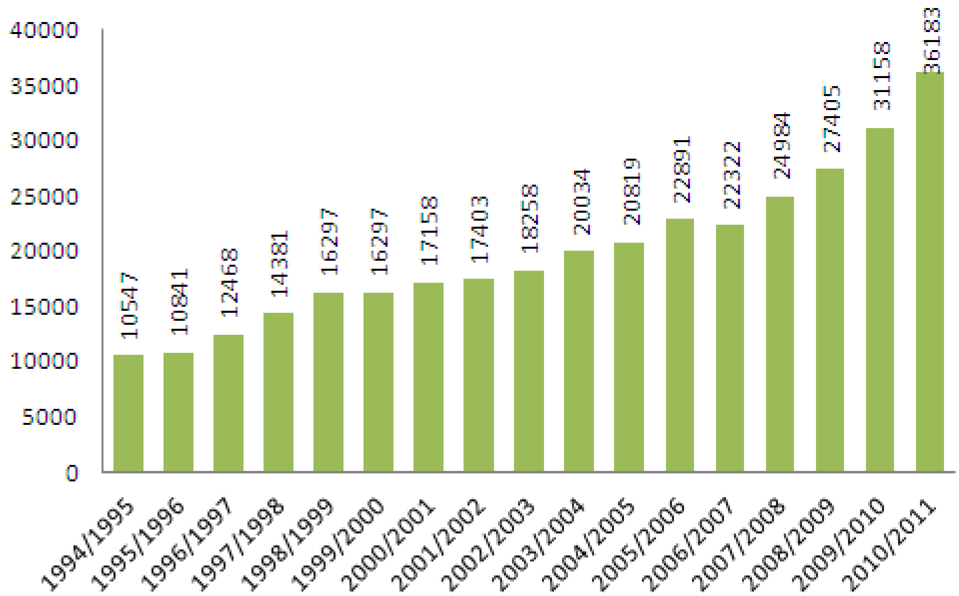
When a student returns qualifies language improvement, cultural experiences and personal development more favorable than academic value of the study period outside their country. With this assessment, people could say that students take this opportunity to do only cultural and leisure activities, but the reality is that students usually invest the same time in the study period in his home University that in the host University.

Exchange programs are an experience where students open up an unknown world; students not only study subjects corresponding to our curriculum. We study the value of diversity. Learning and appreciate diversity is the bridge between experiences of life, normally we would not consider if we don't go abroad, increasing our chances to a new personal and working world.

11 Graphs and tables

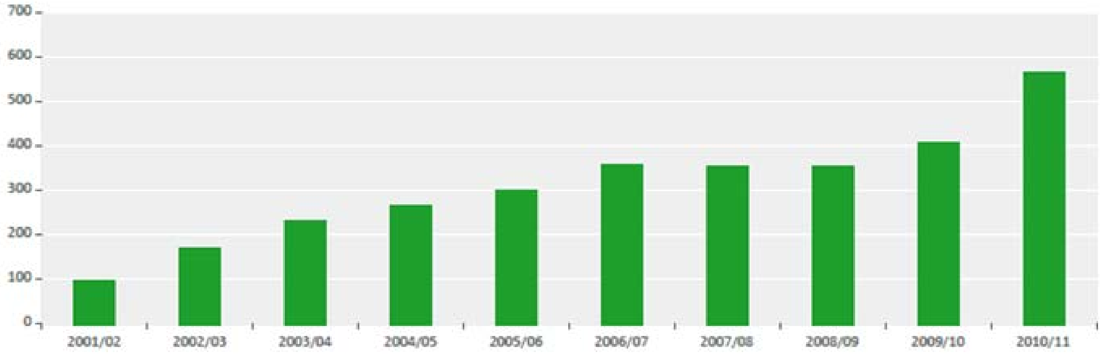
11.1 Graphs

Graph 1: Evolution of Spanish university students in the Erasmus program since 1994.



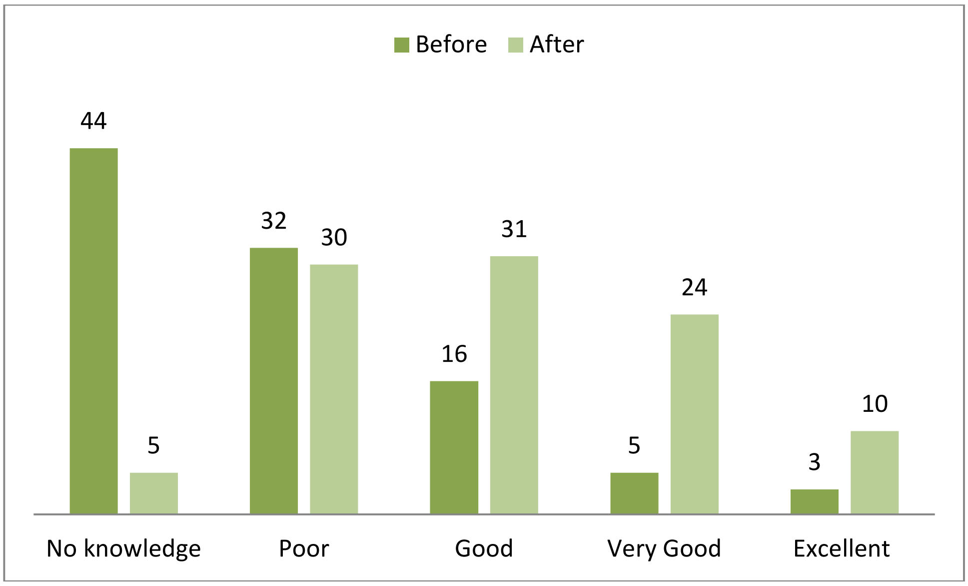
Source: 'Informe Datos y cifras del programa ERASMUS en España. Curso 2010-2011. Ministerio de Educación, Ciencia y Deporte.'

Graph 2: Evolution of the total number of mobility students from higher education institutions from Spain that made an Erasmus Intensive Language Course EILCs (2001/02 to 2010/11).



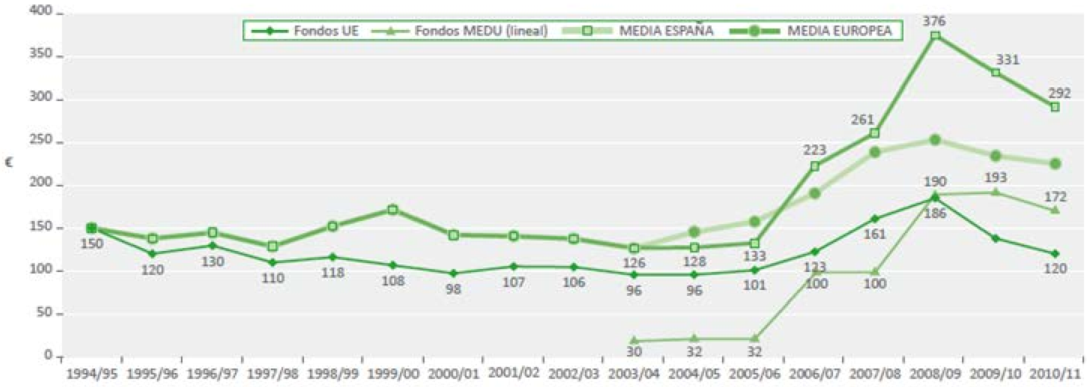
Source: 'Informe Datos y cifras del programa ERASMUS en España. Curso 2010-2011. Ministerio de Educación, Ciencia y Deporte.'

Graph 3: Command of the language in the host country before and after the academic exchange.



Source: 'Oficina de Programas de Intercambio Internacional, Universidad Politécnica de Valencia. Resultado de las Encuestas.'

Grafico 4: Evolution of the average amount of monthly support of the mobility of students from higher education institutions from Spain (1994/95 to 2010 / 2011).



Source: 'Informe Datos y cifras del programa Erasmus en España. Curso 2010-2011. Ministerio de Educación, Cultura y Deporte.'

11.2 Tables

Table 1: Major Erasmus 2011/2012 emitting and receiving students countries.

Major emitting countries	Major receiving countries
España	España
Francia	Francia
Alemania	Alemania
Italia	Reino Unido
Polonia	Italia

Source: European Commission.

Table 2: Major Erasmus 2011/2012 emitting and receiving students institutions

Country	Institution	Number of students
España	Universidad de Granada	2022
España	Universidad de Sevilla	1799
España	Universidad Complutense de Madrid	1708
España	Universitat de Valéncia	1689
Italia	Università di Bologna	1620
Dinamarca	Aarhus Universitet	1522

España	Universitat Politécnica de Valéncia	1509
Republica Checa	Univerzita Karlova v Praze	1157
España	Universidad de Salamanca	1110
Italia	Università Degli Studi di Roma La Sapienza	1107

Source: European Commission.

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ERASMUS, a Union Strategy

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Conference Key Areas: International Networking, Cooperation with industry & international placements, Education and Research
Keywords: Strategy, ERASMUS, Union, Quality, Education

Abstract

The ERASMUS program is probably the most important and powerful policy created by the Union towards European construction. This paper tries to assess the program from two perspectives: what it meant for a student in the short term, and the long-term effects it has had in his life, 20 years after the experience.

1 Introduction

In September 1995 I went on an ERASMUS. Eight ERASMUS classes had preceded me. Almost 33,000 students had left Spain to study in another country, in another language. The opinion of those who came back was unanimous: "It's a unique experience."
At the school, the program was heavily promoted and they helped with the process to get the scholarship. The many agreements signed with European educational institutions had given rise to a such a wide range of scholarships and destinations that practically any eligible student who applied for it had the opportunity to get a place.
Therefore, it was an easy decision to go on an ERASMUS. My destination: the "Grande École d'Ingénieurs" ESIGELEC, which was established in Paris in 1901 and was moved to Rouen in 1978.
Although it is true that I had some experience with travelling abroad, and that those who preceded me had led the way, the fact that I was going away for a year caused some degree of excitement in me, a combination of enthusiasm, nerves and impatience. Enthusiasm because I had the feeling it would be an important year for me; nerves, because I was leaving behind the comfort of what was familiar to enter the unknown; and impatience because, once the decision was made, I wanted the departure date to come as soon as possible.
And finally the day came. In September I took a plane to Paris and then a train to Rouen. At the station I was greeted by the Assistant Director of International Relations and by a student of the school. They took me to the campus, where they had reserved a room for me, and they helped with my initial paperwork.

2 Analysing the first differences

As soon as I arrived to Paris and Rouen, the most obvious fact was that, in France, people express themselves in French. Sure, everybody knows it, but a brain that speaks, understands, dreams, thinks, analyses and feels in Spanish... resists the switch to another language. No matter how much you may have studied and practiced it, changing to another language is not automatic. And at that time, when foreign languages were considered a secondary subject, what you learned did not allow you to have a fluent conversation. Expressing yourself was a real

mental effort. You thought in Spanish and you translated word for word into French. So, misunderstandings, if there was any understanding at all, were guaranteed.
One day in the dining room, as I pointed at a steak, I wanted to ask what kind of meat it was, but actually I ended up asking who it was. With a smile on her face, the lunch lady answered that it was Mr. Dubois. When they explained my mistake, I too thought it was funny.
So, the first task is learning the language properly. The three students from Spain who were at the school were assigned a tutor, who was also a student. Initially it was very helpful, but the truth is that you learn French by speaking... with French people! I don’t know why but we could understand the French spoken by other foreigners much better than that of French people.
Being with other Spaniards did not help with the language learning process. Although we decided to speak French among us, the truth was we always ended up speaking Spanish. That’s why eventually I decided to spend much more time with French people than with other Spaniards. It was a great decision.
The second most obvious difference was food and mealtimes. I ate at university restaurants, where prices were really affordable, but portions were decidedly smaller than in Spain.
What really surprised us was that we had lunch from 12:30 to 1:00 pm and dinner between 6:30 and 7:00 pm. So early? Yes, indeed. However, what was really funny about that system was that I found it much better than the Spanish schedule. Although I was eating less, I didn’t feel hungry the rest of the day. I quickly got used to it.

3 The School. A new vision (or differences) in education

If I had to summarise in one word my experience at ESIGELEC, it would be, without doubt “Quality”:

- Quality of the teaching staff
- Quality of the academic contents
- Quality of the methodology
- Quality of the facilities
- Quality of the attention given to the students
- Quality of the external relations

3.1 Quality of the teaching staff

For us, the students, the quality of the teaching staff could be seen in three main points:

- They were perfectly knowledgeable of the material they taught.
- They knew how to convey their knowledge to the students.
- They were available and had many office hours for mentoring students.

I sincerely think that at any academic institution in our country, the teaching staff know the subject matter they teach. However, there are many differences between teachers when it comes to conveying their knowledge, at least which was the case during my student years. What struck me at ESIGELEC was that there was more or less uniformity on this point, a clear commitment to the transmission of knowledge. Probably because the school’s prestige and income were measured in terms of its graduates’ professional success.

The availability of the teaching staff, together with the time they set aside for student counselling was very important for me. Especially at the beginning, when I needed more help. Later on I relied more on my French classmates.

3.2 Quality of the academic contents

On this subject, the key word is “adaptability”. The rapid adaptation of the curricula to changes and to social and business requirements was essential for the school’s board of directors. Therefore, changes were introduced in the curricula on a yearly basis as a rapid response to the needs of the business world and the job market. Taking into account that it is a general school, there was a stable core program of lecture classes that acted as a support to the dynamic, directed and changing part of the scientific/technical knowledge.
I imagine that through this dynamic approach the goal was to increase the school’s competitiveness and prestige. For, as I pointed out earlier, ESIGELEC competes with other “Grandes Écoles”. Rankings are published periodically in which the schools are evaluated, almost quarterly, on issues that are relevant to them:

- The average starting salary for new graduates.
- Students who end up in management positions.
- The minimum time graduates need to find work after they leave the school.
- Time it takes students to reach management positions.
- Etc.

Let’s not forget that this is not a public school. The greater their prestige, the more students they have competing for admission—which increases their income.

3.3 Quality of the methodology

Each class had 25 students. With this number of students per class, the professor is able to monitor them, assess their progress, and use quasi-personalized methodologies, facilitating the learning process, encouraging class participation and guaranteeing the academic success of the students.
Every day we began at 8:30 and had classes until 12:30, in 55-minute sessions. We had an hour for lunch and then classes again from 1:30 to 5: 30 pm. On Thursdays, there were no afternoon classes to give students free time for their personal affairs.

Class attendance was mandatory, in each and every class! In fact, this was one of the main differences between studying in Rouen and Valencia. Roll was taken every day, in every class. If you missed a class without justification, you lost a point. Losing three points could mean expulsion from the school. Even arriving to class late was penalized.

Due to surprise exams—an accepted fact—the evaluation was continuous.

The times and dates of the quarterly exams were announced at the beginning of the course and took place over a period of two or three days. There was one exam every two hours. Curiously, the people who proctored the exams were usually older people from outside the school. If a student had a question, the professor was called in from his or her office.

Special attention was given to practical skills. Approximately 25% of the time was devoted to the theoretical part of the lessons, 25% to practical issues, and 50% to work in the laboratory. The labs were very well equipped, with state-of-the-art instruments and a maximum of two students per station. Some labs could even be used outside of class time.

Practical training was considered so important at ESIGELEC that, in the last three years of study, students had to do it in companies. In the third year, they did low-skilled jobs, that they called ‘blue collar,’ for one or two months. The following year, they did technical training for two to four months. In the last year, they trained as engineers from four to six months. Their papers concerning their practical training were defended and evaluated by an examining board, made up of people from the company, the school and members of the Chamber of Commerce and Industry in Rouen.
Another striking aspect of this methodology, especially in the last year, were the classes on how to deal with job interviews. Simulations were done under the supervision of specialists in Human Resources to train students to perform well in a job interview and avoid making mistakes.
Other classes were given outside the normal timetable if students requested them. For example, a group of students wanted to learn Spanish and they arranged for a teacher to come in the afternoons. The teacher invited me to attend some classes so that students could interact with a native speaker. It was a very interesting experience for me. The truth is, the teacher asked me questions that I understood intuitively and she knew academically.

The result of this methodology was that nearly everyone passed their classes. Those who quit their studies did it for personal reasons, and only under exceptional circumstances were students allowed to repeat a course. Therefore, classmates started the program together and finished it together.

3.4 Quality of the facilities

It was obvious that the school had economic resources: it was a recently-opened, modern school with well-equipped facilities.
Theoretical classes were given in classrooms with seating for 30 students. The laboratories were equipped with state-of-the-art equipment and allowed work to be done by two students per station. Special importance was given to the language lab, with individual booths equipped with audiovisual and multimedia learning materials. If a minimum group of students decided to learn a language that wasn’t offered, the school would hire a teacher.
They had two large assembly halls for massively attended events, as well as common rooms in all the buildings.
Although they didn’t have their own sports facilities, I suppose they must have signed agreements with the surrounding centres and institutions that did have them. This supposition is due to the fact that the school participated in national competitions, such as the “24 Hour Rouen Motorboat Races”, which takes place every year on the Seine. They must have trained somewhere!

A curious side note: around the month of April, there was a day to celebrate the school. Organized by the Student Union, they used the entire campus for scheduled events: exhibitions, live concerts, and dance halls. On that day, they handed out the diplomas to the new engineers;

guests participated in the ceremony, as well as alumni from graduating classes from 10, 20, 30... years before. The event begins in the morning and lasts until the small hours.

3.5 Quality of the attention given to students.

Students here are “Customers”. And customers need a guarantee that the time spent in this school is a sound investment for their future career, a guarantee that they are learning what companies require. Students pay—quite a lot—to study in this school and that is why everything revolves around them. Their academic needs are satisfied without forgetting extracurricular activities, which also contribute to their development.

Therefore, there is a tutor for each course who is in charge of coordinating academic life, and who implements and supervises the initiatives suggested for that year.
Also, the Student Union, or “BDE”, deals with the students’ other concerns, mainly those related to extracurricular activities. This activity, which focused almost exclusively on sports and culture, provides a sharp contrast to the “Student Delegations” at the Polytechnic University of Valencia, which has a strong presence in the university’s governing bodies.

3.6 Quality of external relations

The best marketing strategy that ESIGELEC has developed and applied is the promotion of external relations that provide a significant added value. The aim of the school is to have relations with all kinds of people targeted by the school. We cannot forget its business nature. It is indeed an education business, but a business after all and, therefore, subject to the laws of the market place. This promotion of relation becomes apparent in:

- Relations with large companies. These are possible employers of ESIGELEC graduates and creators of work pools and company training programs.
- Relations with alumni who are now the school’s main champions and, especially, its ambassadors and prescribers throughout the world. This relation is maintained and developed by the alumni association SIGELEC.
- Their presence at conferences.
- International relations with other educational institutions all over the world.
- Institutional relations. The school is backed by the Chamber of Commerce and Industry of Rouen.
- Relations with possible candidates who come in through national competitions: open-house days.
- Membership in the « Conférence des Grandes Écoles ».

There are also continuing education positions for professionals who could not get the best degrees in the past and would now like to move up to a higher category.

4 Other thoughts

4.1 On language

The fact that I needed to improve my French was obvious from the moment I arrived. And although I had a tutor assigned to teach it to me, it was not enough. I needed to speed up my rate of learning because my first exams were in four months. It is true that, at the very beginning, they were somewhat permissive on this subject and I did a few exams orally. But the quarterly exams were written. What did I do, then, to improve my language skills?

- I tried to spend more time with my French classmates. And I was indeed able to do it. I made good friends which I still have. One of the most satisfying moments for me was when they began to invite me for meals in their homes and, although it may sound silly, to play games with me that required a certain knowledge of French language and culture, like word games, charades or Pictionary.
- I bought a television to improve my language skills.
- I became a member of “France Loisirs”, which is similar to the Spanish readers club “Círculo de Lectores”, in order to read at least two books every three months.
- I bought the Asterix comics in French. I discovered that the name of each character played an important phonetic role in French, as well as having a specific meaning that it didn’t have in Spanish.
- I went to the cinema regularly, and occasionally to the theatre.

I practiced until the time came when I began to dream and think in French. At that moment I knew that my efforts to become integrated were really working.

4.2 Tolerance and relativity

Two values which are quickly acquired through the ERASMUS program are tolerance and relativity.
People from different countries, cultures, religions and values were living together in the same space. I had Asian, African and American classmates and everyone respected each other. We accepted their reasons, explanations and points of view about their own culture and customs as other lifestyles and, on occasion, we rectified our presumptions, prejudices or unfounded suppositions. The values of the ERASMUS community were based on mutual respect, understanding and acceptance. I don’t know if the ERASMUS students who decide to leave their country already have those values or if it is the inevitable consequence of living with others. Probably it’s a combination of both.

What does seem to be a direct consequence of living with people from so many different cultures is relativity. The first thing one learns is that what is good for you might not be good for someone else. True, there is a common foundation for everyone, but the rest is relative. Customs, habits, timetables, food, priorities, colours, clothes, jokes, emotions, perceptions, problems, needs, values, analysis, fears, personal relationships, motivations, dreams... are all relative and depend on individuals and their country of origin. It seems obvious, but the ERASMUS experience is the verification of that relativity.

4.3 Academic results

Two and half years after beginning that adventure, I got my engineering degree from ESIGELEC and the Euro-Engineer degree from FEANI.
The double degree was, without a doubt, the most important academic outcome of my ERASMUS experience. This positively conditioned my academic and professional careers. For this reason, I advise new ERASMUS students, when the conditions apply, to opt for the double degree if possible. Nowadays, with the implementation of the ECTS, foreign degrees in higher education are more readily acknowledged and the subjects are much easier to transfer and validate than they were twenty years ago.

5 Closing remarks

Value the ERASMUS program from two points of view:

- What it means for the student in the short term, and
- What it will mean in his or her life in the long term, twenty years after the experience,

Allow me to make the following personal comments:

1. It was a positive, enriching challenge.
2. These kinds of initiatives are building Europe.
3. Languages are fundamental in this global world and make these programmes a success.
4. I had a lot of fun but I also studied a lot.
5. Thanks to the double degree, I am a Spanish and a French engineer.
6. I learned the real meaning of the word “relativity”. You can’t go abroad and compare everything to what you have in Spain.
7. The faster you accept the local customs, the quicker you can become integrated.
8. The world became smaller.
9. 20 years later, I am in touch with people from France and other countries who I occasionally communicate with and hear their news. They even come to visit me in Spain.
10. After this kind of experience, foreigners who visit our country are not seen in the same way.

Deep down, for all our differences, we are all very similar. Our fears, our joys, our hopes... are similar. What changes is the way they are expressed and what causes them.

6 Acknowledgements

The thoughts I’ve shared with you about my ERASMUS year would not be complete without expressing my gratitude.
My sincerest thanks to:

- The initiators of the ERASMUS program. I think their vision of creating a feeling of European citizenship through the mobility of students has been a success. They continue to improve the initiative.
- The management of the program in every European academic institution for accepting the challenge that was proposed to them and for working tirelessly to improve the conditions of the exchanges and increase the number of students and centres participating in the program.
- To the UPV for the economic effort made so that we could go and study abroad.
- To the ETSID for the energy and resources they put in, in order to obtain more scholarships and better destinations. Their work was so intense and fruitful that there was a time, like I said, when every interested student had access to an ERASMUS scholarship.

International Experience Testimonial

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International Experience Benefits
International, Exchange Program, Testimonial

Abstract

The exposure to an International Educational Experience is today a key element of the personal and professional development, necessary in most cases to ensure competitiveness and efficient access to a job position within the current globalized structure. This paper presents the advantages of an international experience, through the author personal background and using his experience as a driver to elaborate the core message. There is a special focus on the exchange program completed during university student years.

1 Introduction

In a globalized world, International Education has become a key element of competitiveness and a requirement to be able to fit within the current industrial model, especially when considering medium or big size engineering organizations that usually involve stakeholders worldwide.

Analyzing a few of the top engineering projects developed in the last years, we mainly identify international teams driving innovation (new Panama channel, B787, International Space Station). All these initiatives require international funding, competences and a good level of integration of their partners to guarantee a positive performance. Learning how to be part of an international team plays a critical factor to become a core member of the project and influence its direction. University Education abroad usually provides the initial and best opportunity for individuals to support their international skills development and this is presented in my experience below.

2 My International Experience

2.1 Background

Born 20km from Valencia in Puzol, where I completed my primary and secondary education, I started my Aerospace Engineering degree at Universidad Politecnica de Valencia in 2005.

A few years after, in 2009, I was granted a scholarship for an Exchange Program at the Embry Riddle University, specialized in Aeronautical sciences and located in Daytona Beach, USA.

Following my last year of Aerospace Engineering, I applied for the young leadership program of the Aerospace & Defense group Finmeccanica. It followed a Master's scheme approach with participants from different parts of the world living and working together in Rome.

Since 2011, I have worked for AgustaWestland helicopters as a Program Manager on a brand new helicopter being launched to the market next year, the AW169. Our market and vendors composition includes a high international presence being AW the second largest helicopter manufacturer worldwide.

2.2 University Years: International Exchange Program

During the period at UPV University working in my Aerospace Degree (2005-2010), the student community was reasonable well informed of the different development programs and initiatives the university offered. Amongst others, the following were the main development streams available:

- *European Exchange through ERASMUS program*
- *Worldwide Exchange through PROMOE/alternatives programs*
- *Internal collaborations with UPV departments*
- *Internships in local industry partners*

My interest focused on the Worldwide Exchange program as I wanted exposure to an international environment and an experience that could maximize the impact on me. I selected the PROMOE program in the US mainly because of:

- *My passion and curiosity to discover new environments and learning different way of organizing things.*
- *My self-improvement and will to put myself in front of new challenges*
- *A "practical" need of international experience to be able to access to future jobs in the globalized aerospace industry*

The PROMOE program took me straight to Daytona Beach, Florida, to study one year at the Embry Riddle Aeronautical University, specialized in Aeronautical and Space sciences. I was covering the last year of studies at UPV so the student plan had to be compatible between the two institutions and ensure mutual acceptance of the academic contents. My student plan was basically organized as presented below:

- *First semester covered the theoretical content: I completed the remaining courses on Flight Mechanics, Aerodynamics, etc. The formal program included theoretical lessons, exams and a high importance of individual and team assignments.*
- *Second semester covered the final thesis project: in collaboration with Embry Riddle "EagleWorks" flight experimental department, I was part of a multi-cultural team who was tasked to build and design by ourselves a 5 meters long wireless controlled Blimp, powered and guided using four electrical fans.*

The experience at Embry Riddle between August 2009 and June 2010 gave me awareness of the differences in methodology between a European – South European and Anglo-Saxon University, each one with its own advantages and disadvantages:

- *Differences in power distance between Professors and Students*
- *Differences in importance between every day homework and single exams*
- *Differences in the learning approach: rational versus empirical*
- *Differences in the students composition*

And not only on the academic side:

- *change in my diet, the "omnipresent" car, a different society approach, easy problem solving*

The above “differences” were not perceived negative at all. In fact, when we were given a team assignment or during discussions about specific tasks or even general topics, the different points of view and approaches always added value to the final result. It was as synergic effect that is now very present in worldwide international corporations who tend to mix up team players with different backgrounds and cultures to achieve the best results.

2.3 International Exchange Program Outcome

My nine months in Daytona Beach and, in general, an international experience are able to change your life attitude.

It is not only the hard skills you are able to develop in a new environment:

- *Mastering a New language*
- *Learning new methods, subjects and tools*

But it is mostly the social part of an international experience that primarily develops and genuinely re-shapes the understanding and awareness of your surroundings. An international experience truly enhances your soft skills especially (at least in my case) in the following areas:

- *International mindset: reconsider traditional schemes by adding new ones*
- *Multi-cultural: improves tolerance and acceptance towards what is difference*
- *Problem-solving: makes you think twice or consider other ways of when approaching the problems*
- *Uncertainty management: improves self-confidence when dealing with uncertainty*
- *Individual awareness: makes you understand better your limits and your own personality*

2.3 Years after University

After my return to Spain and having completed my Aerospace Engineering degree, I considered different professional options both at national and international level. My final decision was to carry on with an international experience and I applied for the young leadership program in the Aerospace and Defense group Finmeccanica. I moved to Rome on 2010.

The program, called FHINK Master’s, put together 26 young graduates from different parts of the world: Russia, Italy, China, Brazil, Spain, India, UK … We all lived and worked together during 9 months while going through different Master’s modules of Finance, Program Management, Innovation, etc. It was a second opportunity to train my international adaptability.

The FHINK program, as big corporations commonly do today, required a minimum 6 months experience abroad to be considered a candidate. This, again, reinforces the fact of how companies and organizations are moving towards mobility and international experience prerequisites in their applicants. At the present time, going through international education programs is vital for university students if they wish to access efficiently to the labor marketplace.

When I completed the courses required by the FHINK program, Finmeccanica assigned me a Program Management position in the helicopter manufacturer AgustaWestland based on the Milan area.

2.3 Present

I work today as a Program Manager for Interiors and Mission Equipment development in a new helicopter platform AW is lunching to the market, the AW169 helicopter. My current position in the company involves a tremendous effort of internal and external coordination and communication with the program team, suppliers, customers and top management.

Most of the engineering developments requested by our marketing and customers depend on the good alignment between our internal technical functions and vendor partners to achieve good results. In my job, it becomes critical to deal effectively with vendors and to understand customer expectations no matter where they come from.

For example, the initial AW169 helicopter customers come from Spain, Italy, Japan, UAE and Australia and each of them brings to the table a different work approach. The flexibility and understanding of their cultural differences is important to keep under the control the project and successfully deliver within the agreed deadlines and quality.

Every day at work is a continuous learning path for me and the little international exposure I acquired in the last years makes it slightly easier and enjoyable. In such a globalized industry as the helicopter production (there are only four big manufacturers in the world) the opportunity of having gone through an international education program definitely pays off when it is necessary to get the job done and lead international teams.

4 Summary

In an engineering environment, international teams are everyday more present due to its synergic nature. An international experience exposure, during university or professional life, is highly beneficial to develop a mindset and multicultural skills necessary to be efficient and integrated within international teams. In my personal experience, the opportunity of a university exchange program in the US has given a contribution to be more competitive and efficient in the engineering corporate world as well as be more comfortable when dealing with international individuals.

5 Acknowledgements

Thanks to the UPV and the ETSID school for their opportunity and continuous support during university years that directly and indirectly have allowed me to explain the above experience and find a motivating professional life.

References

N.A.

THE ERASMUS STUDENTS EXCHANGE PROGRAMME. PIONEERING THE WAY: A PERSONAL EXPERIENCE

Dr. CENG MIET González-García, Joaquín

Round table: International Experience Testimonial

Abstract

The Erasmus students exchange programme. Pioneering the way: a personal experience.

It is important to understand the Spanish historical and political context since Prince Juan Carlos took the oath as king of Spain on November 22, 1975, and a peaceful transition to democracy began. The Spanish Cortes passed a new Constitution in October 1978, it was approved by popular vote in December that year and Spain became a democratic parliamentary monarchy.

In 1977 Spain applied for EU membership after General Franco´s death and joined it on January 1986 in the third enlargement.

The Erasmus student exchange programme was established in 1987 and in the beginning the Erasmus Student Charter was at a highly experimental state.

In this context instruments such as the European Credit Transfer and Accumulation System (E.C.T.S.) were simply a thing of the future.

In fact even Erasmus official statistics were produced from the year 2000/01 onwards.

The Bologna accords created the European Higher Education Area under the Lisbon Recognition Convention and the Bologna Declaration was signed in as late as1999.

It was just right in the beginning of the Erasmus students exchange programme when suddenly the idea of a double degree award between partners academic institutions sparked in the mind of the visionary and great leader Dean “Directorix” Dr. Enrique Ballester and that was about to be put to the test for the very first time.

It was back in October 1990 when a group of six Spanish students from the former School of Technical Industrial Engineers of Polytechnic University of Valencia joined Middlesex Polytechnic Faculty of Engineering, Science & Mathematics in Bounds Green Road, London, England as a final year students of the B.Eng (Honours) Electronic Engineering course.

The challenge and feeling for us was that of an explorer in an unknown –and possibly hostile-territory however we all firmly believed that when there is a will there is always a way so we were determined to face the challenge and managed to quickly adapt and integrate within the final year BEng cohort of some ninety students at Middlesex Polytechnic overcoming the English language difficulties.

The sense of responsibility and pressure was high among us since we felt like Spanish ambassadors for our Faculty, University and even country and we knew that exchange opportunities for future students might very well depend upon our performance.

After a full academic year of really hard work our abilities, attitudes, and grasp of fundamentals reflected credit on our Spanish education and we all graduated with great academic and social success since we “the Spanish Team” were well liked by our peers and the academic staff.

We now can proudly say that after our successful graduation a very fruitful collaboration between Middlesex University and Polytechnic University of Valencia has been established ever since.

This achievement could never had been possible without the helping hand, back up and support of both academic institutions and our families and I would like to take this opportunity to express my deepest gratitude and to voice a very special word of appreciation to them.

I can still remember the visit that Dean Dr. Enrique and other professors from our home Faculty paid to us in London and the delicious Aberdeen Angus Steaks we all shared for dinner one night in Leicester Square!!.

In life it is very easy to find advantages and disadvantages in everything we do however in this experience I am unable to find any of those disadvantages.

It was for me a great eye opening experience that allowed me to know and understand the English culture, to polish my command of the English language and to live and work in a highly multicultural environment totally unknown at the time in Spain since the country had been almost cut off from the rest of the world during Franco´s dictatorship.

The world today is a very much globalized place and has changed enormously in these almost 25 years that have past. Understandably this retrospective view could even put a smile on the face of today´s students which are very much used to enjoying a fully fledged and well organized Erasmus students exchange programme, nowadays integrated within the European Long Life Learning Programme.

I am very glad to witness that our students can still benefit today from our pioneering effort and success and I would like to remind them that they also have the responsibility for making a success of every opportunity offered to them especially more even so in these very difficult present times

It is in the hands of the newer generation of high caliber young men and woman to lead the way for fostering the cooperation between countries in the European Community and helping to make the world a better place to live in.

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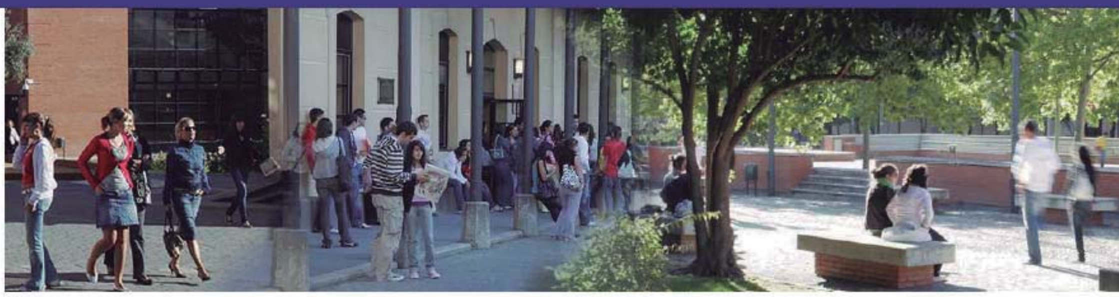
Alvaro Escribano, Vice-Chancellor of International Relations, UC3M,



Internac. Engineering Educ. Valencia Global 2014, June 19th

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INTERNATIONAL STUDENT MOBILITY IN SPAIN AND AT UC3M

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EU UNIVERSITY GOALS

- **European Universities should think globally**
- **European Universities should train students to to work anywhere in the world**
- **European Universities should be attractive for international students.**

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International Mobility of Students in Spain

INCOMING

Colombia	5,792
Peru	3,864
Morocco	3,514
Italy	3,116
Argentina	3,005
Mexico	2,933
Ecuador	2,825
Portugal	2,561
Venezuela	2,550
Brazil	1,969
Chile	1,881
France	1,868
Romania	1,807
Germany	1,439
TOTAL INCOMING	**56,018**

OUTGOING

United Kingdom	5,617
Germany	4,144
France	4,129
United States	3,936
Portugal	855
Austria	610
Switzerland	541
Holy See	386
Italy	386
Ireland	249
Sweden	238
Netherlands	223
Brazil	199
Australia	165
TOTAL OUTGOING	**22,919**

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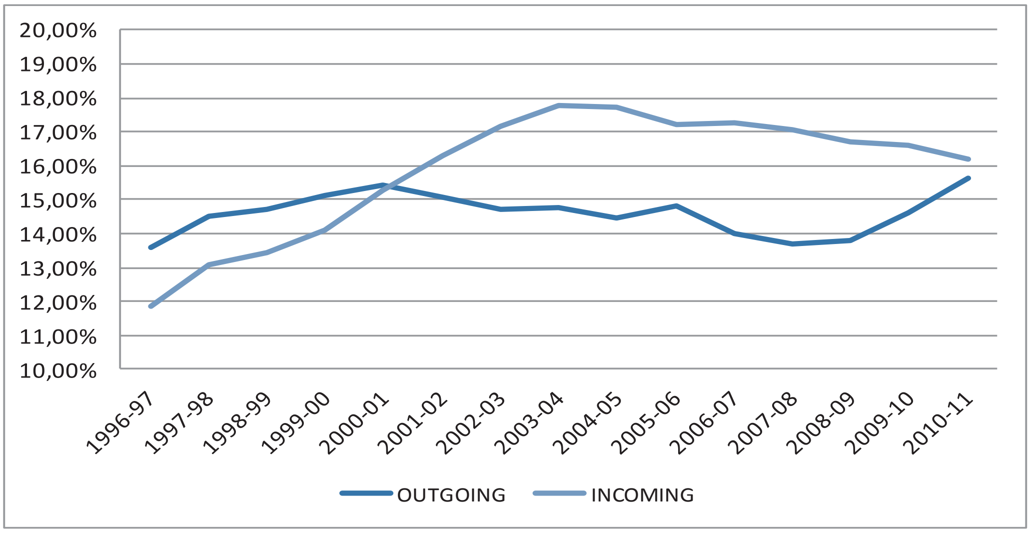
STUDENTS SENT AND RECEIVED BY SPAIN OVER THE TOTAL OF ERASMUS STUDENTS OF THE EUROPEAN UNION



Sources: European Commission and European Office of Erasmus Programme

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Erasmus student exchange flows, by participating country, 2010-11

Students: European

4

Source: European Commission, Erasmus Stastistics

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ERASMUS OUTGOING 2010-11				
País		Erasmus	Estudiantes	% Erasmus/Estudiantes
ES	España	36.183	1.878.973	1,93%
PT	Portugal	5.964	383.627	1,55%
AT	Austria	5.216	350.190	1,49%
CZ	República Checa	6.433	437.354	1,47%
NL	Países Bajos	8.590	650.905	1,32%
SI	Eslovenia	1.480	114.873	1,29%
IT	Italia	22.031	1.980.399	1,11%
PL	Polonia	14.234	2.148.676	0,66%

ERASMUS OUTGOING 2010-11		
País		% Erasmus/Graduados
ES	España	10,7%
IT	Italia	10,2%
AT	Austria	9,1%
NL	Países Bajos	8,9%
PT	Portugal	7,6%
SI	Eslovenia	7,5%
CZ	República Checa	6,4%
PL	Polonia	2,3%

Fuentes: Comisión Europea y Eurostat. Elaboración propia.

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Top 10 European Universities in relative terms of Internat. Mobility: ERASMUS 2010-11

ERASMUS OUTGOING 2010-11						
Posición[1]	País		Universidad	Estudiantes[2]	Erasmus[3]	% Erasmus[3]/[2]
9	CZ	República Checa	UNIVERZITA KARLOVA V PRAZE	18.000 (*)	1.042	5,79%
22	NL	Países Bajos	UNIVERSITEIT MAASTRICHT	14.497	818	5,64%
29	ES	España	UNIVERSIDAD CARLOS III DE MADRID	15.618	722	4,62%
1	ES	España	UNIVERSIDAD DE GRANADA	57.142	2.114	3,70%
5	ES	España	UNIVERSIDAD POLITÉCNICA DE VALENCIA	35.166	1.269	3,61%
17	ES	España	UNIVERSIDAD AUTÓNOMA DE MADRID	25.318	890	3,52%
20	ES	España	UNIVERSIDAD DE VALLADOLID	24.109	838	3,48%
10	ES	España	UNIVERSITAT POLITÉCNICA DE CATALUÑA	29.623	1.028	3,47%
28	PT	Portugal	UNIVERSIDADE DO PORTO	22.480	739	3,29%
15	ES	España	UNIVERSIDAD DE ZARAGOZA	29.860	895	3,00%

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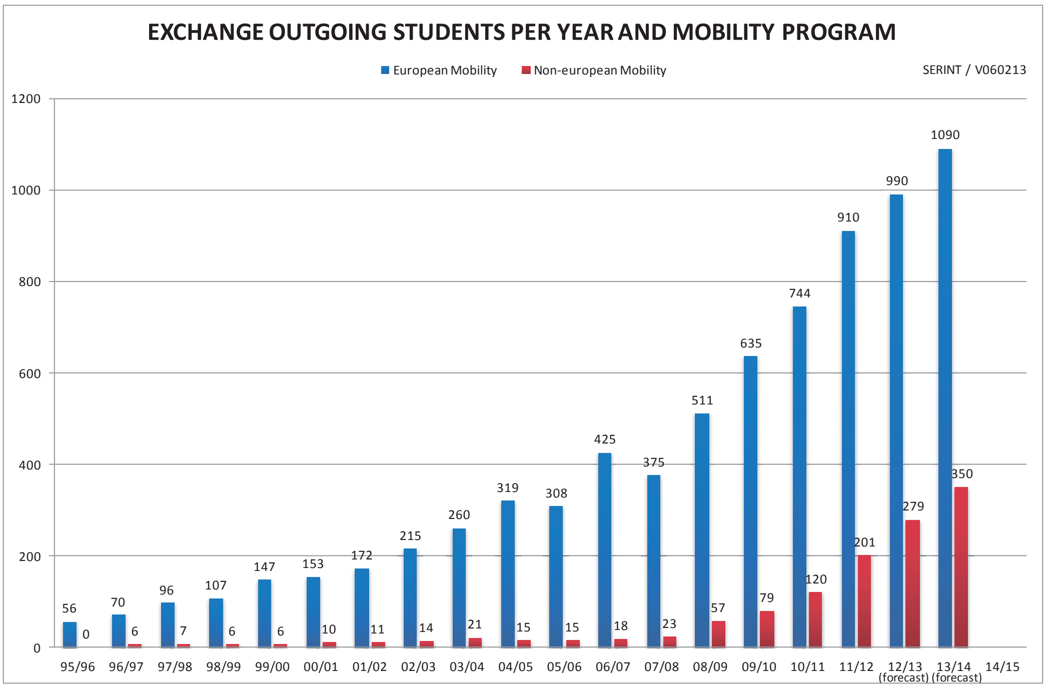

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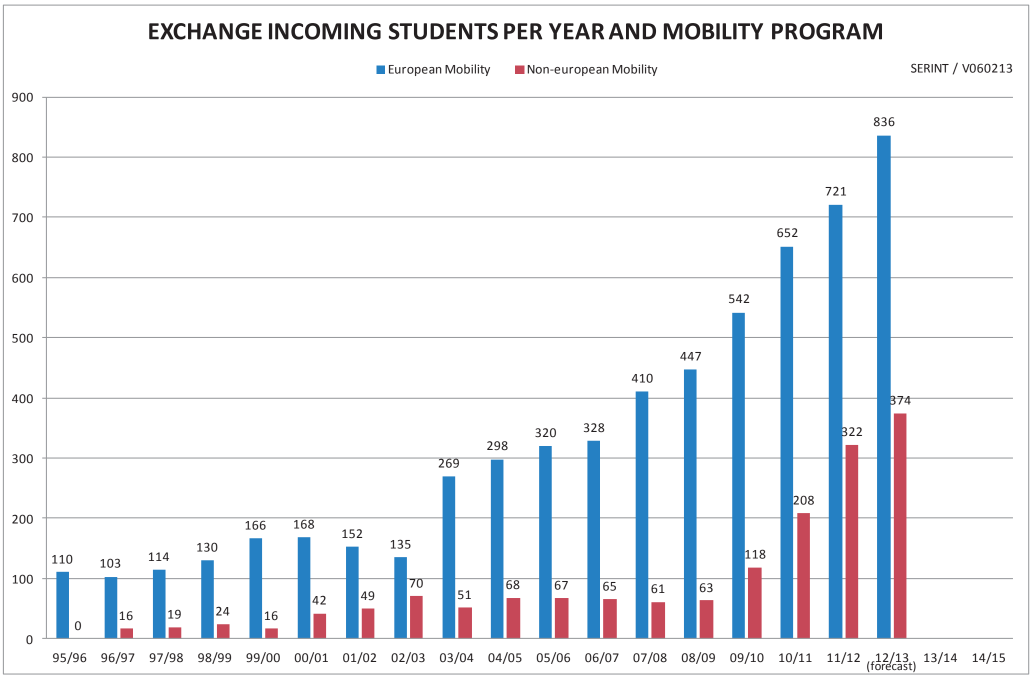

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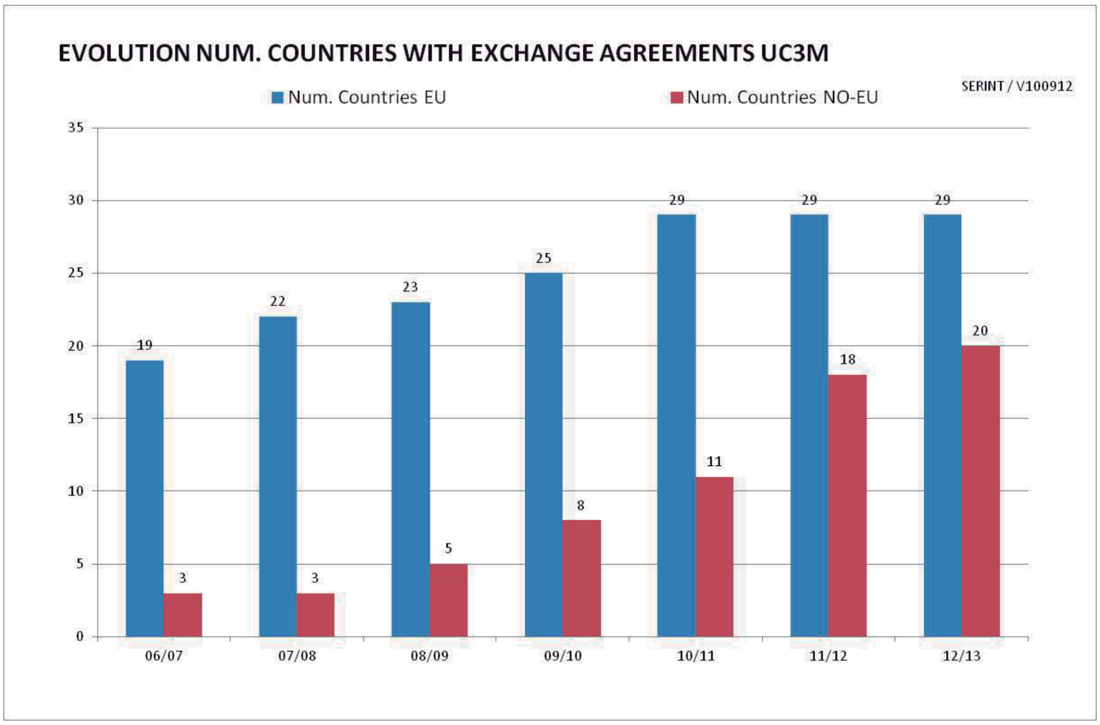


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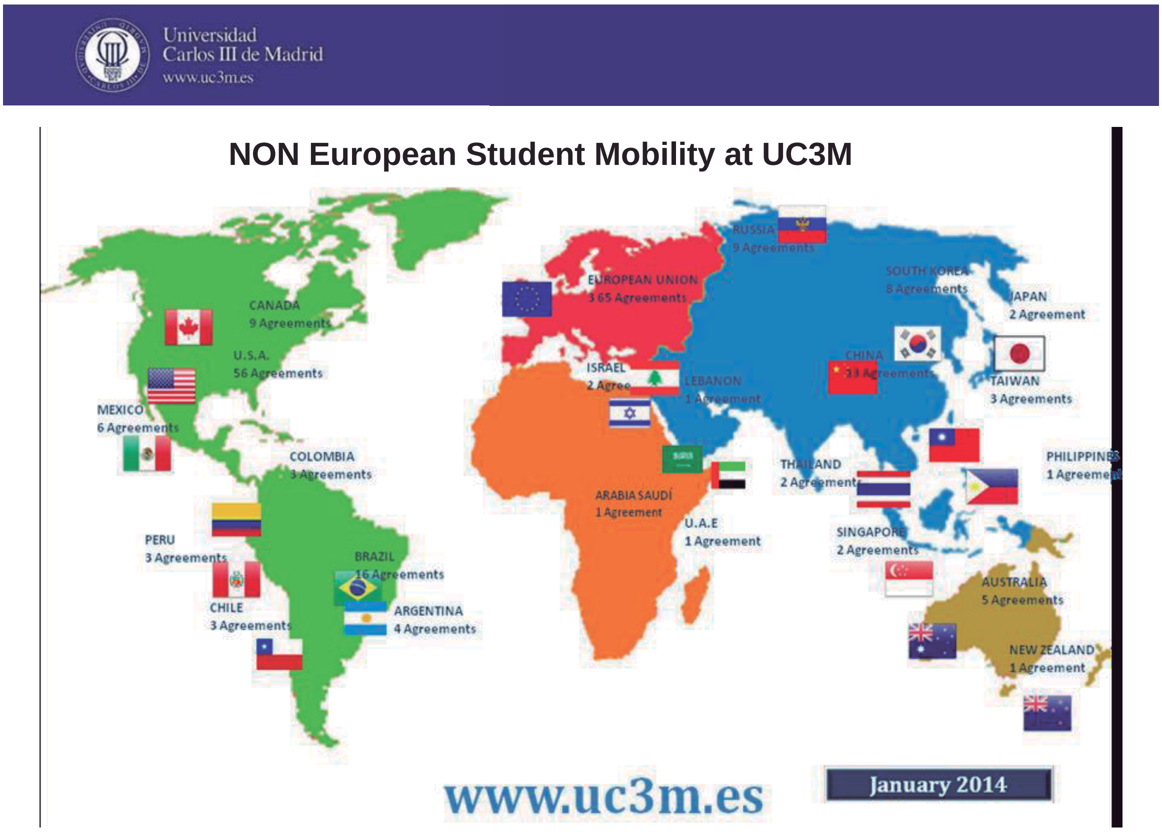
European Student Mobility at UC3M
Iceland 2Univ
Finland 11 Univ
Norway 6Univ
Estonia 2Univ
Sweden 11 Univ
Latvia 3Univ
United Kingdom 34 Univ
Denmark 6 Univ
Lithuania 4 Univ
Ireland-Eire 8 Univ
The Netherlands 14 Univ
Poland 16 Univ
Germany 48 Univ
Belgium 12 Univ
Czech Republic 5 Univ
Slovakia 2Univ
Austria 7 Univ
France 64 Univ
Switzerland 13 Univ
Slovenia 1 Univ
Hungary 3 Univ
Romania 6 Univ
Croatia 2Univ
Bulgaria 1 Univ
Portugal 15 Univ
Italy 51 Univ
Turkey 13 Univ
Universidad Carlos III de Madrid
Greece 5Univ
Cyprus 2Univ
January 2014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NON European Student Mobility at UC3M
RUSSIA
9 Agreements
EUROPEAN UNION
365 Agreements
SOUTH KOREA
8 Agreements
JAPAN
2 Agreement
CANADA
9 Agreements
U.S.A.
56 Agreements
ISRAEL
2 Agree
LEBANON
1 Agreement
CHINA
33 Agreements
TAIWAN
3 Agreements
MEXICO
6 Agreements
COLOMBIA
3 Agreements
THAILAND
2 Agreements
PHILIPPINES
1 Agreement
ARABIA SAUDÍ
1 Agreement
U.A.E
1 Agreement
SINGAPORE
2 Agreements
PERU
3 Agreements
BRAZIL
16 Agreements
AUSTRALIA
5 Agreements
CHILE
3 Agreements
ARGENTINA
4 Agreements
NEW ZEALAND
1 Agreement
www.uc3m.es
January 2014

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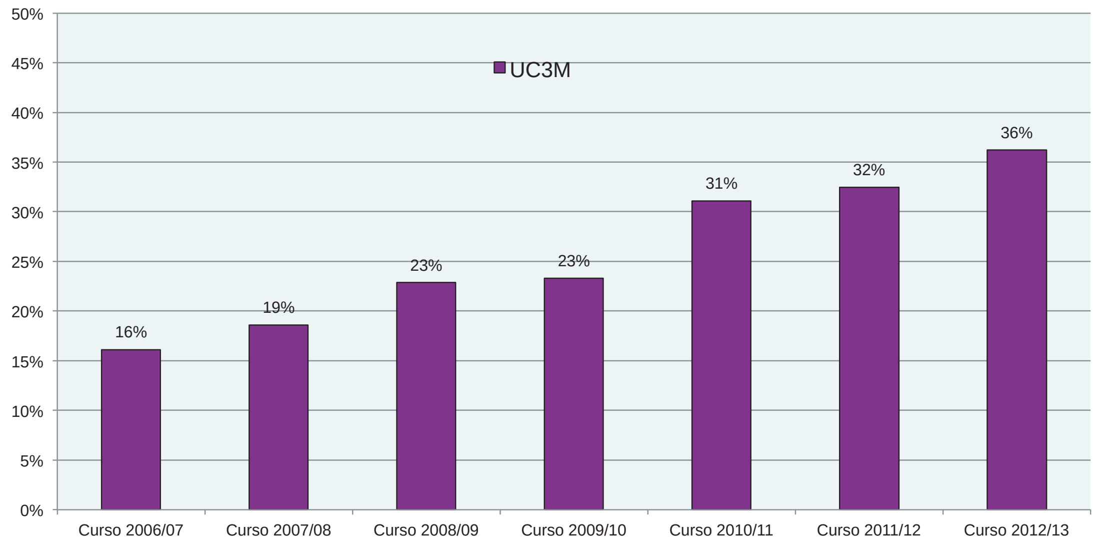
Evol. of % Undergraduate Students with some Internacional Mobility (from 6 months to 2 years) at UC3M



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Placement of Undergraduate students at UC3M

- **In 2011, 88% of undergrad stud from UC3M found a job within ayear after graduation**
- **Students participating in international mobility programs find job offers earlier.**

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Welcome Events at UC3M

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INTERNATIONAL INCOMING STUDENTS AT UC3M

Mobility programs	Fall Semester	Spring Semester
Erasmus	630 students	315 students
Non-European Mobility	220 students	250 students
Hispanic Course Studies (USA)	205 students	150 students
Freemovers	30 students	30 students
TOTAL (1.603 students)	**1.085 students**	**518 students**

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WELCOME WEEKS at UC3M

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
August					Picnic Retiro Park 150 students.		
September	Welcome Event	Picnic Retiro Park (250 students)	Guided city tour (Madrid) (60 students)	Welcome Party (600 students)	Language exchange (60 students)	City Race (150 students)	Trip to Toledo (170 students)
	Sports Social Erasmus (50 students)	Tour Madrid (60 students)	Show Flamenco (55 students)	Weekly meeting point. (200 students)		Pool Party (600 students)	Gymkhana (50 students)
		Spanish Dinner			Trip to Valencia		

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GOAL of UC3M:
Become a Bilingual University

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Carlos III de Madrid
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4 POLICIES TO BECOME A BILINGUAL UNIVERSITY

1) OFFER UNDERGRADUTE AND GRADUATE DEGREES in English, Spanish and Bilingual

2) Faculty with Ph.Ds from good Universities of the USA, EU, etc.

3) Bilingual Administrative Staff (English/Spanish)

4) Bilingual Students (English/Spanish)

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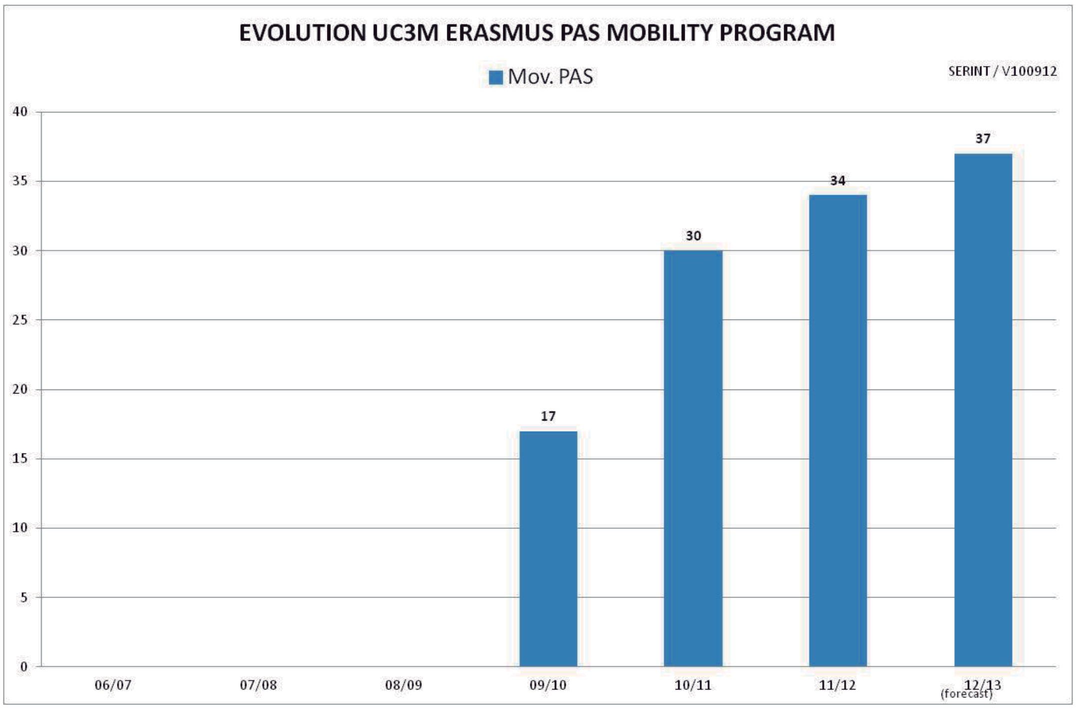

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UC3M, Undergraduate in English or BILINGUAL (50% in English) (2012-2013)

5 BACHELOR´S DEGREES GIVEN ONLY IN ENGLISH (100% IN ENGLISH)
Bachelor´s Degree in Business Administration
Bachelor´s Degree in Economics
Bachelor´s Degree in Aerospace Engineering
Bachelor´s Degree in Biomedical Engineering
Bachelor´s Degree in Computer Science and Engineering (1 minor)
12 BACHELOR´S DEGREES WITH A BILINGUAL OPTION (50% IN ENGLISH)
Bachelor´s Degree in Finance and Accounting
Bachelor´s Degree in Electrical Power Engineering
Bachelor´s Degree in Automation and Industrial Electronics Engineering
Bachelor´s Degree in Mechanical Engineering
Bachelor´s Degree in Audiovisual System Engineering
Bachelor´s Degree in Communication System Engineering
Bachelor´s Degree in Telematics Engineering
Bachelor´s Degree in Computer Science and Engineering (2 minors)
Bachelor´s Degree in Film, Television and Media Studies
Bachelor´s Degree in Journalism
Bachelor´s Degree in Industrial Tecnologies
Bachelor´s Degree in Telecommunication Tecnologies

11 BACHELOR´S DEGREES WITH SOME SUBJECTS IN ENGLISH (less than 25% in English)
Bachelor´s Degree in Law
Bachelor´s Degree in Statistics and Business
Bachelor´s Degree in Arts and Humanities
Bachelor´s Degree in Library and Information Science
Dual Degree in Law and Business Administration
Dual Degree in Law and Politics
Dual Degree in Law and Economics
Dual Degree in Politics and Sociology
Bachelor´s Degree in Politics
Bachelor´s Degree in Employment and Labour Relations
Bachelor´s Degree in Sociology

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Masters in English (I) or Bilingual (B)

Economics and Business (11)

* Business Administration and Quantitative Methods (I)
* Business Administration MBA (I)
* Economic Analysis (I)
* Economic Development and Growth (I)
* Economic Development and Growth (Erasmus Mund.) (I)
* Executive Master in Financial Analysis (I)
* Finance (I)
* Human Resources Management (I)
* Industrial Economics and Markets (I)
* Management (I)
* Marketing (I)

Law (1)

* European Union Law (B)

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Masters and Doctorates in Inglés (I) or Bilingual(B) : Masters in Ingineering (8)

- Aircraft Systems Integration (I)
- European Master in Nuclear Fusion Science and Engineering Physics (Erasmus Mundus) (I)
- Informatics Engineering (B)
- Mathematical Engineering (B)
- Robotic and Automatization (I)
- Telematics Engineering (I)
- Multimedia and Communications (I)

Doctorados en Inglés (4)

- Business Administration and Quantitative Methods (I)
- Economics (I)
- Economic History (I)
- Telematics Engineering (I)

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INTERNATIONAL STUDENTS

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International students as a proportion of all students within higher education systems, 2010

Source: OECD (2012) Education at a Glance 2012

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TWO DIFFERENT MODELS OF INTERNATIONAL MOBILITY: UK and SPAIN

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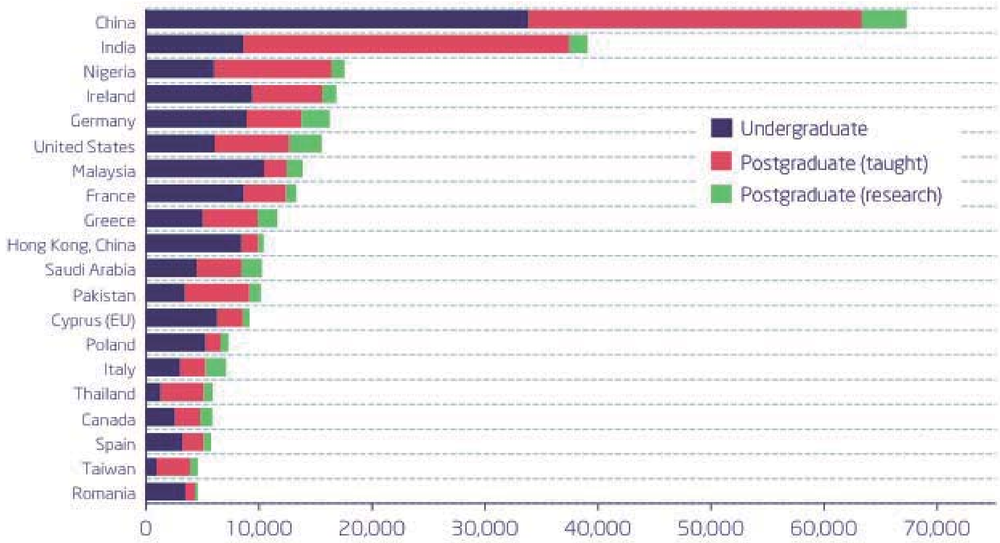
Top 20 countries of origin for non-UK students at UK higher education institutions, by level of study, 2010-11



Source: HESA (2012) Students

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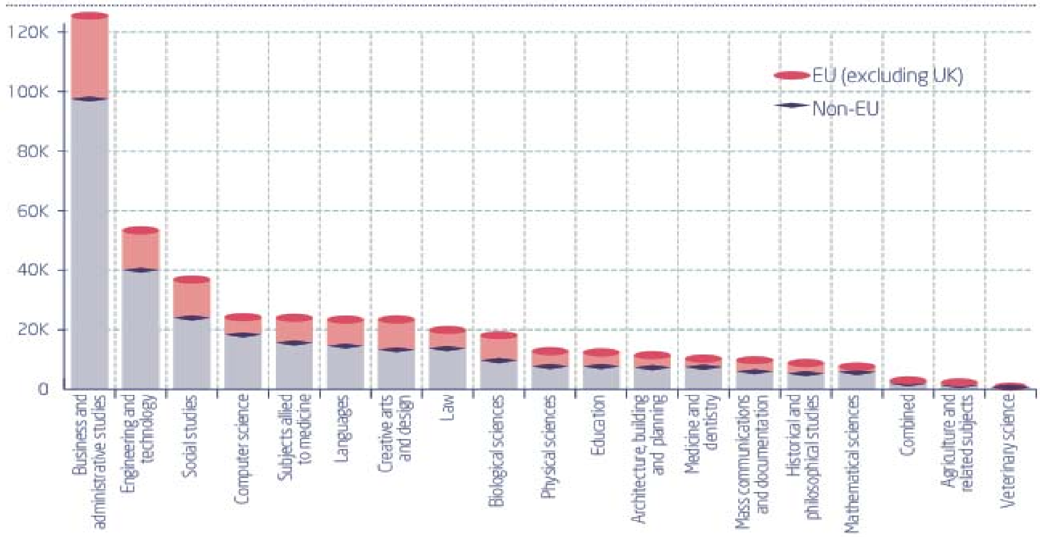
EU (excluding UK) and non-EU students at UK higher education institutions, by subject area, 2010-11



Source: HESA (2012) Students

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ECONOMIC RELEVANCE OF INTERNACIONALIZATION: CALIFORNIA

- **¿DOES THE INTERNATIONALIZATION OF UNIVERSITIES HAS ANY ECONOMIC IMPACT?**
- **¿ARE SCHOLARSHIPS IMPORTANT FOR INTERNATIONALIZATION?**

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California

Total Number of Foreign Students:		102,789
Part 1: Net Contribution to State Economy by Foreign Students (2011-12)		
Contribution from Tuition and Fees to State Economy:		$1,897,716,000
Contribution from Living Expenses:		$2,241,991,000
Total Contribution by Foreign Students:		$4,139,707,000
Less U.S. Support of 23.7%	-	$983,150,000
Plus Dependents' Living Expenses:	+	$58,017,000
Net Contribution to State Economy by Foreign Students and their Families:		***$3,214,574,000***

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Two different Models of Univ. Internacionalization: UK AND SPAIN

1) UK

1.1) LOW international mobility (ERASMUS and Non European)

1.2) HIGH attraction to study full Undergraduate and Graduate degrees

2) SPAIN

2.1) HIGH international Mobility (ERASMUS) and Low Non European mobility

2.2) LOW attraction to study full Undergraduate and Graduate degrees

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GOAL TO REACH NEW MARKETS: POSITION SPAIN AS A COUNTRY WITH DEGREES IN ENGLISH AND BILINGUAL

Alliance of 4 Universities (A-4U)

- *Universitat Autònoma de Barcelona*
- *Universidad Autónoma de Madrid*
- *Universidad Carlos III de Madrid*
- *Universitat Pompeu Fabra* in Barcelona

Universidad Carlos III de Madrid
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QS WORLD UNIVERSITY RANKINGS

Top 10 Univ. under 25 years old (2 are Spanish)

Under 25	2011	Institution Name	Country Territory	Clasification				Est. Year
RANK	RANK			SIZE	FOCUS	RES.	AGE	
8	308	Universitat Pompeu Fabra	ES	M	FO	VH	2	**1990**
10	347	**Universidad Carlos III de Madrid**	ES	L	FO	VH	2	**1989**

Universidad
Carlos III de Madrid
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QS WORLD UNIVERSITY RANKINGS

Top 50 Universities under 50 years old: A-4U

Under 50	2011	Institution name	Country/ Territory	Clasification				Est. Year
RANK	RANK			SIZE	FOC.	RES.	AGE	
14	194	Universitat Autónoma de Barcelona	ES	L	FC	VH	3	1968
19	222	Universidad Autónoma de Madrid	ES	XL	FC	HI	3	1968
39	308	Universitat Pompeu Fabra	ES	M	FO	VH	2	1990
50	347	Universidad Carlos III de Madrid	ES	L	FO	VH	2	1989

Universidad
Carlos III de Madrid
www.uc3m.es

Conclusion

OPTIMAL UNIVERSITY MODEL FOR THE UC3M IS THE MIXED MODEL

1) HIGH international Mobility (ERASMUS) and Non European mobility

2) HIGH attraction to study full Undergraduate and Graduate bilingual degrees

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Thank you!

History of Cooperation between UPV (ETSID) and Mie University Japan with Mechatronic Research, Education and More

JUNJI HIRAI

Professor & Head of International Affairs, Graduate School of Engineering, Mie University hirai@elec.mie-u.ac.jp

Key Areas: Education and Research
Keywords: Academic collaboration, Global internship, Mechatronics

Abstract

For some contribution to VG 2014, this paper describes the history of academic collaboration between UPV and MIU (Mie University, Japan) up to today from 20 years ago first, and refers to several typical international events taken place so far. Then, the paper introduces the possible contribution from MIU to UPV (ETSID, in particular) in the areas of Mechatronics and Lean Manufacturing Management both of which were uniquely initiated in Japan.

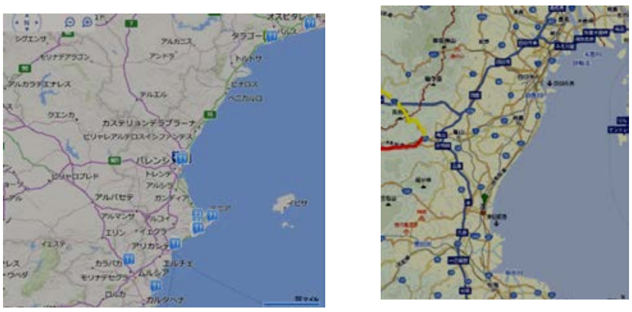
1 Introduction

University Corporation Mie University, Japan (abbreviated as MIU) is a national university founded about 65 years ago and located almost in the center of mainland Japan. MIU has 5 faculties including Engineering one and 6 graduate schools with the number of undergraduate and graduate students which amounts to 7300.

Regarding the international affairs function of MIU, there are two levels. total-university level and faculty level as in UVP. The author of this paper is the contact point to UPV of the total university level and simultaneously the head of international affairs of Engineering Faculty level. From the standpoint of such functions, the author tries to narrate the history and very-near-future scenario of the collaboration between the two institutions, by leaving the purely technical issues to be detailed elsewhere in the other literatures.

2 History of friendship between MIU and UPV

Everything started from the visit of an UPV student to Mie by a bicycle in 1990 (24 years ago). Prof. Tomioka of MIU opened the first door for our collaboration on that occasion, by introducing him to Mie Governmental office, which lead to the sister province-ship between Valencia and Mie (in 1992).



Valencia-Province Mie-Pref.

Location of Mie Univ. in Japan

Geographical resemblance (Valencia and Mie (Tsu))

2.1 Academic collaboration & student exchange agreements (first concluded in 1997 and being updated for every 5 years)

AGREEMENT ON ACADEMIC COOPERATION AND EXCHANGE
between
MIE UNIVERSITY, JAPAN
and
UNIVERSIDAD POLITECNICA DE VALENCIA, SPAIN

UNIVERSIDAD POLITECNICA DE VALENCIA

The President of Mie University, Tsu City Japan and the Rector of Universidad Politecnica de Valencia, Camino de Vera, s/n, Valencia Spain hereby agree to encourage and promote academic cooperation and exchange between their two respective universities. The scope and procedural details of the Agreement are delineated below:

1. The two universities agree to encourage and promote the following academic and educational activities:
   (a) Exchange of faculty and staff members
   (b) Exchange of students
   (c) Exchange of publications and relevant academic and educational information
   (d) Joint research, lectures and symposia
   (e) Other activities such as deemed appropriate by mutual consent
2. Financial arrangements and stipulations concerning, for example, the exchange of students, faculty and staff members, are to be specifically detailed in separate addenda.
3. Modifications and/or amendments to this Agreement can be executed by mutual consent.
4. Should either university wish to terminate this Agreement, written notice should be given six (6) months in advance of the desired termination date.
5. Only the English version of this Agreement has binding effect. English will be the language used by both parties in the relations that derive from this agreement.

IN WITNESS THEREOF, the parties hereto hereby execute this Agreement.

Nagayasu Toyoda
Nagayasu Toyoda Md., Ph. D.
President
Mie University
Japan
Dated this 21 day of December, 2007

Juan Julia Igual, Ph. D.
Rector
Universidad Politecnica de Valencia
Spain
Dated this 21 day of December, 2007

After this conclusion the following collaborative process has been promoted step by stso far.

- ○ Frequent student exchange between the two institutions first in the field of architecture.
- ○ Expansion of student exchange to the other fields, electrical, mechanical and management, recently the bio-resources as well.
- ○ Contribution by MIU to the start of Mechatronics Master Course in ETSID.

2.2 International events held in MIU with the delegate from UPV

1) 60years' anniversary ceremony for foundation of MIU (2009).
   UPV Dir. Prof Luis Manuel Sanchez Ruiz and ETSID Vice Dean Dr Mohamad Houcine joined the event, the former making ceremonial speeches. Thereafter they visited Mie Prefectural Government Office with the UPV students staying in MIU.

Speech of Prof. Luis Manuel Sánchez Ruiz, Director of UPV Programs Office with US and Asia, on occasion of the sixtieth Anniversary of Mie University

Minasan, konnichiwa.
I would like to thank the President of MIE University, Atsumasa Uchida, Mie University and Engineering Faculty to their invitation for UPV, *Universidad Politécnica de Valencia*, to join the celebration of the 60th Anniversary of Mie University. As Director of the UPV Programs Office with US and Asia, I`m deeply honored to be here with you on behalf of the Rector of UPV on occasion of this celebration.

It could be said, our relationships were marked from the ancient times, when Japan was created by Gods Izanagi and Izasami. Maybe it was not a casual fact that the geographical shape of Mie Prefecture and Valencia Region are exactly the same. At that time, the future was already shown, and Gods gave a clue and some signs about their wishes regarding we could develop long and fruitful relationships between both areas.

2) International symposium hosted by the Graduate School of Eng. of MIU (Dec. 2011).
   Prof. Luis Manuel Sanchez Ruiz attended the symposium and contributed to the discussion on the Topic "University Social Responsibility (USR) "

Attn: All VIPs attending International Symposium for Sustainability Held by Eng. Faculty, MIU on 1st. and 2nd Dec. 2011

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Dept. Eng. Mie Univ.
Also responsible for
all the contents below:

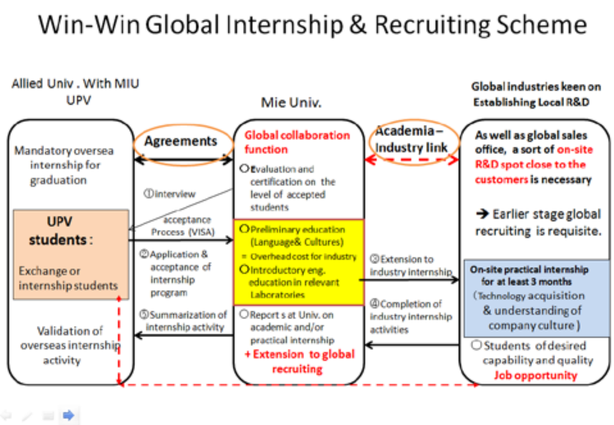
Questionnaire on University Social Responsibility

The concept on CSR (Corporate Social Responsibility) was established over 15years ago especially as one of the key item in the field of project management. Thereafter and nowadays, almost all the companies are requested to state publicly its dogma on its mission statement.

In these years, furthermore in extension from that of CSR, the concept of USR has been created and collecting much attention inside/outside universities in relation to the requested autonomy of not only private but also public ones, as universities are requested to follow the higher publicity than that of the company. Most of the University will be no more stand-alone as an "Ivory tower" as ever.

Friendly atmosphere welcoming UPV students in the Labo. of MIU.

3 Proposal of global Internship- and recruitment scheme based on the academic agreements. (Win-Win and All-Win scheme) 2012-.



YAMAHA: Jeronimo, CANON: Santiago, MIE Electric: Gari , Sergio y Javier
AISIN-AW: Sergio (Only planned), SUMITOMO: Sergio, Santiago, FUJI: Sergio

3.1 Noteworthy stories for UPV (including ETSID) students above all

① Jeronimo de Vargas-Machuca Gabande

succeeded in getting a job in extension from the student exchange (one year stay in Mechatronics Labo. of MIU) and global internship in Yamaha offered by MIU. He moved back to work in Omron Europe, Madrid.

Presentation of project done by UPV student in Mie Univ.

UNIVERSIDAD POLITECNICA DE VALENCIA

HELICOPTER GUIDANCE

Jerónimo de Vargas-Machuca Gabandé

June 25, 2009

VTOL comes from *Vertical Take Off and Landing*, and it refers to flying vehicles. This characteristics make them very suitable to fly in urban areas, where the runways needed for most of the fixed wings are prohibited. They are mostly used for fast transporting and to reach places with difficult access.

This project proposes a complete guidance system for a VTOL, using GPS for location, and a fusion of computer vision system and range sensors for landing maneuvers.

Unaugmented GPS signals are accurate now a days around 3 to 5 meters deviation, but enhancements are being made to make it 1 meter reliable in the near future. This means that we can approach the VTOL to a 1m distance of the landing zone with the coordinates of the GPS. For safeness, range sensors are installed to avoid possible obstacles.

Landing maneuvers are performed with range sensors and computer vision. Landing zone's patterns are not detectable with any kind of range sensors, as they are usually painted, so we use computer vision for the exact location and then range sensors for height measures and obstacle avoidance.

Even though this project is directed to the helicopter, it can be easily extended to other VTOLs (Vertical Take Off and Landing) vehicles. The reason why we address this project to helicopters is because now a days is the most used VTOL vehicle.

② Santiago Peiro Turpin

was successfully hired right after interview by Ford Valencia, in reflection from his impressive talk on experiences in global internship at Japanese companies as above.
.

③ Javier Navarro Ferrand（Video message）

is now still living in Mie (over 5 years) being fascinated by Japanese cultures, after his stay in MIU for student exchange and internship activities.

4 Contribution to the start of Mechatronics Master Course in ETSID in collaboration with Prof. Eduardo Garcia Breijo, 2013


Inicio UPV :: Máster Universitario en Ingeniería Mecatrónica

Desarrollo y funcionamiento del título

- Plan de estudios
- Competencias
- Matrícula
- Movilidad
- Suplemento Europeo al Título
- Progreso y resultados de aprendizaje
- Calendario de implantación

Normativa

- Acceso y admisión (general)
- Acceso y admisión (particular)
- Normativa de permanencia
- Normativa de reconocimiento y transferencia de créditos

Indicadores

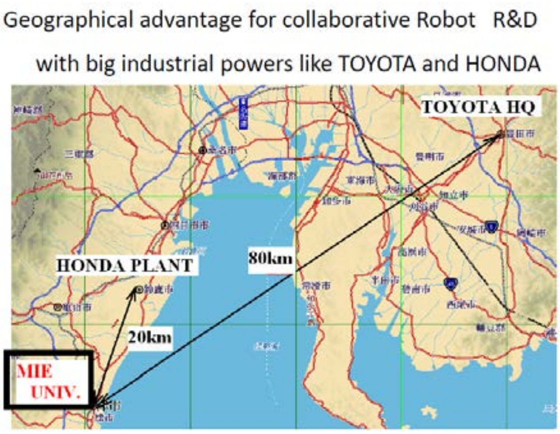
Sistema Interno de Gestión de la Calidad

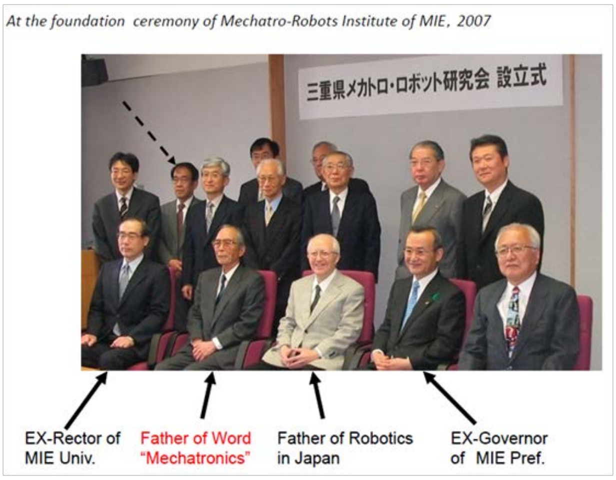
- Descripción

Introducción

La Ingeniería Mecatrónica representa la fusión de Tecnologías como el control, la mecánica, la electricidad, la electrónica o la informática que permiten abordar los retos en Ingeniería que suponen las nuevas máquinas inteligentes. Es una elección natural para explicar un proceso que tiene como propósito, desde su origen, la creación de productos avanzados y sistemas de ingeniería que están indisolublemente vinculados por la combinación sinérgica de tecnologías mecánica, electrónica, control e informática.

Seguir leyendo





Short Lecture on " Mechatornics"

by

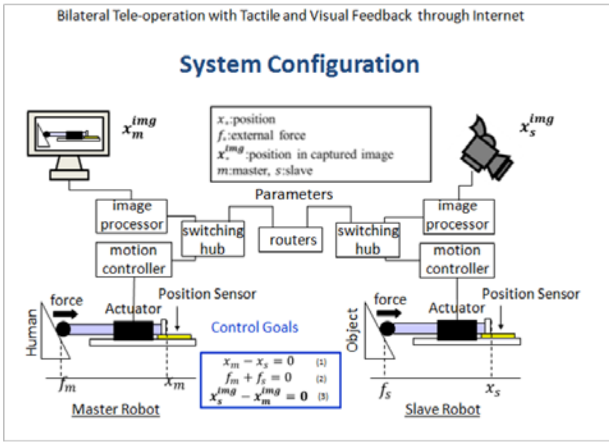
Dr. Junji Hirai, Professor and Head of Intl. Affairs, Eng. Mie Univ. Japan
+81-59-231-9671 (FAX) +81-59-231-9671 Email hirai@elec.mie-u.ac.jp,
Skype ID hiraijunji22

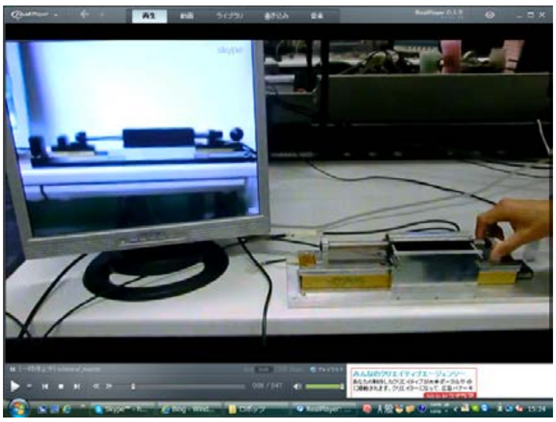
Mechatronics is the technical basis of all the robots and automated machines and manufacturing process. The word and concept of Mechatronics were created first in Japan almost a half of century ago by a Japanese Engineer, Mr. Tetsuo Mori, director of Yaskawa Elec. which the lecturer (Hirai) used to be with. By this lecture, the lecturer would like to try to tell the following key points of it to the audience:

1. Derivation of the word of Mechatronics and the related trade mark registration.
2. Schematic expression on the concept of Mechatronics integrating so many related sub-technologies to compose it.
3. Prediction on the direction of near and far future Mechatroncs is attempted along with the evolution of the above schematic drawing with time.
4. The prediction may be validated by introducing the recent hot topics in R&D activities of Robotics and/or Mechatronics in Japan including those underway in the lecturer's Labo.

5 Short introduction on the state-of-the-art topics in thus globalized academic environments, in connection with the above lecture on Mechatronics.

Bilateral teleoperation through high speed internet





6 Near future contribution from MIU to Lean Manufacturing Management course in ETSID

Taking advantage of geographical proximity to Toyota H.Q. and Honda Plant with Lean Manufacturing, the Graduate School of Engineering, Mie Univeristy is ready to provide the UPV students (either regular exchange- or internship student) with the lecture on the lean manufacturing and practical experience in the real manufaturing line in cooperation with those big names.

ETSID student, Sergio in Lean Manufacturing Course at MIU

7 Summary

UPV and Mie University (the Graduate School of Engineering in particular) have been keeping a good friendship not only for student exchange, collaborative R&D but also for industrial internship and job opportunity as well. Such a relation has been maintained by mutual participation in the ceremonial events and close lab-to-lab intercourse including the supports to the delegated students. As the state-of the-art technology of mechatronics education which started also in UPV (ETSID) last year, the author introduced the bilateral teleoperation technology which will be a great tool not only for research but also for education in thus globalized academic environments. The lecture and practice in lean manufacturing management (Kanban system) will be effective to transfer the Japanese manufacturing know-how to Europe, too.

8 Acknowledgements

The author would like to thank sincerely the Dean, Dr. Enrique Ballester Sarrias and Vice Dean, Dr. Luis Manuel Sanchez Ruiz, of ETSID, for their long-term friendship extended to us the Graduate School of Engineering, Mie University, and for inviting the author here in VG 2014.

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Increasing Aerospace Students Mobility. A New Challenge for the ETSIAE.

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Conference Key Areas: International Cooperation Programmes, International Networking, Bologna Process & New European Curricula.

Abstract

The old Escuela Técnica Superior de Ingenieros Aeronáuticos (ETSIA-UPM) has always supported a strong international outlook, encouraging student exchanges at both graduate and postgraduate level for many years. The harmonization of the diverse European University Systems has led to a higher degree of comparability between universities and more opportunities for student mobility. Increasing student mobility is expected to kindle a competition between countries and universities to attract the most capable students. Otherwise, research-intensive universities need to keep networks of international research over all disciplines, and this is particularly important in aeronautics and space sectors. In this new context, the former engineering faculty is going through a restructuring process, which will result is the new Escuela Técnica Superior de Ingeniería Aeronáutica y del Espacio (ETSIAE) by October 2014. This change forces to renew all the previous agreements with foreign universities. In this work an analysis of previous and future partners as well as type and number of students involved has been performed, in view to increase the skills and productivity of the highly educated and the university quality.

1 Introduction

By October 2014 the new Escuela Técnica Superior de Ingeniería Aeronáutica y del Espacio (ETSIAE) of the Polytechnic University of Madrid will be a reality. It will have the prestige and tradition of the two schools that have merged to form this big Engineering School: the Escuela Técnica Superior de Ingenieros Aeronáuticos (ETSIA) and the Escuela Universitaria de Ingeniería Técnica Aeronáutica (EUITA), with a joint historical experience of more than 150 years. These two study centers have faced the new challenge of combining efforts and resources to adapt to the European Higher Education Area (EHEA), which ensures a more comparable, compatible and coherent systems of higher education in Europe. This harmonization of the diverse European University Systems has led to a higher degree of comparability between universities and more opportunities for student mobility. Increasing student mobility is expected to kindle a competition between countries and universities to attract the most capable students. This change forces to renew all the previous agreements with foreign universities. In this work an analysis of previous and future partners as well as type and number of students involved has been performed, in view to increase the skills and productivity of the highly educated and the university quality.

The new center counts today on 272 teachers and lecturers (147 Ph.D.), 163 Support Staff people and about 3980 total students. The facilities of the ETSIAE include three buildings on campus (around 22.000 m^2, Figure 1), with more than 10.000 m^2 for classrooms, 5.000 m^2 for Laboratories and Departments, and 2500 m^2 for computer rooms and library, among other premises.

Therefore, the knowledge accumulated by the Teaching and Research Staff, and the infrastructure resulting from adding the resources of the two former schools that are integrated to form the ETSIAE, make it a first line center in the international aeronautics and space education sector. The challenge is to ensure that foreign students are attracted by the quality and excellence of the studies in our center and, at the same time, to promote the interchanges of our students with the more prestigious universities for aeronautics and space studies all over the world.

In April 2013, the League of European Research Universities (LERU) established some basis for the mobility principles arriving for next years[1]. They defined the research-intensive universities, where research, education and service to society interact and reinforce each other. These universities are immersed in an international competitive environment that moves researchers to interact, many times in one-to-one bilateral contacts.

Nowadays, mobility of students, researchers and teachers is essential for increasing innovation and creativity. The ability of universities for recruiting the best talents could determine the quality of teaching and research. But LERU recognizes that the current educational programmes at European universities are often not enough to show the students the opportunities of mobility as a way for acquiring skills and attitudes absolutely useful in a competitive and globalized sector. This is particularly relevant for aeronautics and aerospace students.

Many experts agree that international educational collaborations and researchers and students mobility is the correct way to achieve excellence in education. In this study, LERU launches the notion of “structured mobility and curricula” as opposed to “exchange mobility” (as the Erasmus programme). According to them, structured mobility can be as follows:

- Networked mobility and curricula: one university, a faculty or a department forms a network with several partners. This leading university sends its students to one or more partner universities for a certain period of time and specific part of their curriculum.
- Embedded mobility and curricula: a limited number of universities (faculties, departments, programmes) partner up in a consortium - strategic partnerships - in which students follow parts of their educational trajectory subsequently in two or more partner institutions. This is only possible if the curriculum is fully synchronized and developed by the consortium partners together.

Most of the past and current interchanges of ETSIA students correspond to the “exchange mobility” model. This kind of agreements will be the most important for ETSIAE in the immediate future too. But the harmonization of the European University Systems offers new opportunities for new kinds of collaborations close to the “structured mobility and curricula” model. The challenge is to identify these opportunities and to establish new agreements and consortiums with strategic partnerships.

2 Aerospace Students Mobility at ETSIA-ETSIAE

2.1 Present and future agreements and partners for the ETSIAE

The former Escuela Técnica Superior de Ingenieros Aeronáuticos (ETSIA) and the Escuela Universitaria de Ingeniería Técnica Aeronáutica (EUITA) have always supported a strong international outlook, encouraging student exchanges at both graduate and postgraduate level for many years. Although new collaborations can be opened after changing the format for the engineering studies from the old Aeronautical Technical Engineer (3 years) and Aeronautical Engineer (5-6 years) structure, with no correlation in most European universities, to the Engineer (Graduate in Aerospatial Engineering, 4 years) and Master Engineer (Aeronautical Engineer, 2 years at the UPM), the expected situation is that much of the existing agreements will be reviewed and maintained by the ETSIAE both for undergraduate and graduate exchanges.

In consequence, ETSIAE, as previously ETSIA, will belong to ECATA, the European Consortium for Advanced Training in Aerospace, formed by some of the most prestigious universities offering aerospace studies: Cranfield University, ISAE, KHT, Università de Pisa, TU Delft and TU München. The programme includes a yearly course on management of multinational aerospace projects for 20 high qualified young engineers, being the program supported by the ECATA Companies (Airbus Group, Alenia Aermacchi, BAE Systems, Dassault Aviation, SAAB and Safran).

At the same time, ETSIAE will be one of the Participating Universities of PEGASUS (Partnership of a European Group of Aeronautics and Space Universities), being one of its objectives to optimize the services that the universities offer in the best interests of Europe both in terms of continuing to attract the best students and also to offer highly relevant educational and research programmes. Other aims are the curricula definition and harmonization, to award prizes to students with international 'achievements', to increase student exchanges and research cooperation, to be a common voice for High Aerospace Education Institutions and to promote transnational employment. Last year counted on students from Czech Rep. (1), France (4), Germany (5), Italy (5), Netherlands (1), Poland (1), Portugal (1), Sweden (1), United Kingdom (3) and Spain (3).

Of course, ERASMUS has been the main mobility programme at the UPM since 1990, and so was for the ETSIA and the EUITA. The different agreements could include the Final Project work, one semester course or a complete substitution year. The recent Erasmus for All programme for 2014-2020, as proposed by the European Commission (EC)[2] in November 2011, implies an "new style" for exchanges, with more flexibility, intermittent and shorter mobility periods, and stimulate the creation of strategic partnerships at the curriculum level to develop more structural collaboration and mobility between universities. The key actions in Erasmus for All are learning mobility of individuals (staff and undergraduate and Master students), the cooperation for innovation, including sector skills alliances, support to open methods of coordination, EU transparency tools, policy dialogue with stakeholders and a more international dimension. In this context, ETSIAE counts on 47 partners (most from PEGASUS), in France (14), UK (4), Germany (9), Belgium (3), Italy (7), Holland (1), Latvia (1), Sweden (2), Norway (1) , Portugal (2), Poland (2), Romania (1), Czech Rep. (1). These includes some of the most important European universities related to aerospace studies, as ISAE-Supaéro, ISAE-ENSICA and l'École Polytecnique (France),TU München (Germany), TU Delft (Netherlands), Pol. de Milano (Italy), and Cranfield University or the Imperial College (United Kingdom).

ETSIAE also participates at ATHENS (Advanced Technology Higher Education Network/SOCRATES), a ten-day scientific and cultural exchange programme, offered twice a year (March & November) to students of the member universities of the ATHENS Network. The ATHENS network is made up of a total of 16 European Higher Education Institutions (one per country), the UPM being the Spanish university in the network. The ATHENS courses consist of 30 hours (classes, laboratory, technical visits practice, etc.) distributed in a week of classes. Past year more than 60 students from ETSIA-ETSIAE attended some of the different courses offered.

ETSIAE also will promote different programmes with Asian countries. The Polytechnic University of Madrid has been working for years in the Hispanic-Chinese Programme, intended for UPM students who want to complete the Project Thesis or Master's Thesis at universities or academic or scientific institutions in China, for a semester. Beijing Institute of Technology, Behiang University, Northwestern Polytechnic University, Tsinghua University (Beijing), Harbin Institute of Technology and Tongji University (Shanghai) are some of the Chinese universities with bilateral agreements. Each year, 25-30 students participate at this program, most of them from the ETSIA. At the same time, the Sino-Spanish Programme is aimed at graduate students with excellent academic performance from China to conduct research in the UPM for a semester. About 10-15 students come to the UPM each year, mostly at ETSIA to develop aeronautics and space research.

Also in Asia-Pacific area, ETSIAE will have students at the VULCANUS program, a Europe-Japan Industrial Cooperation Programme, and the GE-3 (Global Education for European Engineers and Entrepreneurs), an Asia-Latin-America-USA undergraduate exchanges with Embry-Riddle University Maryland University, Missouri University of Science and Technology, Purdue University, Washington University Seattle and University of Texas at Austin.

The SMILE/Magalhães Programme (Student Mobility In Latin America, Caribbean and Europe) provides bilateral agreements with the Instituto Tecnológico de Buenos Aires (Argentina), Universidad de Sao Paulo (Brazil), Universidad Pontificia Javierana (Colombia), Instituto Politécnico Nacional (Mexico) and the Universidad Simón Bolívar (Venezuela). Near five of our students choose each year one of these universities for studying or researching.

ETSIAE is also renovating different bilateral agreements for exchanges existing for the ETSIA until this course: l´École Polytechnique à Montreal, Instituto Tecnológico de Monterrey, the Ilinois Institute of Technology at Chicago, Massachusetts Institute of Technology, Syracuse University, University of New Mexico at Albuquerque and the Virginia Institute of Technology.

Finally, ETSIA had currently Double Degree Agreements for the Aeronautical Engineer Degree with ISAE-Supaéro (Touluose), Encsma (Poiters), and Pol. Di Torino. These Double Degree Agreements will be renovated with ETSIAE for the Master Engineering Degree, and it is expected to spread out these agreements to Pol. Di Milano and U. Liège (Belgium).

2.2 Past and current reality of Students Mobility at ETSIA-ETSIAE

Analyzing at this point the student mobility historical data at the ETSIA for the last 10 years, some interesting facts can be observed. Each year the ETSIA have received 300-325 new students (having more than 700 solicitudes). It is important to point out that only a 25% were female, and only a 4% were foreign students. In Figure 2 the total number of alumni per academic year can be observed. It is interesting to notice that this number is increasing every year, and currently the promotions are formed by 240 students.

On the other hand, Table 1 shows the outcoming students from the ETSIA under the Erasmus Programme (since 2004). In Table 2 the outcoming students from the ETSIA under non European Programmes (since 2004) can be observed, and finally in Table 3 the outcoming students under other Final Project work Agreements can be seen.

The total number of Erasmus exchanges has gradually grown along these last years, from 40 at 2004-2005 academic year to around 70 for the 2012-2013 course. The ulterior decrease to 61 students for the 2013-2014 and 2014-2015 course is due to the decision of sharing part of the exchange places with the ETSIAE students, due to the coexistence of the two programs (the Aeronautical Engineering at ETSIA and the Graduate in Aerospatial Engineering at ETSIAE).

The increase in mobility has been noticeable for non European Programmes, rising up to 20 students due to the new agreements established with Chinese and Latin American universities. Finally, the number of students that decide to search a foreign agreement on their own (that are called “free movers”) is also increased for the last four years up to 20 total students.

Considering the total mobility figures for the ETSIAE, we can say that almost 100 students participate at some mobility programme. That means a 40% of the total promotion, that is a really good result having in mind that ETSIA has been for many years one of the world biggest aeronautics and space engineering school.

On the contrary, the total amount of incoming foreign students at ETSIA (Table 4) reached a steady-state of around 30 students nine years ago (mostly from France and Italy and practically all of them male students). This is only a third part of the outcoming students, and it is not a desirable ratio. One of the reasons for this unbalanced situation could be the high standards for passing a subject at the ETSIA, really different from the general European educative model. Besides that, there are not subjects taught in English. Moreover, the Aeronautical and Space curricula are quite different between universities. In Figure 3 can be observed the great gaps between the ratio of Fundamental Sciences, General courses, Engineering Sciences and Aerospace Engineering among the most important European universities before adapting to the European Higher Education Area (EHEA)[3]. This has not changed after the implementation of the new programmes.

A strategic approach to increase future mobility in both senses (incoming and outcoming) would be related with the possibility of obtaining an ABET (Accreditation Board for Engineering and

Technology) accreditation in order to increase the mobility with North American and Asian universities. This is absolutely necessary to place the ETSIAE among the more visible and recognized European Aeronautical and Space Engineering Schools.

In relation to the ETSIAE, as Figure 4 shows, we receive around 650-700 new students each year (from 1300 applications), 29% of them being female students. Next year will be only the second one with an active mobility program, and the final number of Erasmus exchanges that can be observed in Table 5 has been limited as it has been necessary to share the total available places with the ETSIA, as we discuss previously. It is expected that during 2015-2016 the total exchange places for ETSIAE increases up to 120 students (including undergraduate and Master students). It is also expected an increase in non European agreements and other due to increasing internationalization and networking.

2.3 Objectives for increasing Students Mobility at ETSIAE

Summarizing, the objectives for increasing aerospace Students Mobility at ETSIAE in the next 10 years should be:

- To continue and to enhance the PEGASUS and ECATA partnership, promoting the networking approach.
- To renovate and increase Double Degree Agreements with some strategic universities, mainly from ECATA and PEGASUS but also in USA.
- To participate in events and actions for aerospace engineering promotion among Spanish and foreign High School students, mainly girls.
- To increase at ETSIAE the amount of subjects taught in English for foreign students, both for Graduate and Master Degrees.
- To promote the embedded mobility and curricula with a limited number of universities (for example, some ECATA members) with a common curricula for some itineraries.
- To obtain an ABET accreditation in order to increase the mobility with American and Asian universities.

3 Figures and tables

3.1 Tables

***Table 1*. ETSIA - Outcoming Students - Erasmus Programme (since 2004)**

	14-15	13-14	12-13	11-12	10-11	09-10	08-09	07-08	06-07	05-06	04-05
Germany	11	5	14	11	14	10	12	11	7	9	8
Belgium	3	1	3	3	3	3	2	3	2	2	2
Czech Rep.	2	1	1	1	1	0	1	0	1	1	1
France	20	18	22	20	19	17	14	14	15	10	14
Netherlands	2	2	4	4	4	4	5	4	3	3	5
Italy	9	9	11	11	12	10	8	8	6	3	4
Portugal	4	2	2	2	2	2	1	1	0	1	0
Poland	2	1	1	3	3	1	1	1	0	0	0
Norway	0	0	0	0	0	0	0	0	1	1	1
Sweden	1	1	1	1	1	1	1	1	1	0	0
UK	7	9	9	10	11	11	10	10	8	11	5
Total	61	49	68	66	70	59	55	53	44	41	40

***Table 2.* ETSIA - Outcoming Students - Non European Programmes (since 2004)**

Year	14-15	13-14	12-13	11-12	10-11	09-10	08-09	07-08	06-07	05-06	04-05
Brazil	5	3	2	4	3	1	1	2	1	0	0
Mexico	2	0	2	1	1	0	1	1	0	0	0
Argentina	1	0	1	0	1	1	0	0	3	1	0
Canada	3	1	2	1	0	0	0	0	0	0	0
USA	4	1	2	8	4	2	5	4	2	1	0
India	0	0	0	0	1	0	0	0	0	0	0
China	8	15	6	3	0	0	1	0	0	0	0
Japan	1	1	0	0	1	0	0	0	0	0	0
Total	20	21	15	17	11	4	8	7	6	2	0

***Table 3*. ETSIA - Outcoming Students - Other Final Project Work Agreements**

Year	13-14	12-13	11-12	10-11	09-10	08-09	07-08	06-07	05-06	04-05
Europe	18	18	13	8	8	4	2	2	8	2
USA	0	1	1	2	2	3	2	0	0	1
Others	0	1	0	1	0	1	0	0	0	0
Total	18	20	14	11	10	8	4	2	8	3

***Table 4*. ETSIA - Incoming Students - Undergraduate**

Year	*Total Students*
2001-2002	11
2002-2003	14
2003-2004	17
2004-2005	45
2005-2006	37
2006-2007	29
2007-2008	30
2008-2009	28
2009-2010	36
2010-2011	38
2011-2012	33
2012-2013	35
2013-2014	28

***Table 5*. ETSIAE - Outcoming Students - Erasmus Programme**

Year	14-15	13-14
Germany	15	11
Belgium	2	2
France	15	14
Netherlands	4	2
Italy	9	6
Poland	1	0
Norway	1	1
Sweden	4	3
UK	4	3
Total	55	42

3.2 Figures, diagrams, illustrations

Fig. 1. ETSIAE facilities at Ciudad Universitaria and Montegancedo Campus

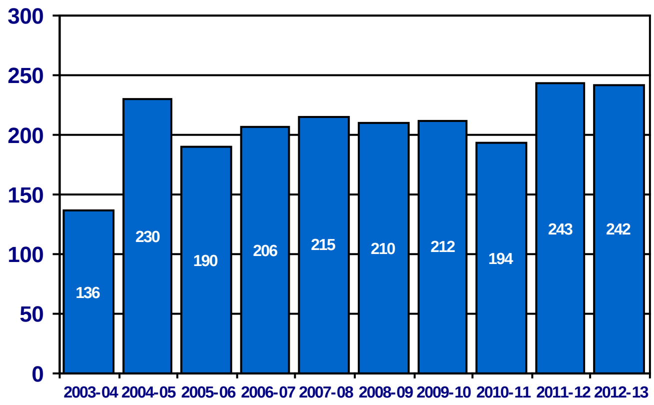

Fig. 2. Alumni per academic year at ETSIA

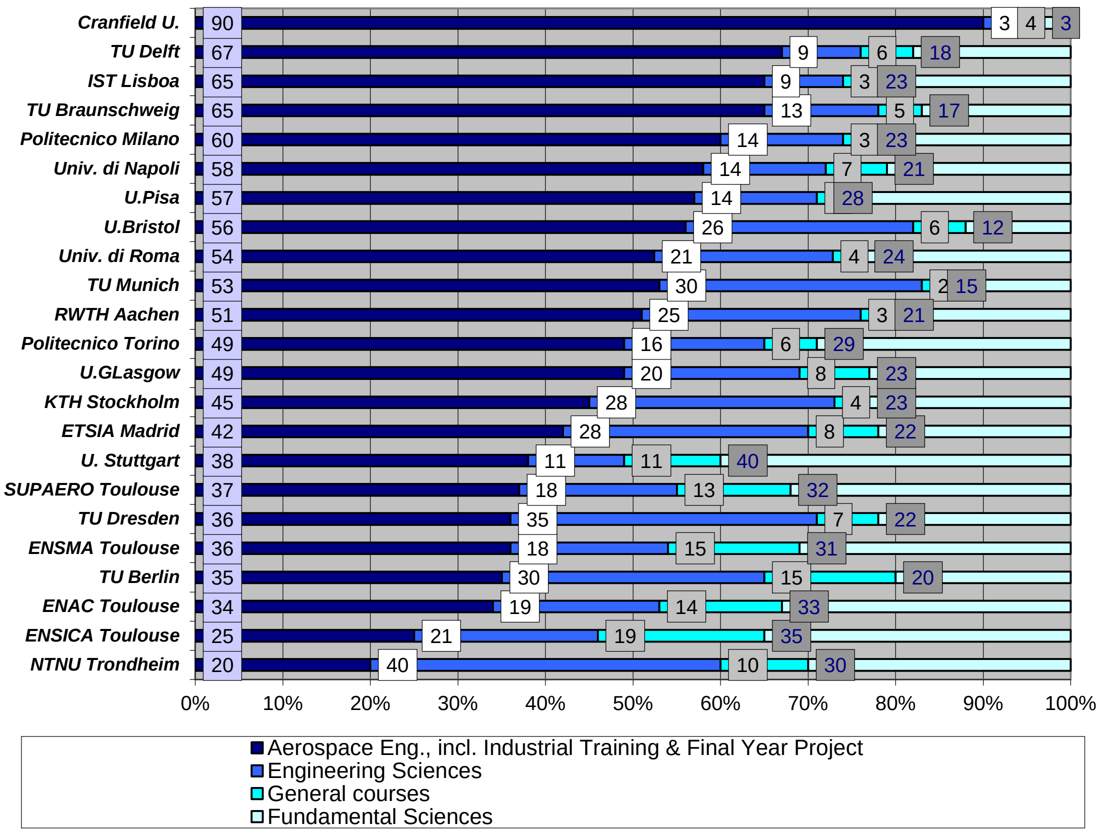

Fig. 3. Differences between the Aerospace curricula at main European universities[3]

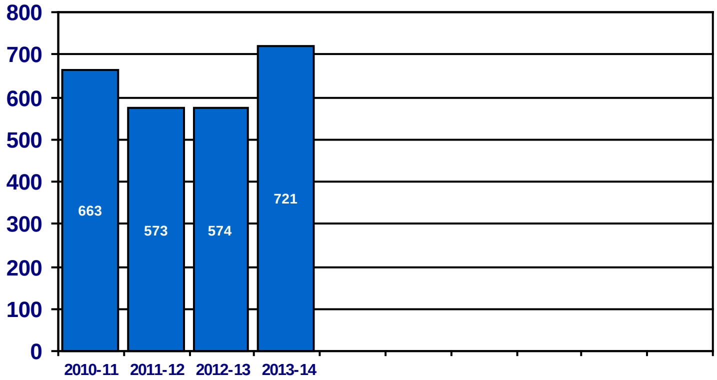

Fig. 4. New students per academic year at ETSIAE

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Towards the Global Engineer: a triple degree approach

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Conference Key Areas: The global engineer, Internationalizing the engineering curriculum
Keywords: Double degree, internationalization, engineering education

Abstract

The global engineer is a need of nowadays industrial, service, and business sectors which demand highly prepared professionals ready to work in cross cultural settings. Hence higher institutes of education are currently engaged in joint and dual degree programs as well as in launching international satellite locations in other countries.

Our approach has been quite unique by involving several institutions from three different countries, with students studying in three different languages and the possibility of a broad engineering education, all of which conform something that might fit quite well in what we might have in our mind as a global engineer. The model deals with the development of an award from the EU and the US Department of Education (The Atlantis Program). Students taking part in this program have received up to now a travel stipend to spend one year in two of the universities in the consortium and by the end of their fourth year they could receive three Degrees in Industrial Engineering and Engineering Management from the institutions they attended. Also, they could receive a degree in Mechanical Engineering, getting a wider spectrum if they select the adequate itinerary within the program.

1 Introduction

Graduating engineers that work in big and spread out companies today have to work and interact in a global environment, [1]. Within smaller companies this need is not so high at least nowadays, but on many occasions they have manage different projects from the initial idea phase through final production and commercial application and some professional with a wide spectrum and international knowledge should fit in perfectly, mostly if they have to deal with some foreign company or have foreign employees. Aware of this fact many institutions of higher education offer study abroad programs, joint and dual degrees, [2-6], and some of them even launch satellite programs which have arisen overseas. One of the major goals of such programs is to expose graduating students to different educational, cultural, linguistic, managerial, and operational environments. Nevertheless, some of these programs are easier to implement than others. To be specific, graduate master degrees are more accommodating to evolution in general than undergraduate degrees, because of accreditation concerns of the latter degrees. However there are exceptions and we find undergraduate programs run overseas by British universities, much cheaper than at home while masters are kept at the host institution, this being a way of assuring the quality that higher degrees may demand as well as facilitating to recruit foreign students to all courses.

Even some institutions do develop programs with the aim of attracting foreign students and staff favoring the internationalization at home, specially meant for its own staff and students that for whatever reason cannot travel to other countries in their academic development.

In this paper we will discuss our experience in the development, evolution, experience, and challenges of an international program born with the goal of preparing highly trained professionals that perform their education in three different countries in three different languages and that are able to obtain three different degrees if they fulfill all requirements of each institution involved. Memorandums of understanding have adequately been signed in order to give the legal coverage to all students involved and facilitating the paths that students should follow.

This triple Bachelor's Degree was born supported by a grant from US-FIPSE and EU-DG Education and Training through the Atlantis Program. The award was given to two leading institutions: New Jersey Institute of Technology (NJIT) in the US and the University of Parma (*Universitá degli studi di Parma,* UNIPR) in Europe. The RFP (Request for Proposal) for this type of grants had several options. One of them which was the basis of our submission was for two US institution with only one of them (NJIT) degree granting while the other one is supporting, Rutgers University being the second US institution participating in this program, and at least two European universities from different countries. Initially, the other degree granting university in Europe was University of Extremadura (*Universidad de Extremadura*, UEX) in Spain and later Technical University of Valencia (*Universitat Politècnica de València*, UPV) through its School of Indastrial Design ETSID joined the consortium in May 2011.

Our objective in this paper is to share our experiences and challenges with such international program which regrettably is no longer open, [7]. In Section 2 we cover a description of the initial proposal and the Memorandum of Understanding (MoU) among the institutions. Afterwards, we share some of the challenges in the logistics and the operation of such program that were faced. A section providing quantitate analysis and results of surveys ensues. Finally, we conclude by a summary section.

2 UMANE Proposal Summary and the MoU

Initially, the UMANE (EU/US International Bachelor Degrees in Engineering Management, http://www.umane.unipr.it) project proposed a joint degree (dual degree) program between two US and two EU universities, namely NJIT and Rutgers University (NJ, USA), the University of Parma (UNIPR) EU-Italy and the University of Extremadura (UEX) EU-Spain. In May, UPV joined the project widening the possibilities of students involved by giving them the possibility to opt to a Mechanical Engineering degree with an adequate selection of subjects throughout the UMANE itinerary, [8-9]. The project is currently running with the support of both the EU-USA ATLANTIS Program of the European Union (Agreement number 2010-2868/001-001-CPT EU/US TD) and the US-FIPSE and its duration is fixed in 4 years, with activities starting on September 1st 2010 and ending August 31st, 2015.

Figure 1: The consortium

During that period, these Universities have developed a consortium (Figure 1) for delivering an undergraduate education in the field of Engineering Management, with a particular focus on global supply Chain Management and Operations Management, food supply chains, as well as in Mechanical Engineering additionally if chosen so.

3 Mobility Program

Among the main objectives of the project was to develop an EU/US Dual Bachelor Degree in Engineering Management. The classes are taught in the local language of each institution. And thus a proper language training activity is foreseen at both home and hosting institutions. The evolution of the program has come into the fact that students are able to get a triple degree from NJIT, UNIPR and UEX or NJIT, UNIPR and UPV, when all requirements are adequately fulfilled.

		US		EU			Main activities
		NJIT	RUTGERS	UNIPR	UEX	UPV	
Year 1	Sem. 1	Learning at home		Learning at home			• Learning
	Sem. 2	Learning at home		Learning at home			• Learning
Year 2	Sem. 3	Learning at home		Learning at home HEI			• learning • EN language training for EU students
	Sem. 4	Learning at home		Learning at home			• learning • EN language training for EU students • IT language training for US students

		US		EU			Main activities
		NJIT	RUTGERS	UNIPR	UEX	UPV	
Year 3	Sem. 5				UNIPR UEX NJIT	UNIPR UPV NJIT	• Learning • ES language courses for IT and US students • IT language learning for US and ES students • Placement in IT companies
	Sem. 6			UNIPR UEX UPV NJIT			• Learning • ES learning • EN language training for EU students
Year 4	Sem. 7	NJIT UNIPR UEX UPV	UNIPR (opt.) UEX (opt.) UPV(opt.)				• Transatlantic learning for EU students • Dissertation
	Sem. 8	NJIT UNIPR UEX UPV	UNIPR (opt.) UEX (opt.) UPV(opt.)				• Transatlantic learning for EU students • Dissertation • Award of Bachelor Degree

Figure 2. Mobility program

The dual Bachelor Degree will be taught in English, Italian and Spanish for which a proper language training activity is foreseen at both home and hosting institutions.

Fig.3 First UMANE Students from the three countries during part of their common study program

The UMANE Dual Degree includes transatlantic students' exchange (a full academic year) and EU-to-EU mobility (one semester). The intended aim of the project is to improve the level of international expertise and competences of both EU and US students, so to enhance their employment opportunities, competitiveness, cultural exposure, and language skills.

The UMANE Dual Degree project plans to mobilize and graduate 48 students during the project contractual period: 24 students from the US and 24 students from the EU. The study-abroad period varies according to the student's continent of origin as reflected in Fig. 2: US students will attend a full 12-month study period in the EU; EU students will spend one semester at the EU partner institutions plus a full 12-month study period in the US. Mobility activities will take place during the 3rd and 4th year for EU students' program of study and during the 3rd year for US students. The mobility scheme is planned in order to have the whole common "international classroom" moving within the EU and to the US.

In Fig. 3 we may see some of the first group of students selected in 2011 that have developed their joint adventure under UMANE during the academic years 2011/12 and 2012/13. In Fig. 4 we may see students from the third group (2013/15) during their study period in Parma together with the Italian students of the first group. The support between students and passing of past experiences is a constant within this demanding program.

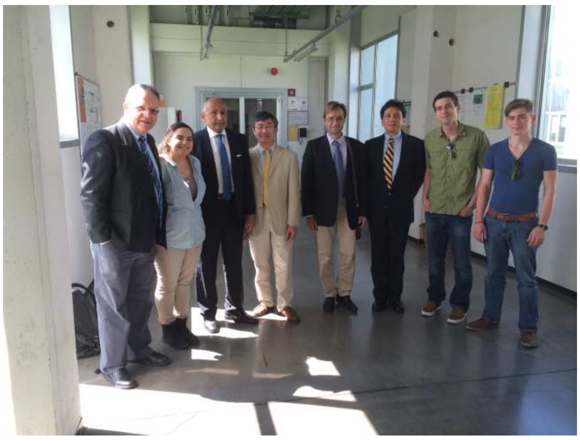

Fig. 4 On the left, students from the third UMANE promotion and faculty from UNIPR, NJIT, Rutgers and UPV. On the right students of 1st and 3rd promotion in Parma, May 2014

The project includes also a plan for faculty exchange. Faculty exchange activity has been planned both to facilitate the activities related to the project coordination and monitoring, as well as to enhance teaching and research activities in the framework of the UMANE disciplines. An overall number of 29 faculties on mobility, 17 from the EU to the US and 12 from US to the EU is planned over the 4 years of the project, for an average 3-week-each duration.

4 Curricula Implementation

Initially, the proposed program established that US students should spend their junior year in Europe. However, both NJIT and Rutgers could not adhere to the proposed scheme for different reasons. Also, European students were supposed to start arriving to the US at a rate of six per annum for four consecutive years starting September of 2011. For logistical reasons this has been changed to eight per year for three years.

Additionally the consortium did not include UPV, EU-Spain which has been added to the members in May 2011 during the signing of the MoU. Moreover, since the outset of this award the awarding agencies have recognized the inherent problems of such collaborative degrees, so they automatically granted one year extra at no cost extension; i.e. the program is extended till 2015.

As stated before, the UMANE project focuses on an undergraduate degree program, where two European and one US Universities are directly involved in awarding the dual degree as project participants, while a further US University (i.e., Rutgers University) is involved in the project with the aim to improve the quality of the proposal by increasing the courses available in the context of Industrial Engineering and Management. With this purpose in mind, and due to the differences in the degree structure in Italy, Spain, and the US, an appropriate program has been designed for students which plan to be enrolled in UMANE project.

In Italy the regular undergraduate degree program is 3 years and covers 180 ECTS; this does not match the corresponding undergraduate degrees (BS) in the US and in Spain, which consist of four years, for approximately 240 ECTS (although the computation of credits is different for the US universities). Therefore, for achieving the dual degree, the Parma students are asked to follow an ad-hoc-4-year tailor-made program. In this program, EU students attend the first 2 years at their home University.

During their third year students from Italy spend one semester at UEX or UPV through the LLP-Erasmus Program, while US students in transatlantic mobility attend the same EU institutions. The following semester see UEX, UPV and US students move to the Parma University (Italy), where the Italian Erasmus students formerly in Spain get back. At the end of the 3rd year, the EU students have to attend the fourth year at the US Universities.

As regards the specific courses offered at each partner institution and its role in the degree program, each institution is asked to identify a set of courses which could be attended by UMANE students.

The choice of defining a set of courses and allowing students to select the specific courses to be attended was motivated by the fact that, although the degree program focuses on industrial engineering and management, the UMANE students may have very different background, since the courses may have a different organization at each partner institution.

Defining a set of courses instead of establishing a specific study plan has allowed for more flexibility, and has ensured that students can attend courses which are appropriate for their specific background. At the same time, to award students with the degree title, the validity of the study plan is evaluated by a specific commission (advisor) at each partner institution.

5 Tuition – Selection – Degrees

As far as the tuition is concerned, according to the project proposal, students participating in the UMANE dual degree program (after a selection) are paying tuition exclusively at their home institution. This arrangement is valid for both EU and US participants.

The network co-operation agreement that has been approved and signed by all participating institutions explains in details this condition. Under a condition of regular tuition-payer at his/her home institution, the UMANE degree students are hosted at the transatlantic university under the same conditions, rights and benefits reserved to local students.

This balanced condition could be achieved mainly due to the very open and collaborative attitude adopted by the US partner institutions for which, as it is widely known, tuition policies are rather very high (in the sense of an average adoption of rather high tuition fees) than for the European Universities involved. This effort has marked itself the clear will to give a consistent contribution to the achievement of the project objectives.

The selection of students applying for the UMANE project was arranged as follows:

- In Europe, the language skills, and in particular the knowledge of English is preliminary tested through a written exam organized by the Language Centers of the EU institutions. Language skills are assessed only for EU students, as a prerequisite for participating to the project, while for non-EU students the knowledge of Italian and Spanish are not tested during the selection because improving or acquiring knowledge of Italian and Spanish is one of the objective of the project;
- The personal motivation of students applying for the UMANE project was evaluated through a colloquium with each student;
- The academic carrier of students was evaluated by examining the number of exams passed and the score reported.

Students were selected if they got a satisfactory score against all the aforementioned points.

As far as the recognition of the degree at national and international level is concerned, each participating institution has undertaken the necessary steps to guarantee full recognition of the degree.

- For the University of Parma, during academic year 2011/12, the official regulation of the University (RAD – Regolamento Didattico di Ateneo) was modified, introducing a note indicating that the Faculty of Engineering delivers the international study plan of UMANE starting from 2011/12, as well as the Dual Degree.
- The UEX has developed an “Own” Degree in Management Engineering (*Título propio de Grado*), designed specifically to fulfill all the requirements related with the international study plan of UMANE as well as the diverse titles granted.
- UPV, according to its internal regulations, has developed throughout its School of Industrial Design ETSID, a Triple Degree Agreement concerning the University of Parma, NJIT and UPV, for conferring the Spanish BEng Mechanical Engineering degree (*Grado en Ingeniería Mecánica*) with full professional recognition in the field of Mechanical Engineering, [10].
- NJIT’s posted university rules confer the IE degrees in Industrial Engineering for students who successfully complete 33 credits of upper level courses (300 or higher) in the discipline. The UMANE students will be advised by NJIT industrial Engineering Advisor about the required courses, upon evaluation of courses that students have already completed in their respective European Institutions.

The computation of academic credits is different among the partner institutions of the UMANE project. To make the whole study plan consistent, the length of the courses offered by the partner universities has been converted (for the purpose of the UMANE project) using the standard measurement unit of ECTS, which is thus used in the project. For the equivalence, the following pieces of information are used:

- In Italy, a conventional year of study for an undergraduate student is 60 ECTS. The three years of undergraduate studies thus account for 180 ECTS. A ECTS also corresponds to 24 hours of student's work, one third of which (8 hours) is covered by lessons;
- In Spain, the whole length of the degree program is 4 years, for a total of 240 ECTS, with a similar amount of hours (25) for one credit as Parma;
- In the US, a conventional year of study for an undergraduate student approximately accounts for 30 credits. A course of 1 credit corresponds to 1 hour/week of lesson for the whole semester, which is 15 weeks long. Hence, we approximately have 1 credit = 15 hours in the US.

Fig.5 NJIT Commencement 2013: on the left Newark College of Engineering Dean Thomas R. Blake sided by ETSID Dean Enrique Ballester (right on picture) and ETSID Vice Dean Luis M. Sánchez Ruiz (left). On the right general view of Commencement 2013 from stage

The equivalence between the US credits and the ECTS credits is mainly based on the mathematical computation (e.g., 3 US credits = 5.625 ECTS). Nonetheless, depending on the specific circumstance, the partner institutions are allowed to consider possible equivalences on the basis of course contents. The equivalence is checked and acknowledged between universities using the existing administrative procedures, and formally evaluated by specific commissions (Advisors) for each institution.

The degrees are awarded through the Commencement Ceremony by NJIT as shown in Fig. 5 and Fig. 6 to which representatives of the partners are invited to attend, and by Graduation ceremony at Parma here being a requisite to be present in order to graduate. In Fig. 7 we may see some pictures reflecting happiness in 2nd promotion students after NJIT Commencement 2014. Spanish universities do not require attending any special ceremony in order to receive the earned grade once fulfilled all requirements.

6 Challenges

As mentioned prior, these types of programs face numerous challenges both logistical and academic. In fact as in any international collaboration, one has to listen carefully to what the partners mean.

Generally, top administrations are usually not aware of what such projects require. When the award is received the administration pays closer attention to what was agreed upon in the proposal which could raise concerns between the member of the consortium particularly regarding accreditation issues and each institute transfer credit requirements. In the case of the triple degree agreement signed by NJIT, UNIPR and UPV, this was not the case within UPV as its internal regulations required fixing the general curricula to be developed by every standard possible student participating in this program and it had to be approved by different boards where UPV administrators intervened actively.

On line registration is also a challenge. The computer cannot recognize that a student has taken the pre-requisite of a certain course somewhere else. So, it may avoid allowing on line registration and the hold has to be lifted manually.

Assistance of international offices is crucial to facilitate this process. Additionally, courses may not be offered in the particular semester when students need them. Again flexibility should be exercised.

When European students arrive in the US and because they could not register on line in due time as the rest of US students, courses may be closed which is problematic for them and faculty alike.

The US system and some of the European ones are different in the way they evaluate students' performance. For example, in the US students have to do homework, take quizzes, term papers, and exams for the course final grade while in some European universities, it may be only one examination. The situation at UPV is between since ETSID does not allow final exams, continuous evaluation is the general form of assessment through tests, assignments and exams.

Fig.6 NJIT Commencement 2014: General view of Prudential Centre where Commencement took place

These are some of the challenges which were faced and mostly are successfully overcome. Anyway all these differences provide a great facility to adaptability in students participating in this program since they have to face linguistic, cultural and academic differences throughout the program.

The real challenge is to begin this coming academic year for European promotion 2014/2016 when the financial support has finished for them and new participants will not be able to count on it. US students will be able to come to Europe funded by the Atlantis program for the last time during 2014/15.

This ending of support is making the participant institutions to search for other possibilities in order to help the students as much as possible and being able to attract them so that the economic issue is as small as possible.

7 Opportunities

All the students involved will clearly benefit the significant opportunity of having a real international experience during their studies. This means that they will interact with different cultural, social, linguistic, and educational environments, and experience different teaching and learning methods, thus improving their entrepreneurial skills.

As a consequence, students will be further prepared to work as part of an international workforce, facing the challenges of our modern globalizing economies and cultures.

Focusing on the US part, the involvement in the UMANE project allows students to achieve specific skills in Italian and Spanish. As regards to EU students, they firstly improve their English knowledge, and secondarily they have the opportunity to learn some basics of a second European language (i.e., Spanish or Italian).

Concerning the EU part of the degree, US students have to attend lectures in English, Italian and Spanish. This is a relevant challenge of the whole program, but the network is strongly convinced that the students are able to successfully overcome language issues also thanks to the strong language plan that has been prompted.

Fig.7 NJIT Commencement 2014. Some pictures after 2nd UMANE students graduate

Additionally, UMANE offers European students who successfully complete their IE Bachelors' Degree in the US the opportunity of employment after graduation.

US immigration law allows students to work for one year in the country after fulfilling their degree requirement.

Also students from UNIPR and NJIT within the UMANE program are able to seek the Spanish BEng Mechanical Engineering degree with full professional recognition in the field of Mechanical Engineering which is highly reputed since it enables the graduates to conceive, develop, sign and implement projects in Mechanical Engineering. Five students from Parma and one from NJIT up to now have been following this specific track, widening their professional perspective by deepening their Mechanical Engineering background, as possible approach to the Global Engineer concept.

Fig.8 Reflections to reflect. A must visit at New Jersey City, in front of South Manhattan, the memorial to 9/11

Some of the students have presented their experience at an ASEE conference collecting UMANE graduates opinion as well, [11], from both sides of the Atlantic. In that paper, the relevance of the program and the deep (positive) influence that it has meant in their careers is clear. One of them Carlos Cocovi, from ETSID, is nowadays working for the Princeton site of an important German company as a Supply Chain Analyst. Another one, R. Lou, an American student, works for a company in New York City and travels around the US owing to his responsibilities in his company.

After that, new possibilities have emerged to some UMANE students and Ignacio José Sancho Alfayé, first UMANE promotion student from ETSID, is working as Process Coach Engineer for one department of the Valencia factory of a well-known American multinational automaker. Very recently, Maria Chiara, an Italian student of the second UMANE promotion has been offered to work in US with engineering responsibilities in the air conditioning system of a well-known American hotel chain.

Thus there are examples of different opportunities in international environments that open up after graduating with the wide education provided by means of the UMANE program.

8 Conclusion

The UMANE project appears to have a very favorable outcome to all participants. Despite the challenges in synergizing different educational infrastructure and cultures, the program continues to attract students and graduate successful ones.

The support of top administration for such projects is crucial to their success. It helps in cutting through red tape, facilitates admission and registration issues, tuition and fees exemptions for involved students, offering language courses to address European and American students' specific needs, and assist in the equivalency of programs' requirements.

At present, one of the major concerns is in how to sustain the UMANE consortium after the expiration of the award financial support in 2015. We are currently exploring various avenues to provide the needed monetary funds to be able to continue this program, including reaching out to conglomerates and private funding agencies.

It should be mentioned that as an outcome of this project, both NJIT and Parma University are in the final stages of developing a joint Master's Degree in Industrial Engineering. It is also expected that in the near future other double or joint degrees between NJIT and other consortium members shall evolve and these degrees will not be limited to Industrial Engineering or Engineering Management graduate education.

9 Acknowledgements

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WHY I AM IN DEBT TO AUSTRALIA

- Benefits of a College International Year Abroad-

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Conference Key Areas: Education, Careers, Networking, Internationalisation, Aerospace, Challenge

Abstract

Doing part of your studies abroad may be frightening at first, as your leave your comfort zone to go somewhere totally unknown. However, if you take the opportunity and travel, you will realize that will be the experience of your life from the first second you land. You will be challenged 24/7 for a whole year and that is what will make you learn and grow.

Moreover, even if initially studying abroad may be seen just as a personal amusing experience, it is considered by most companies as an extremely valuable asset. They are aware of the effort and the skills of a person who has gone through this experience. Therefore, it will set you apart from competitors when looking for a position.

As a conclusion, considering the benefits of an international study period from my point of view, I encourage everyone to get well prepared and gather the required strength to leave home and live it.

1 Introduction

I was on my 4th year of Aerospace Engineering at UPV (Universitat Politècnica Valencia) when I applied for University Scholarships to travel abroad. I had always wanted to live an international experience, so I was mentally ready for it. However, the process was not as easy as I had thought.

Convincing yourself when you go through tough moments that you are really doing what you want and persuading your family of the future benefits of this adventure so that they support you, are essential to keep you strong all the time. Also, letting yourself be helped by the University Departments and their previous knowledge will help you deal with the preparation required before the big change.

2 The process of a College International Year Abroad

2.1 Getting ready

On the process to enjoy this College international year abroad, one of the first steps you have to deal with, is learning about the different options to support your experience. Each university may have different options so it is important to gather as much information you can to get the option that better suits you.

UPV has an exchange program that was extremely appealing to me: PROMOE Scholarship. PROMOE takes you to North American, Australian and Asian Universities for a maximum of a school year. However, to apply for it you are required to have a good average mark at College and a specific mark at the TOEFL English Exam. It was then when I realized that even if I started applying for the scholarship on my 4th year of College, I actually had been getting ready for this for my whole life.

Once you are aware that you comply with those requirements, you need to look for a program on any of the Universities included on the Scholarship that contains the subjects you have left to finish. It is extremely important that you make sure that the subjects chosen on the foreign university will be validated when you go back to Spain. This will probably lead you to thousands of emails and research, but the help from the UPV International Department and from previous students will allow you to get the information required to leave quietly.

After this, you apply for the scholarship and wait to see if you are granted with what you have applied for.

2.2 Being granted

The big day arrives when the results of the Scholarship assignments are known. From that day on, you will not stop thinking of your destination for a second. You start dreaming of your new friends, classmates, roommates and places you will visit. However, none of these dreams will even be close to the experience you are just about to live.

I was granted with a PROMOE Scholarship for a year at UNSW (University of New South Wales) in Sydney, Australia. The program I had chosen to finish my degree was Aviation Management, what included a lot of exciting airports and airlines lectures.

2.3 Arriving in the country

Your nerves are on edge when you actually leave home, family and friends. It was only when I landed in Sydney and no one was waiting for me at arrivals when I realized what I had just done. I had left my comfort zone for the totally unknown: studying in Valencia meant I could be close to those who loved me, I knew the school, professors, evaluation methods and language (see Figure 1). In exchange, I felt I was entering a black hole because, even after a lot of preparation, when you arrive to your destination you realize there is still a lot to arrange and discover (see Figure 2).

Fig. 1. What you leave at home

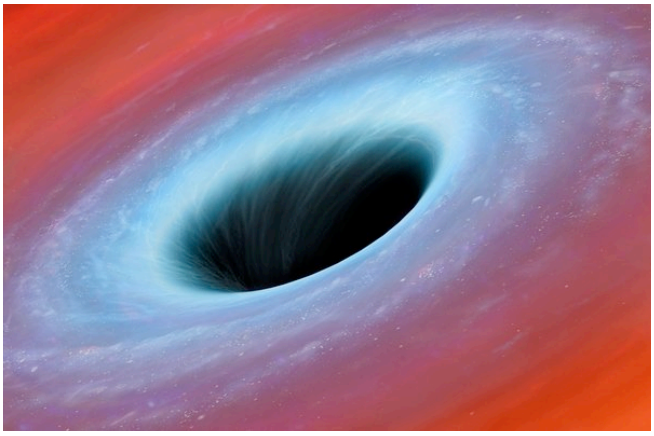

Fig. 2. What you feel is waiting for you

2.4 Leaving the country

After a whole year of excitement, new friends, lectures, opportunities, trips and life adventures, you have to go back home. You leave behind the achievements of your effort, however even if in that moment I was not aware of the benefits of that year abroad, I would soon start to recognize them.

3 The benefits of a College International Year Abroad

3.1 Willing to embrace challenges

In a lot of companies you will eventually need to relocate. They know, no matter what age you are, this means leaving everything behind to be placed in a foreign environment. It is a precious attribute for companies to know that you have done it before, as you will be less scared to do it again.

Therefore, because of your study year abroad, you will be more self-confident and able to take risks on your professional stage, and more ready for any change they may require from you. Being more willing to embrace challenges is then one of the remarkable benefits to be taken into account.

3.2 Embracing new cultures

During your study year abroad you meet friends and share lectures and working groups with people from different ethnic and national backgrounds. Therefore, you are not only learning subjects and a foreign language, you are being exposed to new ideas and philosophies, to new ways of working and cultures.

This is a valuable asset for companies, because it will help you to see projects from different perspectives and it will give you ability to work with people from diverse backgrounds. On our multicultural world, were companies expand and have bases everywhere in the world, this is a basic asset for companies. Basically they want to avoid situations as the shown represented on Figure 3, were you try to approach a different culture from your own one. This leads to misunderstandings, loss of time, money and customers.

Hence, being used to communicating and relating with people from different backgrounds is definitely another benefit to be considered as companies will really appreciate it.

Fig. 3. Approaching another culture from your own one

3.3 Unique Training and New Opportunities

Studying abroad gives you the possibility to experience the academic system of another culture/country, and to learn different subjects from the ones being offered at your home University. This is then a great chance to specialize your degree with a combination of topics that will better prepare you for your future dream job.

Therefore, a study abroad experience on your resume will differentiate you from your peers, as you may offer corporations a better and unique match for the position they are offering. Distinguishing yourself from others by offering a previous knowledge on some business aspects will be greatly appreciated by companies. Be the green fish on Figure 4, and you will be the preferred choice.

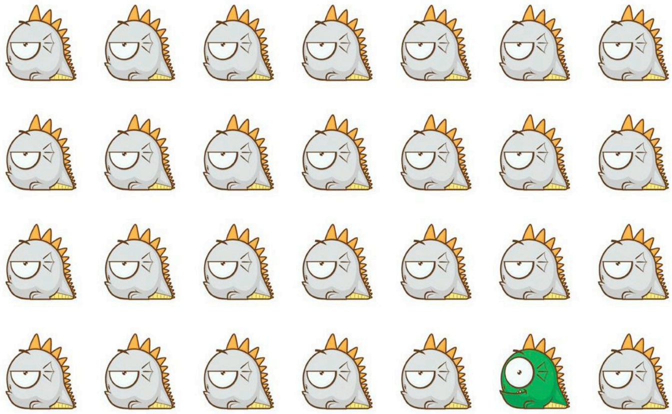

Fig. 4. Be the Green fish to set yourself apart from your peers

3.4 Increasing your network

When studying abroad, you meet a huge amount of new people: friends, professors, school managers, company's representatives… These are people that initially you meet on a University environment, but the relationship you start with them will stay there forever.

Suddenly you realize that those friends you met in your study year abroad, they are now managers of big organizations. The company's representatives may be hiring and they may think of you, and professors may require you for speeches or research programmes. Also, you might be having trouble on solving problems in your corporation and you may want to check how things are done in other places.

This is, studying abroad gives you the opportunity to increase your network with professionals from across the world. So, while growing the amount of friends you are at the same time becoming more connected to the world. Think how difficult it would be to get these connections if you stay at home and do not take the risk to travel.

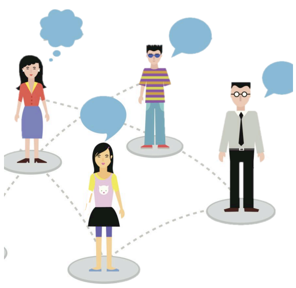

Fig. 5. Your network before

Fig. 6. Your network after. Highly increased

3.5 Life Changing Experience

Studying abroad is an eye opening experience that will change your life forever. It is full of amazing adventures, from learning a new culture and language to making new friends inside and outside the classroom. In the end, you return with a new sense of independence and more confidence that will equip you to face challenges presented by the real world during your whole life.

During the time on the foreign country, you will discover places you would probably never imagine seeing. When you travel for tourism you usually do not have the chance to stay for a whole year in the country or to get to know it from locals. Also, upon your return, you will want to visit your new friends who live everywhere in the world.

Hence, after the study abroad period, you will always be willing to travel again, and this is another reason why you will always be in debt to your host country.

4 Summary

As a summary of all what has been commented, I can only encourage every student who may read this writing to gather the strength they need to do a College international year abroad. Even if they may not be able to see its benefits from what I have explained, they should live it because I am sure they will find their own ones.

However, that said, I also want to emphasize on the importance of being convinced and well informed before doing it. It is not an easy process and sometimes you need to go through difficult moments. Only your commitment and willingness to success will help you go through them.

Also, for some degrees it may be a bit harder than for others. Laws and regulations, are usually totally linked to the country. Therefore, travelling abroad for a long time may be a draw back for some companies as they may think you are now aware of the local state of the art.

So, in conclusion, think carefully about every aspect and benefit that the international adventure may have for you. Just make sure your fears do not push you back on doing it, as you may regret for your whole life not having done it before. Some organizations will appreciate your effort, others will not. However, none will ever discriminate you against for having had that experience.

My experience in an academic exchange program and how it influences my current occupation

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Conference Key Areas: Education and Research, International Cooperation Programmes, International Networking
Keywords: programmes of academic exchange, Erasmus.

Abstract

The present document aims to make an assessment of the importance of academic exchange programmes in the training of college students from the author's experience. It points out how this experience can have repercussions in their post-academic career.

I am Juan Giner Navarro, currently a PhD student in this university, after studying Aeronautical Engineering in this school and finishing my degree and Master in University of Cranfield (UK).

I will never forget that day. We began a new subject. Professor was introducing it and, suddenly, he stopped his explanation. After a few seconds of silence, he said: "Maybe you think this subject will be difficult. Maybe you are looking for the reasons why you decided to study such a complex degree. However, this is not difficult, actually this is the easiest stage of your life because you know you are in the second year and next year you will be in the third, and then fourth and fifth. But, after fifth, what's next? It will be time to get out of the train tracks to start making decisions. That’s what will be really hard."

Those words stayed with me for the rest of the degree. It was true, the difficulty so far laid in survivability, but posed no risk. It was hard, but comfortable at the same time, stressing but so passive. There was something in those contradictions that I liked and therefore reach the end of that tunnel caused me concern.

I remember the end of the fourth year was a hard blow for me. I was finding that all my friends had decided to go on Erasmus, almost everyone had searched their destinies, and I had not heard anything. It was a blow to know that I would not have friends in class next year. Really, it did.

I was and I am still a homely boy. I really love the place where I was born, Xàtiva, and to be near my family has always been a priority for me. However, there was a feeling that haunted me at the time: "You don’t want to go on Erasmus because you don’t dare, not because you are not interested on it". The truth is that I had a major problem with the language (in fact, I still have not finished solving it) and that stopped me.

Finally, I decided to give me the chance to try a new experience (a really hard step for me, I know it can be so easy for others). I had the opportunity to go to Cranfield to study a Master in Aerodynamics (thanks to this school). It was certainly an experience that changed my perspective completely. Very often, when you talk to people who have had an experience abroad, they tell you that it opens your mind completely; it gives you another perspective, showing you another way of doing things. I used to think it was because they wanted to look like interesting people (sometimes, it was the case). But actually they were right, I could check it.

I learned that weather determines decisively the habits of people, their culture and traditions too. I remember how all the people went outside with their bikes (it seemed that everyone had a bike) when the sun rose. I also remember the lack of shutters, so that it was impossible not to wake up in the summer when the sun came out at 3 in the morning. Or double doors to get anywhere, and many other curiosities to preserve heat. Those were for me very revealing anecdotes.

You have to know one such experience changes you, no doubt. One of the first changes you observe is that you become someone who listens to someone else carefully, much more than before. Maybe because you are not using your mother language, listening becomes more important than speaking and, I assure you, you learn much more listening than speaking. Moreover, when you talk, the making of your message is much more elaborate and concise than before, talking to contribute, not to fill, and that is a concept that is often overlooked.

Another curious thing in a university exchange is the need to adapt to a new environment. Manage in a totally different environment to which you are accustomed is not an easy task, but in the case of an Erasmus experience like mine, everyone was in the same situation, that's why everyone were rowing in the same direction, trying to create new ties of friendship and an environment of coexistence.

All these new tools you acquire help you to improve in teamwork, in seeking synergies and in your ability to communicate and exchange ideas, which are strongly enhanced in the Anglo-Saxon universities, rather than the Spanish ones (at least this is my view). And that is why companies value so positively that their employees have been on a program of academic exchange, as they are supposed more prepared to teamwork, which is the only way to move forward with quality projects.

I came here to tell you my Erasmus experience and how this has influenced my current occupation. I have to say that most of my fellow Erasmus found work thanks to its universities exchange, either because they did their projects in companies that eventually hired them, either because the university had agreements with certain companies. For example, University of Cranfield had important links with Rolls Royce and with the world of Formula 1, where many of my classmates are nowadays.

In my case, my Erasmus experience led me back to my home university, which opened me its doors wide. Actually, I did it because I hate competing and I don't understand that I have to work for a company that pays me a wage X to generate a salary 2X and the difference is kneaded for 2 or 3 people. Although I realised that university is also a world where competition is so relevant. But I've always liked the university environment; generations are renewed year after year. Actually, I love this university, I see joy and dynamism, at least when I am out of my office.

I have learned to appreciate much more what I had with distance and perspective that gave me my academic exchange experience. I have learned the value of normality, the value of people. These things I would not have acquired if I had not lived a similar experience. And so, I always advise my students, my smaller (and not that smaller) friends and new generations of my family that they should live the opportunity to study abroad, everything looks different from there. The opportunities are for people that are looking for them, no matter where they have to search for.

Acknowledgements

Thanks for ETSID for give me the chance to explain my experience and encourage students to undertake their own way.

THE WORLD IS ONE

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Conference Key Areas: International Networking, International Cooperation Programs, The Global Engineer

1 Introduction

This is my experience at University of Central Arkansas (Arkansas, USA). How old are my memories but current.

2 University of Central Arkansas

Our arrival was coordinated by the manager that we had met a few months earlier at the UPV. They provided everything and put students who helped us the first days, both to accommodate the University as to register in studies. It was easy to know everything there in a few days. There were enough students coming from Hispanics countries and also from Asian ones (Indonesia, Thailand.). At first Hispanics were always together, but it was clear to me that one of my goals was to learn English and this did not help me, so I tried to keep in touch with American students.

2.1 Dorm / University life

The bedroom was composed of a common area and then two rooms with two bunk beds. In the first semester I shared with a student from Indonesia (I cannot remember his name). It was great because we exchanged our customs and anecdotes. I remember one day I was walking around the Campus and I saw my roommate with a jacket and a polo shirt that seemed be mine. I went to him and I asked about those clothes: “yes, I liked them and I put them on”, no problem. I was surprised, but I found it natural.

People usually were very friendly. They always asked you if you needed something, even when you had not a car, they never had any problem to give a ride. Once, a friend of mine delayed her vacations for one day to take me to the airport. I was going to Vancouver, through Seattle, and my ticket was cheaper that day, so she did it for me. There was once a black girl ride me to Walmart to get something. One moment she told me people looked at us very strange. I did not notice anything. She explained me it was because they could not accept a couple white / black, and she was pregnant. Arkansas is a “South State” where racism is very present. Racism there is both ways. I knew this black girl from French class and once I went to a Godspell in her Dorm, people there looked at me in the same way as it was in Walmart.

As you know people, you get more from them. I have many memories, but I remember the car I got. It was an old Ford, in red colour, two places from a nice friend of mine (do not think wrong). I paid $ 450, when I sold it, I got $ 400.

Back to Dorm: rooms were the biggest disaster to the pure decoration detail. In our room I had to plan a cleaning schedule otherwise it was a chaos. Nobody were worried about cleanliness. They never complained. I found out a while later: I was the oldest in that room, so I was to be respected because of my age. I could take advantage, but I never did it. Dorm was like when Franki sings: “I want live in a city that never sleeps”.

In that Campus you could do whatever you want almost 24 hours a day. I studied piano and I practised from 23:30 to 02:00 almost every day, it was open. Library in our dorm was also 24 hours open. You also could do sports at night.

Canteen was open from 07:00 to 18:00. In this time you came there for three times, and then there were hundreds pizzas deliveries, something about 22:00. Thanks I do not like pizza, otherwise I would have gained weight. A Mexican friend of mine (Javier), gained 10 kg. I can tell you food was not the best in that Campus. I remember once I wanted to cook a Spanish omelette, as I came friendly with the Canteen – Supervisor, she gave me three fresh eggs like something special, and froze chips (there were not fresh ones). I did what I could and she really enjoyed it. She told me she had to cook this to her husband, it was great.

Studies were not so difficult. They use to be more practical than theoretical. We did a lot of works and tests were not so hard. The marks of Europeans students were really good. They use to mix European students with Americans ones so you can share experiences, knowledge and different ways of solving questions. It was important you had everything you needed (we came from our University in Valencia where there were many things left at that time). They give you many chances to study extra subjects. I learned Russian, French, and Piano. It is because my studies of Russian and French as I got a grant in the foreign languages laboratory. With this grant I paid my studies, feeding, room and I could also buy the car I told you before. This was in second semester.

As I told at the beginning, I tried to be with American people to learn English so I became friend of some teachers. I played once a week tennis with them, I played soccer with another teachers and friends so I really enjoyed those times. They invited me to their houses with their families I found that really cool.

UCA is in Conway, where alcohol is forbidden. I could not believe people 50 years old, they drink a beer in dark. We played in one county were alcohol was free, but when you were arriving to Conway, all of them hide their drinks. You can imagine every party we had in Conway, police were there to confiscate our alcohol that was pathetic.

2.2 Outside University life

I travelled to many places in that time. I remember when I went to Vancouver. I contacted with a UCA teacher´s mother who lived in Seattle. I did not know her, I had no picture and I was there flying to Seattle. It was by "Thanks Giving day", at the end I spent that day with her and another fourteen people I have never seen before and I will never meet again, but I played piano for them.

I visited Chicago in March. I was dressed all time with my "bluson" (it was Fallas time in Valencia). I could see St Patricks day Parade, I steel remember it. I visited also New Orleans, Memphis, New York and other places. My roommate visited very frequently Las Vegas to gamble (Asian people love it), I never went there. I also spent one month in Mexico with my friend Javier from Puebla. There I visited many places also.

As I told you, I met with teachers and another American people and I played in a soccer team where I was the star (that was not because I played well, it was only because they did not know how to play), but it was really funny.

As Valencian, I could not leave Arkansas without cooking a Paella. The first one I cooked was dark night, windy, fine rain...I could barely see what I was cooking. I have to recognize it was nasty, burned, etc....they ate all, I could not believe it. Then I cooked another ones not so bad.

Once we were in a park where I cooked a paella, we could not drink “sangria” because alcohol was forbidden. I remember while I was cooking, besides me there was a family cooking hot dogs, burgers, etc...and a little child came to me asking what was that strange food. He was asking his father to taste it, but without success, that was weird. With my first paella, when I asked for a “rabbit” to cook, they told me how we could kill “Bugs Bunny”....and asked them how they could cook squirrels.

2.3 Making practices in a Company

I did this practices in FMC a big Company. In that section I had to develop a wheel balancing machine. I was in contact with another section in San Francisco. My first day was: here is your office, your phone, your computer, secretary, dining room....ask what you need. This was not common in Spain where you have to share a computer, phone...It was really interesting and I think I did a good work, they congratulate me. As I told you, they offered me to stay with them two years longer.

I can tell that experience was really great and because I was almost 32 years old, but I am sure I had stayed there for two or three years more. UCA offered me a grant to study a MBA and in the Company where I was making practices they told me to stay for two years more. I will never know, but I went back to Valencia.

Fig. 1. Dorm, my room (with Valencian flag outside) and my Ford (first car in red to the right)

Fig. 2. Canteen staff. They were crazy with the Spanish omelette.

Fig. 3. With a friend who knew his blood composition (40% American, 25 % Cheyenne...)

Fig.4. Soccer team.

Fig. 5. Spanish (Bea and Elisa) and American friends

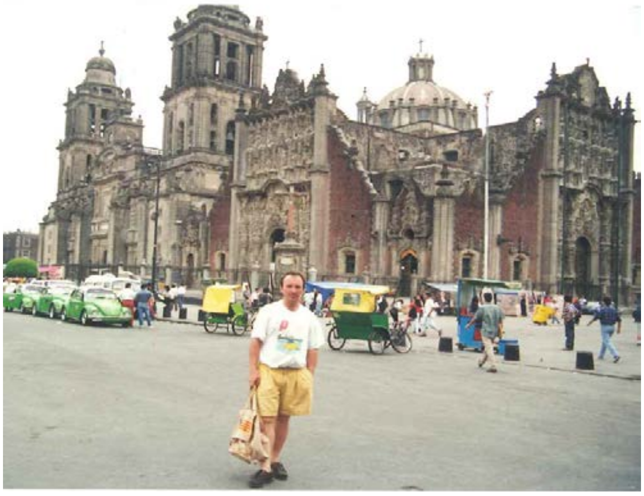

Fig. 6. Mexico DF

Fig. 7. Chicago with Javier (first to the right) and others friends. The one in the middle came to Valencia for a year in 1995 to 1996.

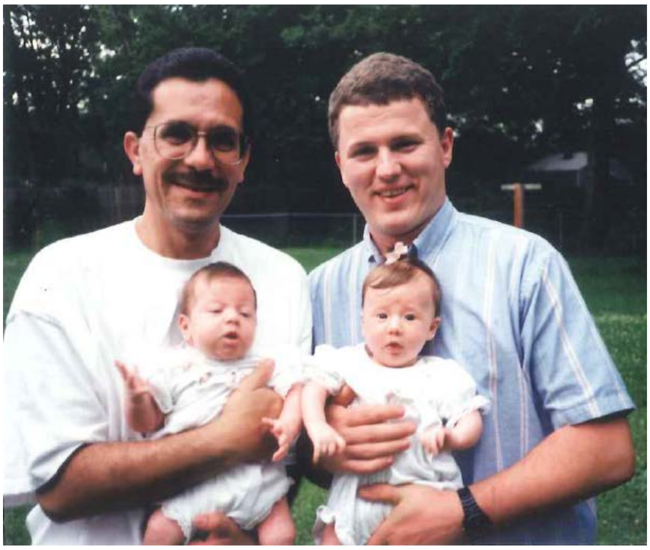

Fig.8. Spanish teacher (left) and French teacher (right) at UCA.

International Experience Testimonial by an Aeronautical Engineer at the Royal Melbourne Institute of Technology

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Keywords: International Exchange, Cooperation, Testimonial

Abstract

The present paper collects the testimonial of the author, an Aeronautical Engineer from the ETSID-UPV who studied his last year of the degree (including the final year thesis) at the Royal Melbourne Institute of Technology, in Australia. This stay was possible via a cooperation agreement among the universities, in the frame of the Promoe program of the UPV. Attention is given to the profit of such an experience for the student, emphasizing the new view of the world obtained after this period, the benefits derived from the stay and the difficulties that the author had to face along this time, always resulting in opportunities for personal growth and maturity.

1 Introduction

The international exchange has always been a great opportunity for undergraduate students to pursue another academic experience leaving their country and getting in touch with another culture and a different language. The experience of the author confirms the benefits of such an experience.

This testimonial is related to the stay that I was able to perform at the Royal Melbourne Institute of Technology (RMIT) [1] thanks to the Promoe program of the UPV [2] during 2010, for a total duration of 10 months. Academically, the objective of the stay was to study the 5th year of the Aeronautical Engineering degree and perform the final year thesis. The Promoe program provided financial support for the aircraft tickets (1200€) and for accommodation (4500€ for the whole stay). On the other hand, I was able to obtain an additional grant (Fernando Alonso) given by the Universia foundation [3], providing an extra 3000€. Given the Melbourne cost of life, this financial support hardly covered for the cost of food and accommodation for the total duration of the stay.

The present work has been structured in sections according to a timeline. Thus, several topics will be dealt with as they happened: before, during and after the stay. The benefits and the difficulties of each of the stage will be try to be highlighted.

2 Before the stay

Once the approval for the Promoe program was given by the UPV, I had to wait for the approval of the host university (RMIT). This issue was not easy to deal with, considering that the Australian academic year does not coincide with the Spanish one: whereas in Spain it went from September 2009 to July 2010, in Australia it covered the period from March 2010 to November 2010. Thus, I got the approval from RMIT once the first semester of my Spanish program had already started. In this situation, I decided to start the Spanish courses in case I did not get the approval from RMIT. Once I got it in November 2009 and I defined my academic program at RMIT and the courses that I would get credit for, I stopped attending to the Spanish classes. Personally, this was a difficult period due to the uncertainty of the future.

2.1 Defining the academic program

Before leaving for Australia, the UPV forced me to define an academic program stating which courses I would attend to at RMIT and which ones from the Spanish program would be given credit for. This is the ideal situation, since everything is agreed before going to the host university and ensures getting credit for all the courses attended to.

It is important to note that I was in the old Spanish program for Aeronautical Engineering, which consisted of 5 academic years and the final year project. On the other hand, the RMIT program is a 4-year long Bachelor Degree in Aerospace Engineering. Thus, the formation given in the Spanish program was more extensive and it was not possible to obtain a perfect correspondence for all the courses. This was compensated by being enrolled in a higher number of credits. In this respect, the old Spanish system for credits established an equivalence of 10 hours of in-class formation per credit, whereas it was agreed that the RMIT credit point is equivalent to 0.625 Spanish credits, which meant that each course of the Australian program required a higher amount of hours of dedication. The academic program agreed is shown in Table 1. The courses shown on the left correspond to the Spanish courses that I got credit for, whereas the ones on the right are those that I attended to at RMIT.

Table 1. Academic program for the stay.

Spanish courses	Australian courses
Projects	Aerospace Engineering Project Management Skills
Aerodynamics II	Fundamentals of Aerodynamics
Flight Control Systems	Aerospace Dynamics and Control
Aeroelasticity	Computational Engineering 2: Computational Fluid Dynamics
Structural Integrity of Mechanical Systems	
Space Vehicles and Missiles	
Final Year Thesis	Final Year Thesis

It must be noted that the academic program included the attainment of the final year thesis, which is treated at RMIT as an additional course. At this stage, the thesis supervisor was not defined and I needed to apply for a thesis topic while already in Melbourne.

2.2 Applying for a visa

The following step prior to leaving was to apply for a visa. This process is totally managed by the student through the Department of Immigration and Border Protection of the Australian Government [4]. The most restricting part of the procedure is the obtaining of a medical certificate, which can only be issued by specific doctors (in Spain, only in Madrid, Barcelona, Bilbao and Seville).

3 During the stay

Once all the paperwork is performed and the approval from both universities and the visa is obtained, the stay is ensured. Even though the first activities from the university started on March 1st, I finally left for Australia on February 12th, to leave enough time to settle. RMIT offered a free service for exchange students for which a chauffeur picked up the student at the airport and dropped him at his place of residence. In my particular case, I stayed at a students' residence recommended by the RMIT site for the whole period, in order to make it easier to adapt and socialize in such a new environment

3.1 Orientation week at RMIT

Given the huge number of exchange students at RMIT (about 350), the International Office of RMIT organized what they called "orientation week" for international exchange students one week prior to the start of the classes. During this week, several activities took place in order to ease the adaptation period for the students. The activities included presentations to explain the Australian culture and language peculiarities, what to do in case of medical emergencies, robbery or similar, how to get a bank account and a phone SIM card, etc. In between these presentations, more social activities were planned in order for the students to break the ice and meet each other, forcing people to speak to each other asking where they were from, what they studied, etc.

As an example, during one activity in a lecture theatre, the RMIT staff introduced all the countries that took part in the exchange. All the students coming from the country that was mentioned had to stand up for everyone else to see them. The author turned out to be the only Spanish student at RMIT during that year. It was unexpected and I came to the realization that I was there on my own, but I also saw the opportunity of getting to learn and mature from leaving my comfort zone, opening myself to new cultures and ways of thinking, and improving my level of spoken English. After some years, I realize this was one of the keys of my stay in Australia being so profitable and successful.

The orientation week also included some free meals (i.e. a typical Australian barbecue) so that the students could keep socializing, a gymkhana and more formal meetings in order to help everyone enroll in their courses. This last topic was not an issue in my case given that I had already signed an academic program agreement with my home university. Finally, the orientation week finished with a dinner and a party at a known pub of the city, where the prizes of the gymkhana were also handed, giving further opportunities for the exchange students to get to know each other.

During this week, I met some of the people that conformed the main group of friends that I had during the first semester. To get an idea of how diverse and enriching this experience was, it is important to mention the different nationalities that composed the group: people from Denmark, Mexico, Germany, United Kingdom, Argentina, Finland, Canada, Chile or Korea shared their cultures and experience.

3.2 Academics

When it comes to the academic part of the stay, I had to overcome the aforementioned courses (recall Table 1) in order to get credit for the Spanish ones. The methodology of the lectures was very similar to the one that is being implemented in Spain at the moment with the European Higher Education Area (EHEA): there are still formal lectures, but more active work from the student is pursued at all stages of the learning process. The continuous evaluation system is implemented, with several evaluation acts, including some assignments to be carried out during the lectures themselves.

With regard to the final year thesis, it is important to note that the procedure is quite different from the one at UPV, where all the qualification is given at the end of the work, both from the thesis document and the presentation. In RMIT, the final year thesis is seen as an extra course where the continuous evaluation is also introduced. Thus, there are several milestones with deliverables that are also qualified, including a blog that must be updated each week, a poster presentation, etc. In my case, I talked to my aerodynamics professor, who was offering topics related to computational aerodynamics, and after an interview where I shared my preferences, he agreed on supervising my work on the topic "*Firefighter Unmanned Aerial Vehicle Airfoil Optimisation Using Particle Swarm Optimisation Method*". We used to have a meeting every 2-3 weeks in order to discuss my progress, sometimes together with the other students he supervised, so that we could check everyone else's progress and see if we were getting behind.

The final year thesis presentation was certainly the most difficult challenge I faced during my stay. I had to orally expose my work at the end of the year, with a limited ability for public speaking and the handicap of the English language. I was not confident at the beginning of the course, but after 10 months immersed in the country my spoken English got higher fluency and this handicap was reduced. The presentation was a great opportunity to learn and develop the transversal skill of public speaking. Nowadays, I regard this fact as one of the main contributors to succeeding in my professional life, since I was able to obtain a position as a lecturer (in a high performance group where the lectures are imparted in English) at my home university.

With all, I must state that with the previous formation I was given at UPV, I felt prepared to face all the courses and studies that I had to perform during my exchange, being able to overcome the difficulties that I found on the way.

3.3 Cultural shock

Being immersed in a different culture for 10 months is definitely one of the key benefits of an international exchange. From the very first moment you step out of the plane, you feel the differences with what you considered the normal way of doing things. Starting with the meal hours, many things you take for granted are dismantled.

One of the main peculiarities of Australia is that it is a really diverse country. Almost 50% of its inhabitants were not born in there. This peculiarity was also reflected in the classrooms. Not even 40% of my classmates were native, and there was a high representation of people from several countries, especially from Asia (India, Indonesia, China...), with a minority of European people coming from an exchange. This resulted in multicultural groups for the assignments, where you could get in touch with different ways of doing things. Another shocking fact I noticed during the lectures was the relaxed and informal atmosphere, since the students were even allowed to eat in the classroom.

With Australia being such a multicultural country, the food was also diverse. There is not such a thing as Australian food, but rather a mixture of tastes from different countries. This was particularly reflected in the corridors of the supermarkets and was a difficulty when it came to preparing meals for myself. One realizes that the necessity makes you able to adapt to any situation in order to survive.

This cultural shock resulted in me getting more open-minded and recognizing that there are different ways of performing the same tasks, none of them being better than the others a priori. This lets you eliminate prejudices, being tolerant, getting a critic sense and being capable of imagining different solutions to the same problem since you are not initially closed to one of them.

3.4 Social life

Every international exchange is an opportunity for meeting new people and developing social skills. As it was stated in Section 3.1, I was able to make friends from different countries. This was powered by the orientation week at RMIT, but there were many other activities that further enhanced the number of situations from which getting to know new people.

For example, RMIT had an agreement with the Australian Football League [5] for which it delivered, under demand, free tickets for Australian Rules Football games to exchange students. The university also offered the possibility of joining a group to go to the games.

In addition, I joined a surf club that organized trips almost every weekend and made it able to get in touch with further people.

Staying at a residence also offered a lot of possibilities when it came to social life, since they organized activities such as barbecues, parties, sports days, small trips...

Finally, I got to travel around Australia with some of my friends, meeting even more people since we used to join tours and stay in hostels. Among the destinations we can encounter the Great Ocean Road, Adelaide, Sydney, Uluru, Tasmania, the East Coast or the southern island of New Zealand.

4 After the stay

After the stay, I got many important benefits from my international exchange at RMIT. Firstly, I would like to mention all the transversal skills that I developed: learning another language, enhancing the critic spirit, being able to speak in public, socializing...

However, there were also tangible benefits from the stay: as a result of my work for the final year thesis, I published an article for an international professional conference in Melbourne, that was exposed by a classmate since I had already left the country. In addition, I was able to obtain further English official certificates. These two facts opened many professional doors for me and were essential for getting my first job and, afterwards, the position that I hold now as a lecturer at the UPV.

In short, all the benefits made up for the few difficulties that I encountered. Even more: the difficulties have been part of the learning procedure. Getting out of my comfort zone allowed me to lose the fear of the unknown and getting to know myself in a better way: my ability to adapt to different situations, to ends that I did not consider at my reach beforehand, discovering my limits. With all, the internationalization of the engineering education has been essential for my personal and professional development.

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Full Papers

Attracting international students: a proposal for the School of Engineering of the University of Minho

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Conference Key Areas: The Global Engineering, International Networking, International Cooperation Programs
Keywords: internationalization, higher education institutions (HEI), HEI marketing, international students

Abstract

In a competitive global environment, higher education institutions (HEI) are pushed to design and implement refined strategies to strive, counting on the quality of education, the excellence of research and the ability to effectively transfer knowledge to society. Bearing in mind that an organized strategy would boost the international visibility and brand promotion of the School of Engineering of the University of Minho (EEng), leveraging its position in the ranking of HEI quality and reputation, and taking into account the motivations regarding the increase of the number of international students (scientific recognition, international scientific cooperation networks, attraction of high potential students and revenue), this paper portrays the evolution of the internationalization pattern of the School of Engineering of the University of Minho, presenting the most significant progress regarding international networking in both research and educational activities, which has contributed to increase the international visibility of the School. Moreover, the paper draws on theoretical frameworks of services marketing and HEI marketing, namely concerning the motivations to study abroad, to support the goal of increasing the number of international students at the School. Furthermore, new strategies are proposed to achieve broader international academic contact networks and establishing even more international collaborative initiatives.

1 Introduction

Celebrating its 39th anniversary in 2014, the School of Engineering of the University of Minho (EEng) has been committed to the world of research, development and innovation, achieving a remarkable reputation as an international engineering higher education institution. The EEng offers higher education and innovative research opportunities on classical engineering areas as a cornerstone of education in the Engineering domain. Notwithstanding, the School also devotes its efforts to innovative ground-breaking scientific areas, the so called “new engineering”, involving new manufacturing technologies, more efficient processes, advanced design, energy and sustainability. With nine departments (responsible for different scientific and pedagogical engineering areas) and eleven research centers, the School wishes to promote knowledge and innovation working towards the reinvention of future and providing effective solutions to the societal challenges of our days: environment, energy, reindustrialization, sustainability, bioengineering, etc.

Considering an international competitive network of high quality and reputable higher education institutions (HEI), and currently facing governmental funding constraints in part due to a financial crisis across the country, the EEng has nonetheless been able to step up to the challenge and promote cross-institutional initiatives to boost the multidisciplinarity of its research and education projects.

The European University Association (EUA) has recently analyzed Portuguese higher education and recommended that Portuguese HEI adopt strategies to increase their internationalization efforts, namely by considering legal conditions allowing the recruitment of foreign students, by increasing the number of international academics and researchers, by increasing operational competence in English and by developing a lusophone Massive Open Online Courses (MOOC) platform [1].

The Portuguese universities affiliated to CRUP (Council of Rectors of the Portuguese Universities) have also been recommended to adopt a joint strategy particularly to attract international students leveraging the internationalization of the Portuguese higher education [2], a concern which is also strategically considered in the University of Minho's (UMinho) Strategic Plan for 2020 [3].

In fact, the number of international students enrolled in higher education projects outside their countries of origin – 4.3 millions in 2011 according to the OECD [4] – shows that students are looking for opportunities to continue their academic paths in foreign destinations. Undoubtedly, this trend constitutes an opportunity for HEI to boost their international cooperation network, not only by attracting more international students, but also using this as a lever to design and implement further international cooperation projects and increase their worldwide visibility and reputation.

The following section will show the evolution of the internationalization pattern of the School of Engineering of the University of Minho, presenting the most significant progress regarding international networking in both research and educational activities, which has contributed to increase the international visibility of the School.

2 Internationalization at the EEng

Globalization and internationalization are not the same: globalization comprises the "economic, political and societal forces pushing 21st century higher education toward greater international involvement" whereas internationalization involves choices and strategies designed and implemented to cope with globalization and maximize the benefits of global actuation [5] [6].

The UMinho is committed to its role in the global community and has consistently been able to attract international academics and other stakeholders, collaborating with renowned institutions worldwide. Each academic year, around 50 UMinho faculty members develop activities in foreign universities. Over the years, the UMinho has signed more than 300 cooperation agreements with foreign universities and research institutes, covering around 90 countries all over the world.

The International Relations Office (SRI – *Serviço de Relações Internacionais*) of the UMinho plays a very relevant role in coordinating, monitoring and supporting the development of all initiatives related to the internationalization of the University, especially as far as academic cooperation and mobility are concerned. The EEng has counted on the SRI's strategic support in managing exchange programs and internationalization opportunities for faculty, students and staff, which has greatly contributed to the success of cooperation activities already established.

Despite being a considerably young institution, the UMinho has already achieved high reputation in the international higher education institutions' network. In 2012, the UMinho reached a position on the Times Higher Education World University Rankings (351-400th position), where only two Portuguese universities, UMinho included, are placed. In 2013, the UMinho has also achieved the 76th position on the Times Higher Education 100 under 50 University Ranking 2013, a ranking of the top 100 universities under 50 years old which in a short period of time have reached a global level of excellence in education and research. The UMinho's profile in Times Higher Education emphasizes the institution's commitment to internationalization. Although the University of Minho is not ranked in the first 100 institutions in the area of Engineering & Technology, this is a goal the EEng intends to contribute towards in the near future.

The rankings are established through performance indicators in four main areas of the HEI mission: teaching, research, knowledge transfer and international outlook. According to the THE World University Rankings methodology, the internationalization in the HEI mission areas refers to the degree in which the HEI collaborates with international partners, namely the number of foreign students and faculty and international publications. This paper will now explore the EEng's own internationalization path contributing to the excellence results achieved by the UMinho.

The EEng represents around 30% of the UMinho in terms of number of students and of number of 1st cycle, Master degree or PhD courses. However, in terms of research projects, the projects developed at the EEng account for around 70% of the total funding and number of research projects of the UMinho.

The EEng has also been consistent with its internationalization results, showing significant progress regarding international networking in both research and educational activities, which has contributed to increase the international visibility of the School.

The EEng carries on participating in several bilateral initiatives and European projects.

The School coordinates the international Erasmus Mundus Master Course SAHCS - Structural Analysis of Monuments and Historical Constructions since 2006 and the Erasmus Mundus Master Course EuRheo - European Masters in Engineering Rheology since 2008.

The EEng coordinates also, since 2006, the MIT-Portugal Program Focus Areas Engineering Design and Advanced Manufacturing–EDAM and Bioengineering. Furthermore, the EEng is involved in collaborations with the University of Texas at Austin since 2007, in the framework of the UTAustin-Portugal Program, particularly concerning the entrepreneurship areas (UTEN - University Technology Enterprise Network) and the focus area Advanced Computing. The EEng was also involved in cooperation activities with Carnegie Mellon University, from 2008 to 2010, in the framework of the CMU-Portugal Program, namely through the focus areas Technology, Innovation and Policy and also Information Processing and Networking, promoting two Doctoral Programs – Telecommunications and Informatics – in cooperation with the Portuguese universities of Aveiro and Porto, which are still part of the School's curricular offer.

From 2010 to 2013, the EEng has promoted 31 cooperation agreements with foreign universities and scientific research institutes, resulting in global cooperation activities, namely exchange programs for students, faculty, researchers and staff, joint research projects, double-degree and joint-degree programs and organization of joint conferences and workshops.

There are several collaboration models currently undergoing, such as:

i) Programs leading to a degree from UMinho: foreign students enrolled in the EEng's courses; Master Courses and Doctoral Programs (comprising a period of student mobility at the EEng) lectured in other countries by the EEng's faculty, in collaboration with local institutions (Timor, Cape Verde, Brazil) and distance learning courses.

ii) Joint degree programs: exchange agreements with several European universities for joint degrees in Doctoral Programs. Furthermore, joint and double degree agreements are currently being discussed with several foreign universities in the framework of Integrated Master Courses and 2nd Cycle Master Courses.

iii) Collaboration programs: Short Courses, Master Courses and Doctoral Programs lectured in other countries by the EEng's faculty, although not leading to a degree of the UMinho (Angola, for example).

Currently, the EEng is drafting a new proposal to increase the number of curricular units taught in English, not only to improve its own students' language skills (preparing them for a globalized market place) but also enabling the EEng's educational programs to be more attractive to foreign publics. As far as the Doctoral Programs are concerned, all Behavior and Innovation Options (which are compulsory for any student) are already taught in English.

The EEng has also successfully incorporated an already existing MOOC in the framework of the curricular unit "Innovation", which is included in the first academic year of all Doctoral Programs. The course entitled "Planning Change and Innovation", by Professor David O'Sullivan, from the National University or Ireland, Galway, was taught through an online platform made available to students. Nonetheless, in the second edition of the course, an initial tutorial and three further support sessions were held by an invited lecturer at the School, collaborating with Professor O'Sullivan. All course activities were managed through the online platform, from assessment papers to debate forums, using videos, reading notes and slides. All students are required to set their self-pace and use the social learning platform.

Considering e-learning, the EEng offers a full Master Course taught through distance learning methods: Master Course in Properties and Technology of Polymers.

Boosting the global reach of its activities, the School promotes also mobility programs of students and faculty, in the framework of several mobility programs, supported by the International Relations Office (SRI) of the UMinho. Tables 1 and 2 present the main results of mobility exchanges in the past 4 years.

Table 1. Mobility of students (outgoing/incoming) per academic year

	2009/2010	**2010/2011**	**2011/2012**	**2012/2013**
Outgoing	114	140	118	124
Incoming	80	173	246	213

Table 2. Mobility of faculty (outgoing) per academic year

	2009/2010	**2010/2011**	**2011/2012**	**2012/2013**
Outgoing	26	31	17	26

As far as research projects are concerned, international funding currently accounts for around 30% of total funding at the EEng. Table 3 presents the evolution of national and international funding (both public and private) for the last 4 years, explicitly portraying a decrease of private funding, both at national and international levels.

Table 3. Funding of research projects (EEng)

	Public Funding (w/ EU support) (thousand €)		**Private Funding (thousand €)**	
	National Programs with EU funding	International Programs with EU funding	National	International
2010	20301	10315	576	803
2011	28990	13327	521	438
2012	31407	18407	467	261
2013	38020	14074	412	212

From 2010 to 2013, the EEng's research centers have been involved in more than 50 international research consortia, which accounts for around 50 million Euros in terms of funding volume. As far as research projects funded by European organizations are concerned, the researchers have led around 70 projects in this period, representing over 15 million Euros in terms of funding.

During this period, the research centers have been collaborating with several renowned international and European institutions, to name a few: Massachusetts Institute of Technology (MIT), University of Texas at Austin (UTA), Carnegie Mellon University (CMU), Autex, Textile ETP, Tokyo Women's Medical University, EMBL European Molecular Biology Laboratory, EBI European Bioinformatics Institute, Fraunhofer Institute, IATA-CSIC, Technical University of Denmark, Aalborg University, Wageningen University, Institute of Chemical Process

Fundamentals, Pasteur Institute, VTT, Technical University Delft, University of Groningen, Katholieke Universiteit Leuven, University of Galati, École Polytechnique Fédérale de Lausanne, CEMEF École des Mines de Paris, Warsaw University of Technology, Wroclaw University, Technical University of Liberec, University of Ostrava, University of Cranfield, University of Southampton, Queen Mary University of London, Technical University Chalmers, University College of London, Imperial College, Politecnico di Milano, University of Padua, University of Ferrara, University of Salerno, IMDEA, Universidad de Valladolid, Universidad Politécnica de Barcelona, Universidad Autónoma de Barcelona, Universidad Politecnica de Madrid , Universidad de Vigo, European Organization for Quality, German Research Center for Artificial Intelligence, CIRP The International Academy for Production Research, Networked European Software and Services Initiative, Hasso Plattner Institut, CERN, Foundation for Research and Technology – Hellas.

During this period, several research projects have also been developed in cooperation with companies from all over the world, such as Bosch, Groz Beckert, MATERIALISE NV, Kedrion, Cell Med, Specialni Polimeri Ltd., Tinfer, S.L., Color-Center, S.A., Tecnologie Biomediche Srl, Inotex Spol. S R.O., Perca Ltd., Fidia Advanced Biopolymers s.r.l., Swerea IVF AB, SAMO s.p.a., INNOVENT e. V., Q-Sense AB, Histocell S. L., Porifarma BV, STUDIO ASSOCIATO GAIA SNC, ATRAHASIS SRL, NanotecMARIN GmbH, SIMPLEWARE LIMITED, DOCK 11 GmbH, ARSTIC AUDIOVISUAL SOLUTIONS SL, MEDOVENT GmbH, Altakitin Corp, Softeco Sismat Srl, DUPONT, Fromageries BEL, Wetsus, Adisseo France SAS, Deltares, Altreonic, Galois, FORD Automotive, TOTAL, BASF, DSM, Bekaert, TNO DIANA, S&P Clever Reinforcement Company, Sika and several others.

As far as international publications are concerned, for the past 4 years, the EEng’s researchers have published over two thousand papers in international publications ISI/SCImago (Table 4).

Table 4. International publications ISI/SCImago

2010	2011	2012	2013
382	528	632	645

The EEng’s research projects have contributed to effective transfer knowledge to society, in the form of new production methods or new products and services, which in the past 4 years led to the registration of 70 new patents, from which 27 are international patents (Table 5).

Table 5. National and International patents

	2010	2011	2012	2013
International	7	11	4	5
National	14	5	15	9
Total	21	16	19	14

The EEng’s researchers have presented more than 3 thousand papers in international conferences over the last 4 years (Table 6).

Table 6. Papers in international conferences

2010	2011	2012	2013
699	991	820	731

From 2011 to 2013, the EEng's researchers have been responsible for or participated in organizing committees of 63 international conferences, 34 of them held in Guimarães or Braga, Portugal, the cities where the UMinho's campuses are located.

These internationalization efforts have consistently contributed to increase the international visibility of the School, resulting in an urge to implement organized marketing strategies to take further action in terms of notoriety and reputation of the School worldwide.

One of the consequences (and, then again, results) of broadening the actuation area of a HEI is the attraction of international students.

In 2013, the EEng received around 6000 students for its 1st cycle, Master courses and Doctoral Programs, from which around 400 are of foreign nationalities, accounting for approximately 7% of the total number of students in the academic year of 2013/2014, for all cycles of study.

According to the Portuguese Directorate-General of Statistics for Education and Science (DGEEC), almost 29.000 foreign students were enrolled in Portuguese HEI in the academic year of 2011/2012 [7]. From these, students from Brazil and other countries of the CPLP (Community of Portuguese Language Countries) and the Mediterranean countries geographically closer to Portugal account for the higher percentage of enrolled international students.

The motivations of HEI to adopt marketing strategies in general and to attract international students in particular will be under detailed analysis in the following section.

3 Marketing Higher Education Institutions

Product marketing principles are not to be applied to services due to specific characteristics of the latter, as these constitute intangible and perishable activities, which do not result in material possession. Services are delivered in an interactive process with the ultimate goal of satisfying the customer [8].

Research in educational marketing is essentially drawn from the theoretical framework of services marketing [9]. Kotler & Fox [10] define marketing for educational institutions as the analysis, planning, implementation and control of carefully designed programs to promote voluntary value exchanges with target markets and to reach institutional goals. According to the authors, marketing involves adapting the offer from the institution to respond to the needs and wishes of the target markets, using efficient price, promotion and place to inform, motivate and respond to those markets. A marketing-oriented educational institution will be able to determine the needs and wishes of its target markets (not only students, but also other relevant stakeholders) and satisfy them by adapting its marketing mix: in services marketing, the 7 P's – product, price, place, promotion, people, process and physical evidence [10], [11].

By defining a marketing strategy, the HEI will be able to [10]:

- Decide to maintain, improve or cancel any particular educational offer;
- Create new programs and market opportunities;
- Analyze its main competitors;
- Position the HEI in relation to its competitors;
- Select target markets and plan their marketing mix.

By using marketing tools, a HEI is therefore able to reach a competitive advantage in comparison with its partner institutions, allowing them to differentiate their educational offer and related activities from fellow competitors. Constant monitoring and definition of strategies will in turn lead the HEI to understand the wishes and needs of its target market, adapting its global service offer, increasing in turn the perception of quality and satisfaction of its customers [11], [12], [13].

The internationalization of HEI and the constant global competition have led institutions to define strategies and implement programs in order to attract more students, more funding and establish broader collaborative research networks, thus increasing their visibility and reputation worldwide.

Altbach & Knight [5] discuss the main motivations HEI have identified for academic internationalization:

a) Profits: universities define several international strategies such as collaborations with local institutions, alliances or branch campuses not only aiming at financial profits (by charging higher fees or increasing the number of students) but also considering improving research and knowledge capacity as well as to increase cultural awareness and provide students with the learning outcomes of an international experience;

b) Demand Absorption: demand for higher education has been increasing and lack of opportunities or capacity itself in origin countries leads to a search for opportunities abroad;

c) Traditional Internationalization: activities such as international programs or study-abroad experiences are not substantially oriented towards financial profit, but nonetheless contribute to increase competitiveness and reputation;

d) European Internationalism: as part of regional integration and cooperation initiatives for Member States, programs such as ERASMUS have been implemented for several years. The Bologna process seeking harmonization of academic systems could also be referred to as an initiative of internationalization;

e) Developing-Country Internationalization: developing countries are interested in attracting international students to local HEI as a way to improve their ratios related to quality, reputation and income.

f) Individual Internationalization: self-funded international students account for the largest percentage of international mobility, leading to conclude that they are the largest source of income for international education institutions.

On one hand, for underdeveloped or developing nations, seeking international cooperation opportunities might be considered as an effort not to fall behind in terms of not only economical but also academic progress, as studies have associated the mobility of students to foreign countries to weak political, social, economic and academic weaknesses of the countries of origin [14]. On the other hand, for developed countries, establishing partnerships with the latter may allow them to embark on different types of internationalization activities, such as offshore campuses, joint degree programs, aiming at increasing not only profits associated with these marketable initiatives but also to expand their influence area [5].

Internationalization through study abroad is a means for HEI to promote their students' cultural awareness, global competences and intercultural communication skills [15].

Several studies have focused on college choice process and decision factors, not only regarding choice of an HEI at the home country, especially in Australia, Scotland or United Kingdom [13], [16], [17], [18], but also at international level.

The student's motivation to choose a foreign institution to proceed with his/her academic path has been referred by several authors in the framework of the push/pull models [19], [20], [21], [22], [23]. The "push" factors refer to economic or political issues in origin countries which lead students to leave their countries; the "pull" factors are characteristics of the destination country or, particularly, the destination institution, working together to attract students, such as cultural, economic and political situation of the destination country, reputation and quality of destination institution, international recognition of granted degrees or the location of the destination HEI [21], [22], [23]. Both factors, either positive or negative, act as an influence to the student: whereas there may be repulsive factors pushing the student to leave the origin country, other positive factors act as attraction stimuli [6].

When looking for international destination HEI, the student is most likely to select those which overall market image best relate to the student's goals and aspirations [24].

Several factors may influence the students' choice of a destination HEI: academic reputation and overall perceived quality of the destination HEI; educational offer, including the number and variety of available programs and scientific research areas; cost, including tuition, cost of living, accommodation and extracurricular activities; the degree of information made available by the destination HEI and its adequacy to the students' needs; the location of the destination HEI; employability rates; and influence of others, namely family, friends or supervisors [13], [16], [17], [18], [20], [22], [23], [24], [25], [26], [27], [28], [29].

A research study by Nyaupane et al. confirms that "social ties", particularly close friends who live in a foreign country, influence the students' decision regarding a destination country to a great extent [30]. The experience of present or former fellow students is also considered of the utmost importance as an information source, as potential students value this information as being trustworthy and consider the possibility of immediate feedback and clarification [16], [27], [31].

In fact, service consumers are more likely to consider promotion and communication strategies focused on interpersonal communication when it comes to information search and trust on provided information, seeking to reduce the risk associated to the choice process in a rather intangible environment [27], [31]. Word-of-mouth is also considered one of the most powerful promotion tools a HEI could strategically use, as the perception of the institution's reputation is largely associated with its consumers' evaluation [23].

Knowing which factors mostly influence the attraction of students may assist HEI to redefine strategies and therefore increase the success of their internationalization strategies by adequately responding to the various stakeholders' requirements.

Indeed, the participation in collaborative international networks presented in section 2 of this paper and the contacts and cooperation activities established through these networks have led to the increase of the number of international students at the EEng (Table 7). In the academic year of 2011/2012, the number of international students represented 5% of the total students enrolled at the EEng, whereas in 2013/2014 it represents almost 7%.

Table 7. International students at the EEng

	2011/2012	2012/2013	2013/2014
1st cycle and Integrated Master Courses	103	86	82
2nd cycle (Masters)	144	114	120
3rd cycle (PhD)	82	77	178
Total	329	277	380

The consequences of the increase of international students at the EEng are notorious: attraction of high potential students and researchers; creation of more collaborative research projects and activities; potential of increasing the number of outgoing students; increasing the international visibility of the EEng and thus promoting its participation in international research project consortia and attracting international funding.

The EEng wishes to maintain and explore the growing trend of attracting cooperation opportunities abroad, namely the increase of the number of international students enrolled in the School's education projects. The following section will look at further strategies which are being designed and implemented at the School of Engineering in order to boost the results of the internationalization of the EEng.

4 Further strategies for internationalization of the School

The University of Minho is currently discussing a structured policy for internationalization activities under a strategic framework, defining main target areas and education and research programs in cooperation, including promotion initiatives, specific market targeting strategies, improving the welcoming experience of international students and faculty as well as mobilizing the whole academic community towards an organizational culture devoted to internationalization.

In the context of a broader general policy at the UMinho, the School of Engineering wishes to act as a test bed for the main internationalization strategies, currently considering several strategic actions to achieve broader international academic contact networks and establishing even more international collaborative initiatives, boosting the attraction of international students.

The EEng plans to increase the involvement of professors/researchers in European projects with international consortia and increase the number of joint doctoral programs in cooperation with international HEI.

As proposed in the Strategic Plan of the EEng for 2020 [32], the School is currently discussing an increase of the number of curricular units taught in English for all study cycles. The EEng also plans to fully teach all Doctoral Programs in English within three years.

Attention is also been paid to countries which are less sough after in terms of academic partnerships, but whose populations lack higher education training and would be interested in taking part of the UMinho's international network. We refer not only to the PALOP (African Portuguese Speaking Countries) but also to other developed and developing countries with a strategic interest in entering Portuguese speaking labor markets of high potential, such as Brazil or Angola.

In fact, as one of the world's most spoken languages, Portuguese can be considered as a valuable asset in the world's economy today. If, on the one hand, the School intends to broaden a curricular offer in English language to respond to a higher demand, on the other hand a complementary curricular offer in Portuguese language is considered as a strategic position to fill in niche market demand in higher education (such as oil, gas and renewable energies in Portuguese speaking countries).

Drawing on the successful results of the first MOOC implemented at the EEng, the School wishes to proceed with creating a broader offer of MOOCs, namely as compulsory projects within the curricular units for all Doctoral Programs.

By involving foreign faculty and students in its Doctoral Programs, the EEng is also promoting research-based international collaboration, as joint degree programs or exchange periods within PhD courses often create cornerstones for broader collaborations in research, development and innovation. The School intends to further capitalize on these strategic opportunities.

International visibility and recognition is a relevant issue regarding brand promotion and quality awareness. Therefore, the EEng plans to promote the School overseas. This will be achieved through direct institutional visits and direct contacts established with partner institutions, presenting the competencies available at the School. A number of missions led by the Dean and the Presidency team to several countries are also being planned.

The role of academics acting as representatives of the School of Engineering in their own countries must also be strategically considered. The School plans on boosting the role of international faculty and Alumni as the Ambassadors of the EEng abroad, as word-of-mouth is proven to be one of the most effective ways of communication and promotion. They would act as individual marketing points at their home institutions, involving their own academic networks and providing relevant information to those interested in establishing closer cooperation with the EEng, either in terms of education opportunities or research partnerships.

Despite international students being received at the University of Minho by the International Relations Office (SRI), the office's welcoming programs are especially dedicated to students participating in institutional mobility programs, such as Erasmus, etc. Students wishing to individually engage in post-graduation course at the EEng often face difficulties when contacting administrative services. A recent study being developed at the EEng in the framework of one of the authors Master Thesis has concluded that students often refer to the need to implement organized welcoming strategies and a liaison office which would help them trigger these difficulties. Aiming at responding to the need identified and in order to improve the welcoming experience of the international student, the School is considering implementing a pilot project, namely an internal welcoming office (i.e., an International Student Ombudsman).

It is also utterly important to understand the students' satisfaction after they complete their degrees or after experiencing a mobility period at the EEng. Other studies have focused on the assessment of former experiences of international students in the framework of exchange programs [33]. The EEng also wishes to implement such as assessment project aiming at identifying improvements which could lead to a higher satisfaction of international students.

We could argue improving communication with international students through the School's official website is relatively simple. Therefore, the EEng's website is being revised for several weeks now, currently in its final stage of revision, to adapt all communication to English language and complement the existing information with more details relevant to international students, namely linking this website to information on campuses' location, accommodation, websites for each Doctoral Program, etc.

The EEng wishes also to increase cultural awareness of the national students' and general community by organizing activities involving international students with the local community. Other researchers have suggested the success of such strategies in terms of improving communication skills of students by allowing an exchange of cultures but also of different backgrounds, promoting multidisciplinary learning experiences and involving the whole of the academic community in welcoming foreign students [34], [35].

5 Conclusion

The EEng has currently achieved a remarkable international reputation regarding its education and research projects, contributing to the UMinho's relevance in the global HEI network. However, further internationalization strategies are needed in order to broaden the cooperation network and attract high potential students and researchers, boosting the EEng's visibility worldwide. It is of the School of Engineering's strategic interest to establish joint cooperation opportunities which could have a global impact on its education and research results. Providing a global actuation environment encourages the academic community to engage in excellence education and research cooperation networks worldwide, boosting the School's recognition as an international reference institution, contributing to the UMinho's overall visibility and reputation. The EEng is keen on making the most out of joint international synergies by combining the excellence and expertise of its partners with those of its own researchers in order to successfully face challenges ahead.

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European Project Semester: Good practices for competence acquisition.

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Abstract

The world is changing rapidly in many ways, including technologically. Therefore, current engineering students have to acquire new competence to survive and compete in the future global scenario. What new mindset and skill set should they acquire and what existing work values should be preserved? In order to answer partially this question, we are developing an innovation Project: Integration, communication and teamwork. The goal is to conduct a research about the contribution of European Project Semester (EPS) on competence acquisition. Thanks to a multicriteria approach and rubrics, we evaluate and assess the integration of knowledge, the ability to design and manage projects and the effective communication.

EPS produce a strong learning environment thanks to multidisciplinary and multicultural atmosphere and the potential of POL supported with teamwork and open and experimental context.

The process and the timing are focused on the acquisition of key competences and skills, with particular regard to their relevance for the labour market and their contribution to a cohesive society, in particular through increased opportunities for learning mobility and trough strengthened cooperation between the world of education and training and the world of work.

EPS is aligned with Education and Training 2020 and 2011 EU modernisation Agenda.

1 Introduction

1.1 To be or not to be competent

During the last decade, the importance of acquiring competences has begun to replace the classical content-based learning model. The notion of competence, as well as its taxonomy and evaluation, can be defined in several ways [1] [2], but in general terms it can be regarded as relevant knowledge and skill applied to the standards of performance expected in the workplace [3]. It includes the capacity to apply skills and knowledge to new tasks in a range of environments.

Most definitions highlight the following key aspects of competency:

- It is a combination which goes beyond the simple possession of resources;

- It depends on the conditions/situations in which it is activated;

- Its organization is stable (relatively) across a full range of situations.

These aspects are essential to understanding and emphasizing the close relationship between competency and the work situation. Each definition is based on a particular model of competency. We assume that the development and use of each competence needs the simultaneous occurrence of different kinds of interactions in the real work situation.

Boterf [4] defined competency as "a result of a combination of several individual resources (knowledge, ability to do, qualities, skills) and of resources from the environment (relationships, documents and other). Individuals put into play physical resources and know-how to achieve results. Competencies are dynamic by nature, and they largely depend on the relevant social context."

In this view, competence development implies a holistic immersion of learners regarding the potential professional demands. What am I really able to do with quality and how can I show or demonstrate it? This ability is individual but also objective and recognizable by society. Following the philosophical perspective of Rey [5] “a competent person is someone openly recognized as a holder of a power or ability". In that direction competence should be subject to public visibility, but at the same time, the respect reinforces the mysterious and personal character. All this makes the tutor's task more complex because it includes in the teaching framework the personal and individual application of what is to be learned in one particular context.

On one hand, there are specific/technical competences, which are directly related to a profession/discipline. Parallel to these we can find methodological competences concerning learning and instruction methods and social-communicative methods as well as professional knowledge. These competences contribute significantly to self-direct learning and the correct application of information.

But competences describe the outcomes of a syllabus in an integral sense, including the mindset, knowledge and skills acquired in the learning period. It’s difficult to see what is new in the modern socioeconomic context. Most of the knowledge would be invaluable in a short period of time; therefore, transversal competences such as adaptation and self-learning become fundamental competences (in fact are very appreciated on labor market). Other representative transversal competencies are team work, leadership, project work, problem solving, autonomy and flexibility.

Despite the desirability of transversal competences in academic fields and in the labour market, they are not always explicitly established in higher education. This may be due to the difficulty of assessing individual differences such as mindset, study methods or work habits, all of which are capable of generating an infinite number of valid performances.

Additionally, the context is each time more global and the new opportunities offered by ICT seem to strengthen multiculturalism and coworking in many areas of engineering. ICT strengthen, further and reinforce established educational goals, curriculum contents, teaching and learning methods. The accessibility to information becomes easier at different levels and represents an interesting, challenging and essential educational theme; a necessary key for understanding and participating in a competitive and demanding world.

1.2 Competences at UPV.

A number of studies have proposed competences for engineers; the European research survey Careers after Higher Education [6], the ABET criteria [7] and the Tuning project [8] are examples. In Spain, the basic competencies and skills required by an engineer are regulated by law. For example, the basic competencies and skills considered necessary for an Industrial Engineer are regulated by a Spanish Ministerial Order CIN/351/2009 of 9th of February, 2009 and include:

1. Ability to draft, sign and develop projects in the field of Industrial Engineering aimed, according to the foreground as provided in paragraph 5 of this order, construction, alteration, repair, maintenance, demolition, manufacture, installation, assembly or operation: structures, mechanical equipment, energy facilities, electrical and electronic installations, facilities and industrial plants and manufacturing and automation processes.

2. Ability to manage activities involved in the engineering projects described in the previous section.

3. Knowledge, understanding and ability to implement the necessary legislation in the exercise of the Industrial Engineering profession.

4. Knowledge of basic materials and technology to learn new methods and theories, giving them the versatility to adapt to new situations.

5. Knowledge of making measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans, and similar work.

6. Ability to deal with specifications, regulations and mandatory standards.

7. Ability to work in a multilingual and multidisciplinary environment.

8. Ability to apply principles and methods of quality.

9. Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.

10. Ability to analyze and evaluate social and environmental impact of technical solutions.

11. Ability to organize and plan in a company, other institutions and organizations.

The UPV also created its own list of *Dimensiones competenciales*. The group of professors in charge of the *European Project Semester* at ETSID-UPV selected four competences from this list and prepared an Innovation and Education Improvement Project (henceforth referred to using its acronym in Spanish: PIME (Proyecto de Innovación y Mejora Educativa). One of the goals of this PIME (called "Integration, communication and teamwork") is to conduct research into the contribution of the European Project Semester (EPS) to generic/transversal competences, which are especially interesting for multidisciplinary contexts. The project focused on four competences: Understanding (and integration), Project Design, Team work (and leadership) and Effective Communication.

1.3 European Project Semester: EPS

European Project Semester is a programme offered by 14 European universities in 11 countries throughout Europe to students who have completed at least two years of study. EPS was created with engineering students in mind, but other students who can participate in an engineering project are also welcome. EPS aims at enhancing the employability of students by bridging the gap between higher education and the needs of the workplace. Therefore, EPS is designed to improve transversal skills, mainly multicultural, teamwork, project management skills. We propose to formalise the experience of working together in multi-cultural and multi-disciplinary teams from different countries and different disciplines. We focus on the need to develop personal competences, especially the ability to work and communicate within cross-cultural groups.

Tables 1 and 2 show some of the key data for EPS in general and for EPS Valencia.

Table 1. Summary of European Project Semester.

Start	Number of EPS providers	Number of nationalities	Participants
1995	14	>50	>3000

Table 2. Summary of European Project Semester at ETSID-UPV.

Start	Number of Departments involved	Number of nationalities	Participants
2005	10	32	292

Figure 1 (below) shows the variation in the number of EPS providers over time. We can see the clear trend in growth with recently more than one HEI/year becoming an EPS provider. In Figure 2 we find the variation in the number of EPS students over time at ETSID-UPV. We include the goal and our risk level and industrial scale.

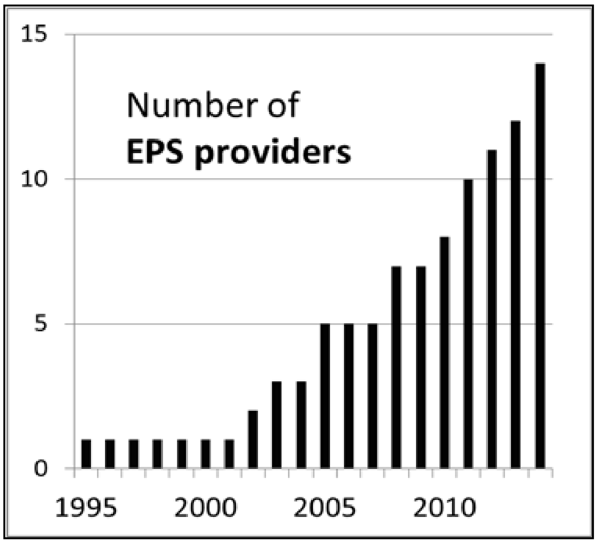

Fig.1. Number of EPS providers over time

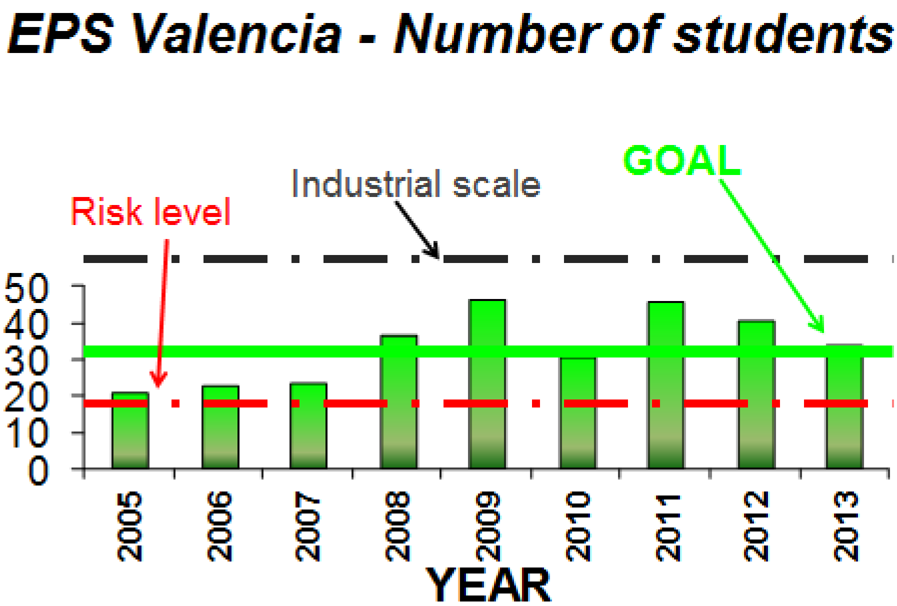

Fig.2. Number of EPS students at ETSID-UPV over time

2 EPS as vehicle to develop competences

EPS is a semester long course for engineering and other students who have already completed at least 4 semesters. It is based on international and interdisciplinary teamwork in cooperation with industry, and includes a mixture of 8 ECTS courses/seminars (range 5-10 ECTS) and a 22 ECTS project (range 20-25 ECTS). One of its prime objectives is to contribute to the education of engineers who, in the future, must be able to work in interdisciplinary teams, operate internationally, speak foreign languages, cooperate with people of different cultures and communicate well.

The above mentioned PIME is focused on four competences: Understanding (and integration), Project Design, Team work (and leadership) and Effective Communication.

Understanding (and integration). Students are required to demonstrate understanding and integration of knowledge in their own specialization and in other broader contexts. The particular conception of EPS favors the immersion in a project from a new reality in a broad sense. EPS generates a strong learning environment thanks to its multidisciplinary and multicultural atmosphere and the potential of POL supported with teamwork and an open and experimental context.

To give an example: 3D laser scanner. In EPS Valencia 2009 a team of students from Japan, France and the UK aimed to convert a 2D laser scanner into a 3D laser scanner. Due to time constraints the results were to form a 3D digital image of the scanners surrounding. However, future objectives for this project are to enable the complete autonomous movement of a robotics platform. This research could be applied to diverse domains such as surveillance and 3D mapping. For a robot to move and to know where it is going it requires a 3D map and to verify each movement against this map.

Project design. To design, direct and evaluate an idea effectively to realize it in a project. Early in the semester EPS students follow a short, intensive course on Planning and Project Management based on a simple model (task, resources, interested parties and environment) and basic tools. More complex models (Prince 2, ISO 21500 Standard) and software are introduced in some cases.

For example: Inclusive Design of a collective route mapper. This project was part of EPS Valencia 2011. The group contained students from 5 different countries; Finland, Sweden, the Netherlands, France and Norway. The project was about how to design a product which anyone could use, regardless of disabilities. In this project it was decided to design a collective automat that would be placed in a public transport terminal, and that would help people find their way from one location to another. The goal of the project was to make the collective automat fast and easy to use for people without any disability and also as user-friendly as possible for people with sensory, physical or cognitive impairment. The final outcome of this project was a well-designed and well planned concept model that fulfills the latest standards and requirements for this kind of product.

Team work (and leadership). To work in teams and to lead teams effectively in order to achieve common objectives, and simultaneously to contribute to professional and personal development.

Group project work must be well organized. Students must learn to prepare and chair meetings and to write minutes of the meetings. Supervisors help with technical advice, follow the team-process closely and help with all kinds of problems including conflicts. We devised protocols to enable the participants to become aware of the quantity and quality of their work, about the initiative and cooperation shown, about planning, and about attitude. We include role plays to develop the ability to solve problems and conflicts if necessary.

Effective communication. To communicate in an effective way, both in writing and orally, by using appropriate resources and adapting the message to the audience and the situation.

For the purposes of EPS we define **communication** as 'the effective sharing of knowledge and information', and the objective of this art of the EPS course is to develop communication skills - in English - in a variety of mainly academic and work-related situations and contexts.

Of course, there are many different features of communication; verbal, written, formal and informal, interpersonal and group, and so on. We explore these aspects (and also basic skills such as listening, speaking, questioning and **sharing feedback**, as well as organising and presenting information in a structured and informative way), through a variety of **practical** activities. These activities themselves allow us to examine several different features of the English language (such as degrees of formality, style, propriety), as well as the structure of technical reports and of shorter text elements such as chapters and paragraphs. We also look at how techniques of persuasion (such as those used in advertising) can be **applied** to presentations.

3 EPS methodology

There are a number of steps or phases in every EPS course. Broadly speaking, these are: course definition, project statements, team creation, brainstorming and planning, task definition, mid-term project development, mid-term project evaluation, project development, project evaluation, exploitation of results.

Course definition includes the provision of resources and the selection of students: agreements between universities, level of English proficiency, soft skills orientation, ECTS background and expectations.

Usually before they arrive at the UPV, students are sent a broad conceptual statement about each project which will be offered. Once at the University and after the initial welcome session, each project supervisor presents the main outlines and objectives of his or her project. At this stage, the projects are deliberately open as it is the students themselves who will define the final details. Further discussion with project supervisors follows, usually during 2 or 3 sessions, after which students choose projects according to their interest. The choice is fairly crucial in terms of motivation, involvement and engagement. Presenting projects in this way at the very beginning enables the students to base their decision of which project to follow on as much information as is available (as well as forming an idea of what the supervisor expects, what it will be like to work with him/her), and in turn enables the supervisors to gauge the level of knowledge and interests of his/her potential team and make any necessary adjustments to the project brief. The Coordinator of the EPS course decides the composition of the teams based on the student choices and with the help of supervisors and/or the Belbin Test if necessary. Two key points to define the teams are: a) all teams should be international (at least 3 nationalities) and b) students' backgrounds will enable them to meet the technical demands of the projects; in other words, they have the necessary subject knowledge.

From the student's point of view, EPS includes many activities. These range from the very first reception meeting to selection of projects, icebreaking activities, meetings with supervisors, team building tasks, transversal seminars, eye opener activities, team working, submission of reports, networking, visits to local factories or doing sports such as canoeing or trekking. In general terms, EPS engages students individually and jointly on a common project based on a new and real situation. In effect, the projects require students to solve multi-disciplinary problems and encourage ingenuity, open-mindedness and teamwork.

Competences are developed mainly through the students having to work in certain situations and under certain constraints. They choose an interesting task, a preferred role, collaborate in the definition of goals and the planning, feel part of a team, and get the support of the staff and the pressure of the 360 degree evaluation. The projects are diverse and a set of options and orientations are available within each particular project. The participants can choose both the project and their particular focus, in terms of subject-matter contribution.

Teaching should be a mixture of good ingredients. An international semester with project-based teamwork like the EPS is a valuable ingredient because students are different, professors are different, and subjects are different. All teaching will be boring and inefficient if it is always done in the same way.

EPS is an "eye-opener". Not only for the already mentioned reasons but because we include academic trips, conferences, specific seminars and self-reflection to create insights and to stimulate creativity.

3.1 Example: BEGO; A mobile theatre

The project was to develop a mobile stage that provides people from small towns with the possibility of enjoying theatre, cinema and concerts. Here we describe briefly the design process of the stage,

the target audience, financial assumptions, its function and how the stage is to move from place to place efficiently.
The name Bego stands for 'Blue with Golden Stars'. Originally, the brainstorm session for the name was aimed at finding a name that had something to do with water, waves, a port (Valencia) and so on. 'Blue' was one of the ideas suggested. That, together with the goal of achieving multicultural operation in future led to the European flag, blue with golden stars.
The scope of the project was originally very wide, and discussions were made on how to narrow it down to more specific details. In the beginning it was not determined whether the stage should be on land or water or even if it should provide facilities for both theatre and music or not. Questions were also raised about whether or not the stage itself should be able to move under its own power or be taken from place to place, as well as if the audience should be on the same structural surface with the stage or not.

The research in total consisted of surveys for possible audiences, interviews with theatre groups, employees from the Culture departments of local towns, boat manufacturers and port workers and research on stage construction, requirements and design.

The group discussed their plans with several different theatre groups, two of which had toured with theatre performances. From them the group learned some basic facts, for example how much the fixed costs of a small mobile theatre group are, as well as the basic needs of a theatre group on the road.

After much research and discussion, the concept included a stage that would be placed on water, was non-motorized and docked to ports. The audience was seated on the same surface with the stage, making it a simple, solid unit. The whole structure was sectional, so that it would be possible to easily disassemble and transfer it to different places either on land or by sea. The stage would travel to small towns without their own theatre but with enough interested inhabitants to provide an audience.

The stage would lie on top of 12 pontoons, which were to be connected to one simple level. On top of that, there would be a floor made from recycled plastic, and the seats and stage elements (made from different recycled materials) would be placed on that. The dimensions would be 15 meters by 10 metres, of which the audience would occupy the major part. The stage itself would be an area 10 x 4.5 metres with a toilet and dressing room behind. Audiovisual design was planned to allow good lines of sight for approximately one hundred people. Illumination and a sound system were included in the design. The 20 different stage lights, loudspeakers and microphones were mounted on a truss system above the stage. Even a fog machine was included.

The stage was completely dismountable, and could be transported in containers located in trucks, via roads and by ferries to the Balearic Islands. Disassembling, as well as assembling was to be done by the Bego crew itself. Two different trucks transport the cargo, one for the pontoons and one for the rest of the material. The route decided on followed the east coast of Spain, including two of the Balearic Islands, all the way down to the south coast. Four shows per day were planned in each city over 4 days (making 16 shows in total). Rest of the week was to be filled with dismounting and transferring to other towns.

The Project team also devised a marketing plan and ways of financing the project. Marketing would be carried out through the local media of each small town. Radio interviews, web promotion, leaflets and posters would be sent some weeks before to the upcoming town. The initial cost would be largely covered by different cultural and governmental funds and ticket income. However, ticket incomes are not the main source of money and basically most of the budget was expected to come from private and public sources of funding.

3.2 Average, exotic or adjusted requirements

In order to adapt our effort to the real needs of our students, we have monitored the most attractive job offers for EPS participants over 4 years. Table 3 shows the most frequently demanded skills in 623 job offers.

Table 3. Requirements of most desired job offers (frequency > 5%).

1. Degree/Accreditation/Experience.
2. Autonomy. Initiative. Independent and with self-learning ability.
3. Team player, able to share and learn in a team.
4. Excellent communication skills. English (speaking, reading, writing). Superior interpersonal skills.
5. Strong leadership skills and a high energy level capable of motivating others. Able to attract and develop new talent.
6. Demonstrable management skills. Good organizational skills and time management, ability to prioritize.
7. Business Acumen. Able to identify situations that present an unacceptable business risk.
8. Conceptual thinker, able to detect upcoming opportunities and needs in changing business environments.
9. Creative thinking, able to find creative solutions in a timely manner.
10. Service and reliability oriented.
11. Proficient in using MS-Office tools (Word, Excel, OL, PPT), using social media platforms and 2.0 tools.
12. Unquestionable integrity/strong work ethic.

The list above is consistent with the results of larger studies and reinforces our ideas about how important is to complement engineering studies with soft skills. We found an adequate balance between Task and Relationships orientation, by integrating different stakeholders in a common personal and team agenda and make a reference to hard skills, ICT and ethics.

4 Acquisition and evaluation of competences

In EPS we evaluate and assess the mindset and practical knowledge of teams and individuals. The students are involved in a complex environment of thinking-action-feedback. The 6 principal assessment tools we use are listed below. They are a combination of the cooperation with HEI partners (not only EPS providers), available research literature (e.g. University of Wisconsin) and our own observations and reflections.

1. Students write a self-evaluation focused on the a) specialist (subject) contribution to the project; b) social contribution to the process (the teamwork); work done so far (product and process) and contribution to it.
2. Students provide peer evaluation about the team members focused on contribution and mindset. That is a critical action in the midterm report. A first part is carried out by the team. Each team should agree unanimously on the distribution of 100 points among the team members

Table 4. Items to evaluate team work.

Subject contribution in major field (quality)		Subject contribution in major field (quan-
Willingness to build upon the ideas of others		Understanding of the team process
Leadership at the appropriate times	Positive attitude	Initiative shown

3. The students provide peer assessment to the rest of the teams. As part of the main public presentations of team projects, the participants are required to provide quantitative and qualitative feedback. This is valuable both to improve the communication skills of the teams and to develop the critical and assessments skills of the listeners. They use the following chart to provide peer feedback on each oral presentation. They should identify the speakers' strengths as well as suggestions for improvement in a constructive way.

Table 5. Chart to provide peer assessment feedback. Beginner level.

		Grade (1-5)
Planning	Evidence of careful preparation	
Objectives	Clarity; appropriacy to audience/subject	
Content	Extent; relevance; appropriacy; subject knowledge; research	
Approach	Message support and reinforcement; variety; humour	
Organisation	Coherence; clarity; appropriacy	
Visual aids	Appropriacy; clarity; handling	
Delivery	Pace; enthusiasm; rapport/eye contact; audibility; intonation; confidence; body language	
Language	Clarity; accuracy; fluency; appropriacy; pronunciation; signalling	
Overall	Clarity of message; Achievement of objectives; interesting? Enjoyable? Informative? Motivating?	
Other		
Strengths		
Suggestions		

Grade scale: 1 = unacceptable 2 = poor 3 = average 4 = good 5 = excellent

Table 6. Chart to provide peer assessment feedback. Competent level.

		Grade (1-5) 1=weak 5=excellent
Aspect	**Comments/Suggestions**	
Organisation&style		
Communications aids		
Content		
Use of language		
Personal appearance Responsiveness to audience		

4. Project supervisors deliver an evaluation of the performance by filling the following chart and providing an overall assessment on each team member. They identify areas of improvement and are constructive. The grade is based on chart (50 %) and on written report assessment

(50%) accordingly with the quality of content, structure of the report, layout, clarity and language.

Table 7. Supervisor chart to provide feedback and assessment.

Name of the team member:		**Grade (0-6)**
Adaptation to & integration into working environment		
Dynamism and motivation		
Efficiency at work		
Ability to work out and analyse the project		
Ability to apply knowledge in the course of the project		
Ability to develop new knowledge in the course of the project		
Sense of observation		
Sense of organization		
Ability for (intercultural) communication		
Self-reliance – sense of initiative at work		
Report-writing (personal work, ability to synthesise…)		
Ability to produce an operational report		
Conscientiousness		
Observance of the working rules: attendance, punctuality, safety…		
Overall Assessment:		
Areas for improvement	**Signature**	

Grade scale: 0=unacceptable; 1=very weak; 2=weak; 3=average; 4=good; 5=very good; 6=excellent

5. The students are evaluated by external examiners. Academic colleagues from Spain and abroad as well as colleagues from industry participate in the overall assessment. They evaluate both oral and written presentations. When students have a company supervisor or mentor, a reference question to summarize the student's work is: "Do you think the student would be able (professionally) to work (with quality) in a company?"

Table 8. Student evaluation matrix for company mentor.

	Strengths	**Weaknesses**	**Comments**
Technical abilities knowledge			
Ability to work independently, to organize his/her work, personal initiative			
Ability to integrate into the company, to communicate and work with others			

6. The students are also required to write a full technical report of their Project, including plans, drawings, technical specifications and so on. The list of contents of the report is flexible and varies depending on the nature of the project. However, the format and contents of the report must adhere to basic standards and requirements. Detailed technical specifications, sketches,

diagrams and so on are included as appendices. The report is evaluated using the criteria set out in Table 8 below.

Table 9. Criteria for evaluation of the technical report.

Focus	Main aspects	Evaluation
Ethics	Plagiarism, confidentiality, fraud and other ethical concerns	
Originality, novelty and innovation	Is the project sufficiently novel and interesting? Does it add to the canon of knowledge? Is the content realistic and relevant? Has a new potential user been identified?	
Technical aspect of the report	Presentation and analysis of the problem Methodology and organisation Summary of project work, answers to problems, results obtained	
Utility of report	Conclusions and follow up suggested Perspectives of the study	
Structure and presentation of the report	Organisation Language: appropriacy, efficacy General presentation and layout	
Relevance, appropriateness, significance and quality	Importance, usefulness, and/or applicability of the ideas, methods and or techniques described. Suitability, compatibility, congruity and adequacy of the content Depth of discussion, link of results to objectives Quality of discussion/conclusions	

4 Conclusions

We cannot predict the future, but we see clear trends in the global job market and hard competition. It is also clear that knowledge and new advances in science and technology are increasing too rapidly for one person to keep up-to-date. Nobody can cope with these developments alone. Engineers have to cooperate in teams with people of different skills and from different cultural backgrounds.

One of the responsibilities of HEIs is to improve systematically the learning environment to adapt, at least partially, the formation and development of students to the changing world.

We will further develop EPS because participants learn actively, become motivated and committed, become creative, change the ”you and I” to “we”, mature, acquire an international network of friends and learn to appreciate cultural and individual diversity.

When they have completed EPS the students are asked for their feedback. One of the most important questions is “What I learnt about working with other people?” Their answers nearly always include remarks on how their self-esteem has improved, on their greater awareness of the importance of soft skills, on their greater tolerance of cultural differences.

5 Acknowledgements

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ETSIDI: A NEW INTERNATIONALIZATION STYLE

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Conference Key Areas: Management of International Offices and Mobility
Keywords: Engenieering studies, Internationalization,

Abstract

One of the main objectives of the School of Industrial Design and Engineering (ETSIDI) is the internationalization of the students. UPM upholds and promotes exchange programs with other universities around the world. ETSIDI has improved the quality and variety of the international mobility possibilities. New rules have been established and great efforts of diffusion have been made in order to increase the mobility. The Erasmus mobility has been increased in more than 150% with respect to the last year. However other mobility exchange programs have lowest possible impact .The presence of incoming students has been duplicate, the majority of them come from South America.

1 Introduction

The School of Industrial Design and Engineering (ETSIDI) of the Universidad Politécnica de Madrid (UPM) has undergone dramatic changes in the last year. In July of 2013 the school's name changed from the old Escuela Universitaria Técnica de Ingeniería Industrial (EUITI) to the current denomination ETSIDI. This change implies more than a new name for one of Spain's oldest engineering schools. The ETSIDI is taking advantage of this change of name to reimagine and redesign itself and its educational and research goals and aims.

The academic degrees the ETSIDI currently offers include:

- Five official undergraduate degrees: Chemical Engineering, Electrical Engineering, Industrial Electronics Engineering and Automation, Mechanical Engineering, and Industrial Design and Product Development.
- Three official Master's degrees: Master in Electromechanical Engineering, Master in Production Engineering, and Master in Industrial Engineering and Design.
- Master's degrees given in the ETSIDI in cooperation with other schools of the UPM: Master in Energy Engineering, Master in Energy Efficiency in Building, Industry and Transport.
- Master in Renewable Energy and Environment.

The ETSIDI has committed to educating future engineers in a manner integrating studies from the undergraduate level to the doctoral level so as to respond adequately to the needs of the business and professional sectors. The diversity of its educational offer makes the ETSIDI a dynamic institution, capable of adapting its study programs to technical innovations, research advances, and changes in professional engineering practice.

Because the ETSIDI believes that its students benefit from international exchanges, and that, reciprocally, the presence of international students in the school benefits its educational offer, it has committed to internationalization. On the one hand, the ETSIDI seeks to increase the number of exchanges available to its students under existing agreements, to improve the quality and variety of the international possibilities available, and to diversify the possible destinations to include Asia and the Americas as well as the traditional European partners.

International students are particularly welcome at the ETSIDI, regardless of their countries of origin and whether they are undergraduate or graduate students. Via existing programs established by the UPM, new agreements made by the ETSIDI and the UPM, and independent student mobility, the ETSIDI receives students from all over Europe, North and South America (Brazil, Mexico, United States, Columbia, Chile, etc.), and Asia (principally China).

We have set up many exchange programs that the UPM upholds and promotes with other universities around the world. Through these exchanges, international students can access our education system and culture and enjoy a range of experiences they would undoubtedly miss out on without the opportunity to participate in a student exchange program.

International mobility programs are based on the reciprocal recognition of the formative activity centers. This means that, if ETSIDI_UPM participated on it, it is force to establish mechanisms that facilitate the recognition of the academic activity. The mobility Programs guarantee that the period spent abroad is recognised by their university when they come back, as long as they abide by terms previously agreed. It should be noted that this recognition is not simple because there are substantial differences in the curricula of universities from different number of credits to contents of subjects with similar names which really they are not the same, this is clear even in Europe despite the existence of an European area of high education. For example, in some countries such as Germany, Denmark, France,… the Bachelor lasting studies are different. However the simple and establishment rules that governs the mobility within the school allowed us to improve this situation.

Among the mobility programs, Erasmus is the world's most successful student mobility programs. Since it began in 1987-88, the Erasmus Program has provided over three million European students to go abroad study at a Higher Education Institution or make trainings in a Company [1]. Mobility supported by Erasmus has thus promoted the internationalization of European higher education systems, contributed to its modernization. It significantly contributes to the Bologna goal that on 2020 at least the 20 % of all bachelor students from the European Higher Education Area should have had spent a period of time studying or training abroad.

This paper describes the improving efforts and successes of the ETSIDI's existing international mobility possibilities, and some of the difficulties that remain to be solved.

2 International Mobility

2.1 Rules governing international mobility

In the past, opportunities for undergraduate students of the ETSIDI to realize international exchanges were principally limited from two factors: the difficulty to exchange fitting in the three year study programs, and the rules only permitted exchanges at the end of the studying year, and then realize the free chosen courses or the final degree project.

In July 2013, the ETSIDI approved new rules for international exchanges, particularly on the official recognition of studying courses abroad [2]. These new rules allow exchanges in the third and fourth years, and give facilities to the recognition of obligatory courses abroad. These rules have substantially improved the possibilities for the ETSIDI's students to go abroad. Students that have got high academic records with a high level in languages are favored by these rules. Students that make exchanges must have passed all courses on the first two study years.

Studying abroad is possible on all degree programs. The self-option destination depends on what is the student studying.

2.2 International mobility opportunities

The available mobility current opportunities of students in the ETSIDI is noticed in Fig. 1, indicating the wide range of places to study abroad and the main mobility programs [3].

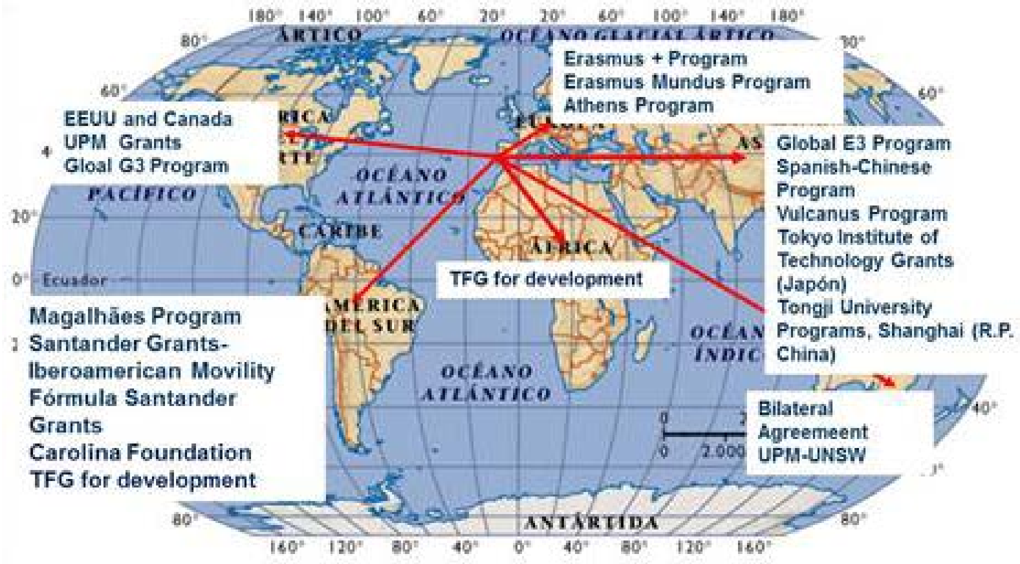

Fig. 1. Map of international exchanges of the UPM with indication of different mobility programs.

Nowadays, the School has a total of 56 international bilateral agreements with 21 different countries and 146 places available, on where ETSIDI students could apply (Fig. 2). These places are distributed to the 5 undergraduate degrees in Chemical Engineering, Electrical Engineering, Industrial Design and Product Development, Industrial Electronics Engineering and Automation and Mechanical Engineering. Apart from these, UPM students can chose other different places that are in our UPM general agreements (Fig. 1).

However, we can say that mobility is something dynamic, generally we received new bilateral agreements from different universities. The ETSIDI takes part in one of the most demanded Engineering Spanish universities from where students want to study here.

Within the mobility programs, Erasmus+ program is the most demanded by our students. There are 42 agreements with 15 countries in Europe, with 124 places available for students. However, some British and Danish universities have not renewed or have reduced the number of places. As same we have increased the number of places of the most demanding destinations signing new bilateral agreements with five universities. After this process an increment of 21% exchanges places has been reached compare with the 2013 year. Likewise teachers' short stays mobility have added, including 25 signed agreements with 11 countries and 46 places.

In the UPM there is a mobility network program through the Maglhaes/Smile program, this program allows mobility with South America. This network allows the mobility between 19 European universities and 16 South American universities. Among Spanish universities only 3 are involved: the Universidad Politécnica de Barcelona, the Universidad Politécnica de Valencia and the Universidad Politécnica de Madrid. Students' selection of this mobility program is made at the level of the UPM, getting a place can be very competitive. More ETSIDI students have asked for a grant on these programs from three years up to now.

Fig. 2. Distribution of partners' universities in different European countries.

Other mobility programs are Global E3 (destinations in Asia or United States universities), USA-Canada, Spanish-Chinese and SINO Spanish grants. The aim of the last two programs is to promote the technical and scientific communication with the Chinese citizens. Other programs are for exchanges of undergraduate and master's degree at Tongji University in Shanghai (P. R. China), Vulcanus Grant, Tokyo Institute of Technology (Japan) grants, or UPM - SANTANDER grants, Santander-CRUE Ibero-American mobility grants, Formula Santander grants,…

2.3 Double degrees with Hochschule of Hannover (HSH)

A double degree gives the students the opportunity to study an international degree by combining studies in two types of engineering, at the same time as it prepares them better for their future career. On completing their degrees, students will simultaneously rise a degree from the UPM in addition to a degree from the foreign university they have been attending.

The ETSIDI – UPM has signed some double degree agreements with the Hochschule Hannover, University of Applied Sciences of Hannover (Germany). These agreements cover the following undergraduate degrees awarded by the ETSIDI-UPM and HSH:

- Fakultät II-Maschinenbau und Bioverfahrenstechnik:

- Graduado en Ingeniería Mecánica (Bachelor in Mechanical Engineering) and B. Eng. Allgemeiner Maschinenbau (Bachelor in Mechanical Engineering).
- Graduado en Ingeniería Química (Bachelor in Chemical Engineering) and B. Eng. Verfahrens-, Energie- und Umwelttechnik (Bachelor in Process-, Energy- and Environmental Engineering).

- Fakultät I-Elektro- und Informationstechnik:

- Graduado en Ingeniería Eléctrica (Bachelor in Electrical Engineering) and B. Eng. Elektro- und Informationstechnik (Bachelor in Electrical Engineering and Information Technology).

At master level, this accord covers the following postgraduate degrees awarded by the ETSIDI-UPM:

- Máster Universitario en Ingeniería de Producción (Master in Production Engineering)

and the postgraduate degrees awarded by the FII-HsH:

- M.Eng. Process Engineering und Produktionsmanagement (Master in Process Engineering and Production Management).
- M.Eng. Maschinenbau Entwicklung (Master in Mechanical Engineering Design).

3 Results

Students language level has considerably increased in the recent years. In the Bachelor degrees students must credit a B2 level to get a fee for the “English for professional and academic communication” obligatory subject. This fact has promoted the exchanges and academic achievements at the abroad universities. Likewise, although some of our students speak a second foreign language, it is not usual. So, English studies classes destinations are the most requested.

Fig. 3 shows the evolution of Erasmus exchanges in the last 12 years. During these years the mobility has got ups and downs. The academic course 2010/11 was the most drastically high European flying students. 2012/13 academic year was only 24 outgoing exchanges for the Erasmus international mobility. Low number of applications was due on the disleveling among students from 2002 Plan and the new graduate studies. This was the first time that students of new degrees could apply for an Erasmus interchange. Harder requirements of our school limited much the mobility of the students.

61 students applied for the Erasmus exchange in the academic course 2013/14. Four of them were rejected because they did not achieved the basic requirements. The succeeding 57 students were given an exchange place for their studies, as much a first or second options at universities for their studies were awarded.

On reference to other mobility programs, one student has applied for Magalhaes/SMILE program concretely for the National Polytechnic Institute of Mexico City (Mexico), and 3 students for program Vulcanus (Japan), two of them have passed the first phase of European level selection.

Therefore, mobility demand has considerably risen this year, thanks to the new rules of mobility that allows exchanges since third grade [3], the interest of the students and the hard work done by the Subdirection of Students and International Affairs on increasing the dissemination of the international mobility programs.

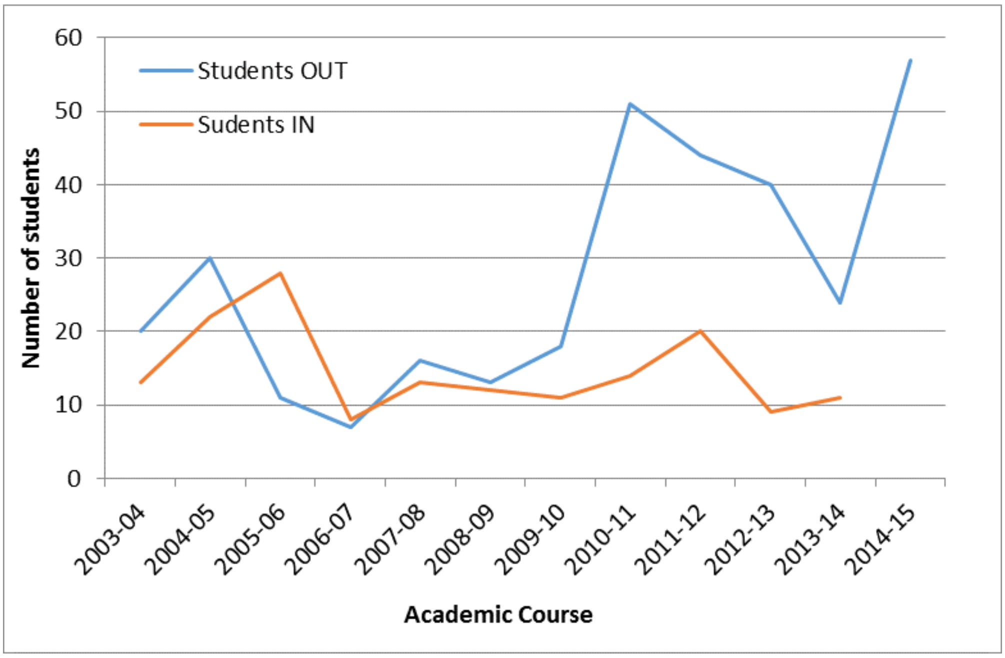

Fig. 3. Exchange progression in the last 12 years.

ETSIDI Students prefer mainly going abroad Europe. Germany and the Nordic countries are the most requested by their English teaching courses, in spite of their high living cost of life. This year Eastern European countries were much demanding as well for the level universities are high and the cost of living is cheaper. France has not being highly demanded by its training absolute French language teaching on where our students are not keen on it.

There has been 30 incoming students in this academic year course. 12 of them have remained for the full course year. At the beginning of the winter semester 20 were in: 5 Erasmus students and 3 students of Magalhaes/SMILE program and 10 of Science without Borders programs, 1 by bilateral agreement and 1 visiting student at the Autonomous University of Nuevo León. In spring we have got 10 more students: 5 Erasmus, 3 Magalhaes/SMILE, 2 visiting students of the Massachusetts Institute of Technology.

English courses lack in our ETSIDI School is the reason for the less incoming European students, being this a problem to make new agreements with European universities, Spanish is not well spread as a language in the rest of Europe. However, South America demanding students has doubled year after year. In 2009-10 course as much one incoming students arrived to our school with Magalhaes program. It is remarkable how South America students have got better academic results than European students, this is because the Spanish language lack of comprehension European students have got.

The efforts to the Subdirection of Students and International Affair to promote the interest of students for the rest of mobility exchange programs has not got well results. This could be due to different reasons: competitive students from the UPM students give our students university a frighten competition facing, these countries are further away from Spain and the flying and living cost to the country of destination often involves a greater economic outlay. Although some of the grants are high economical than the Erasmus, it is not enough.

However, we will increase the number of meetings with students to explain the different mobility programs, apart from Erasmus+ one, as they seem to forget that those programs offer the possibility of study abroad in high prestigious universities in USA, China and South America.

The economic crisis in Spanish is affecting the international mobility of students, because it is too expensive for them and to their family to support a student abroad. This is why the increasing of economic amount of grants should be promoted by the UPM and by the Spanish government.

4 Acknowledgements

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Teaching Innovation through International Staff Mobility at the Universitat Politècnica de València

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Conference Key Areas: International Networking, Internationalizing the engineering curriculum, International Cooperation Programs.
Keywords: staff, mobility, teaching, innovation

Abstract

Teaching staff mobility has always proved to be a powerful internationalization and networking tool. At the *Universitat Politècnica de València (UPV)* we believe in its key role in teaching innovation, advanced institutional co-operation and joint curricular development. Based on these fundamentals, and facing the social demand for increasingly internationalized University Degrees, the *ETSIAMN (Escuela Técnica Superior de Ingeniería Agronómica y del Medio Natural)* set up a teaching initiative known as International Seminars in Life Sciences (ISLS) seven years ago. The general objective of the ISLS course is to introduce students to current research developments and the latest in technology in a variety of domains related to Biosciences and Bioengineering. Teaching staff for the course consists of professors visiting the UPV through academic and research exchange programs, who give lectures designed from an engineering perspective, and encourage students to take an active part in seminars and class discussions. Problem solving, teamwork, debate and oral communication skills are reinforced. At the end of the course, students should be able to readily follow the scientific and technical focus adopted in the classes, thereby improving their understanding of the English language and academic discourse required for research and study within and beyond the European Union. The overwhelming support shown for this teaching initiative among students and teaching staff has confirmed the ISLS course as a new method to enhance the efficiency and value of teaching staff mobility.

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1 Introduction

The European Higher Education Area (EHEA, in Spanish, *Espacio Europeo de Enseñanza Superior, EEES*) is based fundamentally on the idea of extensive and continued mobility among academic and research communities. In the case of university students, the 1999 Bologna Declaration aimed to promote mobility by eliminating obstacles to the effective exercise of free movement, with particular attention being given to students' access to study and training opportunities and to related services. The development of cooperative agreements, thematic networks and mobility programs among European universities in recent decades has given way to an unprecedented internationalization of the Spanish university system. In terms of Spanish integration in the EHEA, it is clear that students have the most to gain from the proposed reforms given the significant advantages in terms of their training, mobility and professional integration. Nevertheless, at the *Universitat Politécnica de València* (UPV), far too many students still graduate without having participated in any study abroad program. There are, in our opinion, still two barriers to overcome in our process of convergence: the inadequate system of academic recognition and, more importantly, the insufficient linguistic preparation and communicative competence of our students.

On the one hand, the restrictive system of academic recognition for courses taken abroad has always been a major obstacle for students who want to participate in mobility programs such as

ERASMUS. One conditioning factor in this situation is the fact that some partner universities are fully incorporated into the Bologna framework (including the three-tier degree program) while others like the UPV are still in the adaptation phase. There are partner universities that require students to register for courses exclusive to one particular degree program or another, thus limiting the students' choices of subjects needed for their UPV degrees. Until recently, most students at the *Escuela Técnica Superior de Ingeniería Agronómica y del Medio Natural* (ETSIAMN) have chosen to complete their final research project (*proyecto fin de carrera*) abroad; thus, they have been able to avoid the problems associated with the validation of subjects taken in the host university. Fortunately, measures have also been taken to improve the transparency and flexibility of Spanish higher education degrees. These measures include 1) the comprehensive restructuring of university degree programs, 2) the adoption of the European Credit Transfer System (ECTS) along with the necessary changes in methodology and evaluation, and 3) the creation of integrated study programs and joint degrees among partner universities.

On the other hand and somewhat more complicated to overcome in the short term are the linguistic and communicative barriers that prevent a great many students from even applying to study abroad. Traditionally, the Spanish educational system has not been very effective in promoting foreign language acquisition and communicative competence. So while many Europeans speak two or more languages, the fact is that most Spanish undergraduates speak only one. Our first-year university students generally have some basic knowledge of English since it is required for college admissions, yet their skills are rather limited in terms of oral and written production. Furthermore, most engineering and technical degree programs in Spain have few, if any, language requirements; in the case of the UPV, students must now demonstrate that they have a B2 level (upper-intermediate in the ALTE Framework) in at least one foreign language in order to graduate. However, the vast majority of UPV students have had great difficulty in obtaining this level, as only a limited number of credits are available to students who wish to enhance their linguistic competence as part of their university studies. The convergence with Europe has also meant that the new study programs have been designed so that undergraduates can theoretically spend at least one semester in a foreign university. The Spanish Framework for these new programs and the emphasis on mobility highlights the need to provide students with all the skills necessary to build more Europe, bridging not only the cultural and academic gaps, but also paving the way towards a world of career and professional advantages.

In an attempt to promote students' use of foreign languages and their interest in mobility programs, the UPV has encouraged the development of certain subject-specific courses whose language of instruction is English. In the ETSIAMN, however, the faculty members participating in the program have reported having to invest considerable time and effort to develop the subject adequately in English, with little or no support from either linguistic or pedagogical consultants. Given the added effort needed to pass the course in English, it is logical that Spanish students prefer to register for the courses in their native language. Further, the majority of the students registered for these courses are those participating in the ERASMUS program and are unable to follow courses of study in Spanish. Consequently, this program cannot be considered totally successful or particularly beneficial for Spanish students. In light of this and other developments, the ETSIAMN began to search for other means to promote opportunities for mobility among our students and faculty and to facilitate their access to the European academic and professional landscape.

2. The ETSIAMN proposal

To form part of a multicultural and multilingual Europe, Spanish graduates must naturally be competent in terms of cross-cultural and cross-lingual communication and information exchange. However, despite previous efforts to reduce the obstacles to mobility on an institutional level, it seems that ETSIAMN students needed more exposure to subject-specific courses in English to build their confidence and motivation in the language. So in 2007/2008 our cross-disciplinary team embarked on a process to implement two parallel courses, *International Seminars in Life Sciences* (ISLS) and *Preparation for International Study* (PINTS), which aim to enable our students to benefit from the opportunities awaiting them in the European community and beyond while strengthening relations among European teachers and researchers and the ETSIAMN faculty. On the one hand, the courses are designed to provide a favorable setting for students to practice their language skills, to explore study programs and research possibilities, and to become thoroughly familiar with partner institutions, admissions processes and requisites for courses, internship grants, and so forth. On the other hand, the innovative approach of the proposal also addresses three basic needs of the ETSIAMN, namely, 1) to integrate subject areas and foster collaboration among departments; 2) to solidify contact between European researchers and ETSIAMN faculty members and 3) to establish a proper forum for visiting STA/STT Erasmus teaching staff so that they can actually meet and converse with the largest possible number of ETSIAMN students.

Finally, at the end of the course, students of the ISLS course report benefiting from the scientific and technical focus adopted in the class, improving their understanding of the language that they will need for research and study. For students of the PINTS course, a more practical academic focus has allowed over 400 students to prepare for enrollment and integration in their host universities.

3. Materials and methodology

International Seminars in Life Sciences and *Preparation for International Study* are both free-elective courses (4.5 credits or 3.6 ECTS each) open to students of the four degree programs offered in the ETSIAMN (Agricultural Engineering, Forestry, Biotechnology and Food Science and Technology). The three-hour classes for each course are scheduled for Thursday afternoons (16-19h) and Friday mornings (11-14h), respectively, so that the guest lecturer can benefit from a brief, but intensive stay in the UPV, while the students can register for the courses without having overlaps in the timetables for their required subjects. Students need not register for both subjects and registration is limited to 60 students in ISLS and 30 in PINTS.

The thirteen sessions are planned at the beginning of the academic year (i.e. in September) after partner universities have been contacted with information about the initiative and presented with a call for participants. Our ETSIAMN International Relations Officer schedules the guest lecturers as their agendas permit and makes all the necessary arrangements for the ISLS/PINTS sessions, establishing as well institutional contacts with faculty in the corresponding ETSIAMN departments. The participants are requested to send, at least two weeks prior to their arrival, their abbreviated curriculum vitae in English along with a summary of their research topic and the power point presentation. These documents are then posted on the virtual blackboard so that students can become familiar with the lecturer's area of specialization and the selected topic prior to the ISLS class. For the PINTS class, the guest participants are asked to prepare a short presentation about their home institution, highlighting any aspects of particular interest to exchange students such as the courses offered in English, research possibilities, student life, and so on.

As for the class structure and procedure, the ISLS sessions are designed as round table discussions in that the visiting professor gives a 1½-2 hour lecture about his/her area of research. Students must take notes to foster their understanding of the topic and acquire the vocabulary and structures specific to the field. Obviously, not all students will like all the topics all the time; however, students are encouraged to consider each session as an opportunity to broaden their knowledge of the distinct research fields within the realm of agriculture and related sciences as well as the common language used in academic and professional discourse. Once the lecturer concludes his/her presentation, the host ETSIAMN faculty members open the floor for a more in-depth discussion of the research issue and facilitate student participation through questioning, debates or other related activities. Evaluation for ISLS is based on a) attendance and participation in the round table sessions (40% of the final grade), b) individual seminar reports (30%) and c) a semester project on a given topic (30%). The individual seminar reports must include an introductory description of the topic presented, a structured discussion of the key arguments or ideas given during the session, and an individual statement reflecting the student's own position regarding the seminar contents. Finally, the semester project is meant to be a comparative study of the structure and contents of academic curricula in the student's Home Institution and the corresponding degree at the UPV or another instructor-approved topic.

To complement the approach adopted in the ISLS sessions, the PINTS sessions follow a more traditional classroom structure in the computer laboratory of the ETSIAMN. First, the guest lecturer gives a 30-35 minute presentation about his/her home university, focusing on information for exchange students: language requirements, faculty and departmental organization, course structure, registration deadlines, international relations, campus life and the like. Students are required to take notes and participate in a 10-minute question-and-answer session. Then they are given 15 minutes to explore the lecturer's home university web pages, ask any further questions and complete their notes. Bearing in mind that this part of the initiative also prepares students for mobility programs, for the remaining class time (two hours), the in-class coordinator (in our case, a specialist in English for academic and professional purposes) instructs students as they work a variety of tasks to foster their autonomy in lifelong learning with resources specific to academic and professional development. To this end, students are evaluated, the instructor providing individual and group feedback regarding both the content and the form of their work.

4. Results and reflections

It is indeed beyond the scope of this paper to relate all the valuable experiences we, the coordinators, have shared while developing and implementing this proposal for innovation in higher education instruction. Certainly, reflecting on these experiences and on the feedback provided by the students and participants will allow us to continue to identify the positive aspects of the innovation and to re-examine those aspects that must be improved in the future. For brevity's sake, in the following lines, we will center on five aspects that reflect the observations made in class, in student reports or in conversation with the participants in this innovative experience in learning and exchange.

First is the question of the student profile. Our aim has always been to address the needs of Spanish students applying for mobility programs; unfortunately, certain administrative delays prevent ETSIAMN students from pre-registering in September while ERASMUS students continue registering until mid-November (almost two months into the semester). The resulting diversity in language backgrounds and English competence leads to certain difficulties in the classroom activities in both courses. Thus, for the ISLS course, we have involved linguistic or pedagogical consultants to create didactic materials based on the lecturers' presentations, publications and the like. Ideally, these materials are made available to students prior to the sessions and highlight specific vocabulary, grammatical structures and discourse strategies in English. Finally, for the PINTS course, an initial English language assessment has been included to establish competence levels and, if necessary, smaller groups are formed for the practice sessions.

Second, the participants have, for the most part, been well received and evaluated favorably by the students. Nonetheless, in scheduling the guest lecturers, it is imperative to diversify the areas of research addressed since there is often a lack of topics related directly to our students' profiles. Ideally, we schedule three lectures for each of the programs offered in the ETSIAMN: Agriculture, Forestry, Food Science and Technology and Biotechnology. Moreover, we try to schedule participants so as to avoid repeating the "institutional presentations" of partner universities, and should two representatives coincide in the same semester, we request that they collaborate to provide PINTS students with distinct perspectives on their home institution. Perhaps the greatest obstacle is that not all participants send their materials in a timely manner, that is, prior to the speaking date so that students have enough time to prepare for the sessions and so that specific didactic tasks can be developed to enhance the acquisition of knowledge and language.

Regarding the ETSIAMN faculty involvement, the results of the seven courses continue to indicate the need for a more direct participation of departmental representatives, especially in ISLS. With the experience gained over the years, the organization of the seminars has required ETSIAMN staff establishing contact with the guest participants prior to their arrival in the UPV. This facilitates information exchange, research initiatives and the international networking which is crucial to the success of the proposal and to greater integration of Spain in the EHEA. Additionally, if the seminar materials were always available early enough, the host department members could work with the language and pedagogical specialists to develop the learning tasks for students.

5. Conclusions

The incorporation of Spanish universities in the EHEA has resulted in a wide variety of innovative approaches to classroom instruction. The results of our experiences in the ISLS and PINTS courses have shown that we can successfully bring Europe into UPV engineering classrooms. To this end, in this paper we have described some basic obstacles to Spanish mobility and explained our approach to innovation in the ETSIAMN. The experiences have clearly resulted in enriching effects of multicultural interaction like those that take place in the two courses. Additionally enriching is the opportunity for students to experience true multilingual communication given the representation of a multitude of nationalities in the classes. Moreover, the results from the course evaluations indicate that students, participants and the ETSIAMN faculty see this initiative as one that is indeed worthwhile and one that opens new frontiers in life science education and research. Finally, as we continue to learn from the innovation experience, we shall also continue to hone our methodology and improve the quality of our instruction to produce graduates who can truly benefit from all that awaits them not only in programs of academic mobility, but far beyond in their professional careers and lifelong learning processes

Intercultural skills, key in the internationalization of engineering curricula

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Keywords: intercultural skills, mobility, engineering curriculum.

Abstract

To strengthen the control of our students in intercultural skills is a priority to ensure its success in the international mobility. In recent years many commercial tools have been developed. They allow us to know the level of this transversal skill that our students have. The general problem of all these tools is that they are not free tools, making it difficult to use them in universities. Researchers from Télécom-Lille and ETSIT, two engineering schools with wide experience in mobility and with a professional relationship that has existed for several years, goes a step further. In this paper, after a description of the current situation in both centers, we propose a work plan that will finally lead to the definition of a procedure of learning and assessment of intercultural competence of our students prior to their period of mobility, which allows us to select the best candidates, ensuring their adaptation and success in the destination.

1 Introduction

For several decades, thanks to the mobility programs promoted by the *Universitat Politècnica de València* (UPV), the *Escuela Técnica Superior de Ingenieros de Telecomunicación* (ETSIT) have driven academic exchanges between members of its community. It is well-known the opportunity for students to study in another university during a semester, a full academic year and even get a double degree through the Erasmus program. Less known is the possibility for the teachers to teach a seminar in one of the schools in which the ETSIT maintains these exchange agreements via the same Erasmus program [1]. However, from various departments and different areas, some teachers have requested it and reciprocally, have been visited by teachers from several European universities. In our particular case, since 2000 these visits have been taking place and we want to point out in particular the French homologous schools with whom the exchanges were quite frequent. These exchanges have led to initiatives regarding educational practices and research that continues today.

This is the case with Télécom-Lille with whom we started the ICTP project (*In-situ* Certifying Teaching Period, [2][3]) since 2009. The project aims to improve the language skills of students by immersion and in situ production of a certificate level through an on-line test, oriented to enterprise and telecommunications (BULATS). To obtain this certificate the respective schools put their facilities to disposal of the teacher and group of students. This learning approach has led us to investigate in parallel on the acquisition and assessment of intercultural competence for engineers.

The current framework of the degrees of Bachelor and Master in the ETSIT responds to the new orientation of higher education to train students in cross-disciplinary (transversal) skills, competencies that are defined in the teaching guides, but where the intercultural skill does not appear explicitly. Hence our interest in exploring this skill that some scholars have been defined from various points of view [4][5][6][7][8].

Furthermore, a brief contrastive analysis between the organization of the studies in ETSIT and Télécom-Lille is necessary for understanding the formal differences and contents between the two institutions. It is also important to know the differences in training the skills, particularly in intercultural skill. So it is imperative that the final objective be a similar line of action and collaboration between the two schools.

Finally, the paper describes the current state of our research. This research is focused on the evaluation criteria in intercultural competence and the actions to be taken in the next future.

2 Intercultural skill

Our students are often interested in traveling abroad to other universities to complete and expand their education. But often we find that the student has serious problems of adaptation to the new environment and new customs. Although the language is not unknown to him, the kind of relationship with the new environment can profoundly affect their work. All this has disastrous consequences, which in many cases led him to make the experience a failure. Intercultural competence is the key to what international education should mean. In today's society employers (in any country) are very interested in finding employees who are not only technically competent but also and above all, culturally astute and able to thrive in a global work environment; i.e., they have the skills to transcend national and cultural boundaries and to know how to interact with people and organizations from countries and cultures that are not their own.

What does interact successfully with people from other cultures mean? We can define intercultural competence as "*the ability to interact effectively with people of cultures that we recognize as different from ours*" [8]. In a later article, the same author concretes the term "effectively" explaining that "*interact effectively across cultures means to conduct a negotiation based on both specific and general characteristics and to be respectful and friendly to everyone*" [9].

Many definitions emphasize that while the recognition of cultural differences is a cognitive function, the ability to interact effectively across cultures is largely behavioral. Moreover, we cannot forget the definition given by the *Instituto Cervantes* [10] according to which intercultural competence would be integrated into the linguistic competence: "*The intercultural competence is defined as the ability of the learner of a second or foreign language to function properly and successfully in intercultural communication situations that occur frequently in today's society, characterized by multiculturalism*".

In general, the most relevant aspects of intercultural competence [11][12][13][14][15][16] includes: the ability to understand different cultural backgrounds and different points of view, to show respect for others, the knowledge of a foreign language. To contribute to the development of this competence among our students, then we must give priority to: teaching communication skills, offer classes in foreign languages and to provide opportunities for students to acquire international experience.

We understand that these approaches are perfectly complementary and that the key is to establish how we should teach / learn and assess transversal skills in a context of teamwork because the intercultural comes into play in communication with others.

2.1 The Escuela Técnica Superior de Ingenieros de Telecomunicación (ETSIT)

In 2012 ETSIT achieved the positive accreditation of the American agency ABET [17] to the studies of Telecommunication Engineering [18]. The process was a great and rewarding experience for us. One of the consequences of this process was the setting up of a training and assessment procedure of transversal skills along the studies. Specifically, subjects were selected as checkpoints to generate concrete evidences of the assessment of the skills. Also a questionnaire on acquired transversal skills was defined to be responded by the students prior to submit their final project (to measure the perception of the students' attainment in these skills after their studies) and a similar one for the evaluation jury of the final project [19][20].

With the creation of the European Higher Education Area (the Bologna Process EHEA) was proposed in 1999, among other things, to facilitate the convergence of the different systems of higher education towards a more transparent system based on three cycles: bachelor, Master and PhD. The Bologna Declaration launched the process of the same name. This process was intended to create a system of academic degrees easily readable and comparable, encouraging the mobility of students, teachers and researchers, ensuring high teaching quality and adopt a European dimension in higher education. The Bologna Declaration of June 19, 1999 was signed by 30 European countries, including all 15 EU Member States at the time (Austria, Belgium, Germany, Denmark, Greece, Spain, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden and the United Kingdom) and the ten countries that joined the EU on 1 May 2004 (Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovenia and Slovakia). Are also signatories Iceland, Norway and Switzerland, as well as Romania and Bulgaria, the EU Member States from 1 January 2007. Kazakhstan joined the Bologna Process in March 2010.

As we have just shown, a major goal was that academic qualifications were comparable and to promote mobility. In this regard, promote mobility requires to improve the intercultural skills of our students.

Adaptation to the EHEA has led the transformation of telecommunication engineering studies to a new grade structure (4 years) + Master (2 years). In this process of transformation, we are also shifting the structure of training and assessment of transversal skills. Each engineering study is regulated by separate legislation that involves, in this respect, different listings of the transversal skills. The UPV, in order to standardize and provide teachers and students a quality skills training, has decided to make a list of competence dimensions (transversal skills) common to all programs offered in this university and collecting the various proposals transversal competences that exist). Along with this list, each program accompanies a table crossing this list with the official transversal skills, ensuring that training in all UPV competence dimensions, the transversal skills officially defined in the program are also covered. After the definition of the list of competence dimensions, at this moment it is compiling material for teacher use which includes a detailed description of each of the skills, acquire forms in different subjects and mechanisms for assessment and evaluation.

Table 1 shows the UPV competence dimensions, which are being completed.

Table 1. UPV Competence Dimensions

	Competence Dimension
DC1	Understanding and integration
DC2	Implementation and practical thinking
DC3	Analysis and problem solving
DC4	Innovation, creativity and entrepreneurship

DC5	Design and project
DC6	Teamwork and leadership
DC7	Ethical, environmental and professional liability
DC8	Effectively communicate
DC9	Critical thinking
DC10	Knowledge of contemporary issues
DC11	Lifelong learning
DC12	Planning and time management
DC13	Specific tools

Alongside this, at this time, each program is changing to the protocol followed in earlier studies because of the implications of ABET accreditation, i.e., having been selected checkpoints and it is compiling a survey to the students, prior to the completion of their studies, and the same survey for the tribunal of final project (and final master). In this case, these surveys contain the list of UPV competence dimensions described in Table 1 that, as already indicated, are the same for all the programs of the UPV.

As we can see, intercultural competence is not explicit on that list, but obviously it can be considered as part of the learning process in the DC6 competence, teamwork and leadership. This will be the manner in which we will consider in the work that we carry out in the coming months. Many documents on intercultural skills include: effective communication in a multilingual environment, work effectively in different teams, establish good relationships quickly, adapt to new conditions without judgment, tolerate ambiguity and cope with adversity, manage and negotiate the different expectations time and time management ... All of them appear implicitly reflected in the list of Table 1.

2.2 Télécom-Lille

In contrast to Spain, the French engineering schools such as Télécom-Lille have not acceded to the Bologna Process and, as refer to [21][22], their studies which are based on a selective system of two years preparatory work, after obtaining the BAC (PAU Spanish or equivalent entrance examination to college). Students must take these 2-years before accessing specific engineering studies. Called *prépa* courses, as the name suggests, they prepare students in basic subjects: mathematics, physics, and computer science. Once this phase is finished, students begin their studies to obtain the diplôme d'Ingénieur or engineering degree.

As shown in [23], the training of students of Télécom-Lille includes at least a mandatory 3 month stay abroad between second and fifth year. This immersion allows the acquisition of a first experience in a professional context. This autonomy develops multicultural openness and curiosity. The stays are made within firms or universities with which the school has agreements in Europe, Asia and North America.

Beyond the technical learning, staying abroad is often an opportunity for the student to discover a new culture and a new way of life, to develop their open-mindedness, to live in another country and to improve their knowledge foreign language.

Moreover, students of Télécom-Lille have the opportunity to study abroad for a semester at most schools in the international network of universities that they have agreements. This can be done during the semester Bac + 4 year or last year. These exchanges are validated by the European standard ECTS system (European Credit Transfer System) or equivalent system of the country.

Finally, students have the opportunity to do their final year abroad and for a semester or an extra year, to also get the diploma Master (or engineer) of the host university. These exchanges are likewise validated by the European standard ECTS system (European Credit Transfer System) or equivalent system of the country.

In either situation, to work abroad, to lead international teams, to maintain the exchanges, strong intercultural skills are necessary.

To achieve these competencies, it is essential to reflect on our own culture and to recognize the role of culture in all fields.

To ensure that students are trained in foreign languages and intercultural communication, the school has a department dedicated to this purpose: *Département des Langues et Communication Interculturelle*. Small group activities are conducted in various contexts developing adaptation and collaboration skills oriented to professional environment in which students have to communicate, collaborate, negotiate, and coordinate teams in a multicultural context. Courses and activities of intercultural communication provide those concepts and the tools to decode behaviors, understand different perspectives in order to function effectively and appropriately in another culture.

3 The joint working to develop

With the previous curriculum, the difference between the French and Spanish systems was not as pronounced and it just had to take into account that a student of a French engineering school in the first year was homologous to a Spanish engineering student in third year. Traditionally our students have been able to apply academic exchange from third academic year in which they had already completed the core subjects (core, compulsory) as well as elective or foreign language. Therefore exchanges were feasible.

With the new curriculum, the gap between the two systems is greater, since the bachelor includes only four years and some courses have been deleted, moved or transformed in content, while the curriculum in France has not changed. This has led both sides to make a great effort to find ways to allow the continuity of exchanges. Recently it has signed an agreement of double degree with Télécom-Lille and Télécom-ParisTech for French students to pursue master degrees in ETSIT and for our students to get the double degree in those schools.

We have seen in previous sections that ETSIT is starting to have the necessary tools. The UPV is developing the tools to make available to all schools sufficient means with the aim of guaranteeing the training of skills of students. Some courses are organized from the Institute of Education Sciences (ICE) of the UPV for all the teaching and research staff. During this academic year we have been able to attend courses on this topic, including: “Integration and evaluation of competencies in the final year project in Bachelor and Master” and “How to evaluate and teach transversal competences”.

Once described the respective structures of the two schools and the situation in both with regard to training in intercultural skills, we can raise certain criteria to arrive at a common approach. Clearly, the current situation in the UPV is more advanced in terms of the overall design of transversal skills and strategies to integrate their training and evaluation in the curriculum. Télécom-Lille does not have an educational service like ICE to train its teaching and research people; by contrast, there is a demonstrated experience at Télécom-Lille in intercultural teacher and student training although it does not use a global institutionalized design. And the existence of a department that includes in its name the word *multiculturalism* is already very significant.

Therefore, unlike what happens in the UPV, where training in transversal skills is incorporated into the development of the different content of the subjects of the curriculum, Télécom-Lille has defined specific courses to give such training for intercultural competence, addressing the following key issues [23]:

- Objective culture, subjective culture, cultural awareness
- Definitions of culture, levels of culture
- Stereotypes and generalizations
- Norms, values and cultural products
- Fundamental in the development of identity issues, cultural perception
- Nonverbal elements of communication
- Communication Styles, context.
- Values, beliefs / convictions and behaviors
- Cultural dimensions of national companies
- Relationships

On the other hand, there are deepening workshops on these topics:

- Building Multicultural Team Group Competence.
- Building Your Intercultural Competency - Intercultural Effectiveness at Home and Abroad.
- Communicating Across Cultures - Japan Asia and the World.
- Understanding Japan Family Business and Society.
- Picture This: An Introduction to Interpreting Intercultural Imagery.
- Cultural Values in Contrast: Latino and North American Communication.
- Developing Bicultural Competence for the Professional Workplace.
- Sources and Consequences of Globalization of Telecommunications and Cyberspace.

Télécom-Lille thus sensitizes students on cultural differences in order to train engineers to be able to function effectively, respect and mutual enrichment in a multicultural context.

The UPV, however, does not offer specific courses on multiculturalism, but we must understand that the requirement of a B-2 level in a foreign language which is defined as a compulsory subject in all new curricula at the UPV provides training in languages not limited to language learning but includes in its programs learning a set of skills that students must develop to succeed in their profession: writing, public speaking, talking on the phone, meet, have a general knowledge, know how to improvise, communicate with people from other cultures, ... [24].

In view of the above, noting the distinct and complementary situation between the two schools, we are starting to propose a joint research project. The project is based on sharing a definition of intercultural competence to ensure a profile similar and transparent for students of the two schools. We are going to create a template of equivalences on important aspects of the measure of the skill, assuring that our engineers to be effective in an international context. At first, using the experience of the team of Télécom-Lille on these topics, we will begin by transferring the training to the members of ETSIT. Thereafter, the next step is to select the points to be measured over the competence. Once elected, will be to define how to introduce such training in the programs of the two schools. At the same time different measurement tools will be built. Our expectation is to achieve this within two years to be able to apply in full in the year 2015-16 to students from both schools.

4 Summary

After a professional collaborative relationship between Télécom-Lille and ETSIT for several years, we have found the need for intercultural communication in engineering education as the key to their employment in a globalized world. To do this, we have begun to analyze the situation at both schools, noting the differences and those areas in which we can complement and highlighting the strengths and weaknesses points of each of the schools in this area. From there, we are introduced to the development of a joint project that ultimately will lead to the design of common measurement tools to assess the scope of intercultural competence in the training of engineers. As an added value, we intend to use these tools not only as a measure to select students participating in mobility programs but also to prepare all students for working life in a multicultural environment

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Engineering Education for the Future. European Project Semester at Universitat Politécnica de Valencia, Spain, and Lodz University of Technology, Poland.

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Abstract

Engineering education is facing globalization and other new challenges beyond technological ones. Therefore, future global scenario is demanding innovative proposals from Higher Education preserving its core values. In order to react in some measure to this situation, selected Higher Education Institutions include EPS where students are expected to develop transversal competences that are essential for employability; especially social, systemic, intercultural and communicative competences.

This paper introduces a reflection on these new challenges and describes the basics of EPS methodology as well. A shared vision of EPS from International faculty of Engineering (Lodz University of Technology, Poland) and (Escuela Técnica Superior de Ingeniería del Diseño, Universitat Politécnica de Valencia, Spain) is provided. Some examples of multidisciplinary/multicultural projects and some future prospects are included as well.

1 Introduction

1.1 Globalization and New Challenges for Engineering Education

Today's business and industrial environment, characterized by constant and dynamic changes in a global scale, positive and negative in their nature, creates new perspectives of faster development for companies and enterprises but also challenges businesses with a necessity to become more competitive in order to survive and be profitable and sustainable on the market. Being successful in unstable environments, organizations have to become more adaptable, to "restructure continually" [1], change according to what markets dictate. Thus, competitive advantage today depends, to a high extent, on an ability of a company to be flexible and able to address unexpected changes of the global business environment in an innovative way much quicker than other business entities. The lack of stability and certainty puts new pressures on companies and their employees. The role of human capital in creating competitive advantage cannot be overestimated; it is a crucial factor in the development of business success.

To succeed, we must do two things: (1) discover new scientific knowledge and technological potential through research and (2) drive high-end, sophisticated technology faster and better than anyone else. We must make new discoveries, innovate continually, and support the most sophisticated industries. We must also continue to bring new products and services to market faster and better than anyone else, and we must design, produce, and deliver to serve world markets. We must recognize that there are natural global flows in industry, that, the manufacture of many goods will inevitably move from country to country according to their state of development [2].

Globalization with its consequences on the arena of international markets influences the sector of university education, issuing new challenges for the curricula and for the graduate of engineering.

Universities have to answer the basic question of who the future “engineers will be, what they will do, where they will do it, why they will do it, and what this implies for engineering education” [2].

The engineers of the future will have to be able to work in and international environments, no matter if they will be working in their own country or abroad, although the abovementioned global flows in industry result in an inevitable flow of jobs from one geographical location to the other. International context is created by omnipotent presence of multinational accounts, free flow of capital looking for more profitable markets and people searching better compensation or jobs in the times of more and more frequent economic crises. International environments are inherently connected with diversity, diversity of cultures, systems, educational backgrounds, values, perspectives, behaviours and expectations and that is why there is a strong necessity to equip young people with an ability to be able to communicate effectively and work together across these cultural differences.

Another important component of competitive advantage, namely an ability to bring new products and services to the market faster than your competitors can be easily translated into a demand for well-educated, creative and innovative individuals who can constitute human capital of companies. This puts a real emphasis on the high quality engineering education that will let young engineers not only have a solid professional basis but also provoke them to be more open-minded, visionary and brave enough to think independently and frequently across disciplines since real life problems require more and more complex, interdisciplinary and integrative approach as well as an ability to work with people representing other disciplines than engineering: science, business, sociology, ethics, etc. Future engineers will have to possess abilities to address more and more complex and diverse problems while working in diverse international teams.

Thus, universities are expected to become more committed to engineering education and research focusing on new technology development in order to address the challenges that the markets and reality pose and simultaneously include interdisciplinary angle of real life projects, diversity of global educational contexts as well as fast change, which seems to be a permanent attribute of today’s world.

How to prepare young people today for a constant change is another challenge that universities face. The direction of that change is not fully predictable and that is why it seems that the only way to design curricula and educate young people today is to teach students how to be lifelong learners, how to find information in order to solve complex problems, how to get into new fields of knowledge and how to change and develop in a resilient way together with the changing environment.

Engineering programmes are designed with particular definitions in mind. The question of what engineering is or should be is a crucial matter as those definitions imply what is taught and how the content is taught. The time taken to study for a degree makes up less than 10% of the working life of a student. What should be covered in this short time period? What will last as long as graduates’ working lives and not become obsolete within a few years or forgotten after passing their exams?

Harrison [3] suggests that the purpose of a modern university education is to teach students how to solve problems and to provide the fundamental tools to solve those problems. What are these fundamental tools and how they can be taught? One approach to this is through the use of multidisciplinary projects carried out in international teams.

1.2 The European Project Semester.

The programme that started at The Engineering College of Elsinore in Denmark in 1995, European Project Semester is one of the educational options to consider while addressing the abovementioned challenges of contemporary engineering education.

In 1997 it transferred to The Engineering College of Copenhagen where it was carried out every spring and every autumn semester. Gradually, other engineering schools and universities adopted EPS, Avans Hogeschool in ‘s-Hertogenbosch in the Netherlands in 2002, Hoegskolen I Oslo in

Norway in 2003. In the spring of 2005, The International Faculty of Engineering, Lodz University of Technology in Poland and in the autumn, Universidad Politécnica de Valencia in Spain. Today, it is run by a large network of 14 European universities and engineering schools in 11 European countries.

The European Project Semester is a semester for mainly engineering and business students who have completed at least four semesters of college education. Yet, depending on the specificity of the project students of other majors are required since they can contribute with the right fields of expertise. Originally, only European students were accepted but since 1999 all the students from all countries worldwide are more than welcome. The major component of EPS is a large multidisciplinary project that accounts for 20 to 25 ECTS, depending on the country, and this is accompanied by regular short intensive courses that and support students in project execution and international team management and cover the rest of required ECTS for EPS to be classified as a full 30 ECTS semester. The courses range from Team Building, Communication, Project Management, International Business, Systematic Innovation, European Law, Environmental Studies, Foreign language courses.

All project groups are composed according to the students' fields of study, the requirements of the projects and intercultural as well as gender diversity. The group size is usually 4 or 5 students which ensures easier communication, better conflict management and helps the group develop cohesion which is positively correlated to efficacy.

2 European Project Semester as example of Project Organized Learning.

All EPS providers work within a common framework with some singularities. At Escuela Técnica Superior de Ingeniería del Diseño (ETSID) - Universitat Politécnica de Valencia (UPV) ten phases were identified for Project Organized Learning process. Table 1 shows these phases.

Table 1. Phases of POL.

1. Course definition	6. Mid-term project development
2. Project statements	7. Mid-term project evaluation
3. Team definition	8. Project development
4. Brainstorming and planning	9. Project evaluation and assessment
5. Tasks definition	10. Exploitation of results

A brief explanation of the meaning is provided below.

1. In this phase, the overall outline of the course is defined, including the scheduling of initial, mid-term and final evaluations and reports. Built in to the course are some preliminary seminars so that students are shown several aspects of working in a project. These include, for example, self-evaluation, the different roles of the members of a project team, as well as raising awareness of the students regarding why they might or might not choose a particular project. The course also demands the definition of a group of supervisors from different areas of expertise and the definition of the evaluation committee. We try to reach levels 5 to 8 on the classification proposed by Thomas [4].

2. This task has been carried out by the supervisors. Based on their background and previous experience, supervisors need to identify a real-life problem that students can solve. It is highly recommended that the problem is closely related with industry or with a definite service and has a

clearly defined starting point. Both these characteristics motivate students to participate. It is the task of the supervisors to contact companies in order to get funding from industry or to receive feedback. We create a broad spectrum of proposals where students can develop projects and provide solutions to complex problems. The projects integrate practical activities, an interdisciplinary approach and teamwork. Our aim is that the students learn what it really means to work in an integrated context. In the case of Lodz University of Technology, projects are conducted in collaboration with companies or are related to bigger TUL projects currently in process, which are of more academic or research character. This type of an approach contributes to a greater variety of projects within EPS and allows us to include students whose interests are more oriented towards academic disciplines. The students may then become more fully integrated in the research settings, may use laboratories, explore new fields and discover and expand their scientific interests.

3. The students are encouraged to choose a project based on their interests and motivation and they are formed into teams of four to six, whenever possible consisting of different nationalities and cultures. At IFE students are offered several projects during a presentation session and they select three options. It gives the students a sense of control over the process of project selection which helps them later identify with the task they will have to work on and accept it as their own. The groups are formed in such a way as to ensure proper fields of expertise for a specific project and diversity of cultures and, if possible, gender.

It is well-known that a team working together is much more powerful than individuals working alone. Team members play different roles. Teamwork requires a collective effort and a concurrent approach and the performance of specialists with different kinds of expertise. Students attend team design and team building courses. Here they take the Belbin self-perception inventory test and learn the value of the diversity of roles in a team. Although Belbin self-perception inventory is specifically prepared for teamwork, students at The International Faculty of Engineering (TUL) are encouraged to explore different possibilities of defining roles and behaviours or personalities in teams such as the DISC personality test for teams, Myers-Briggs personality Test or Jung Typology for Team Building and others. The questions we explore here are among others: How can we join our own effort with the efforts of others to achieve greater success? How can we better communicate being aware of differences and similarities in our team? How can we become more cohesive and effective in reaching a common goal?

4. Creative work in a free and open atmosphere encourages innovative ideas and solutions. Although all projects are based on engineering problems they also contain elements of business, economics, design and marketing. Each team is involved in defining, systematizing and navigating their own project. To achieve a required level of control over the project execution the EPS students go through an instruction process during such courses as Project Management, Team Building and Communication where they can insight and support in acquiring methodology and techniques to plan, monitor and manage their work as well manage their team dynamics.

5. It is a requirement that each project be a mix of different tasks. We help the students to write a team charter, a responsibility matrix, and a work breakdown structure. At least one supervisor is allocated to each team.

6. During compulsory weekly meetings issues such as project development, teamwork problems, communication problems and cognitive and political problems are discussed. In brief the three Ps are maintained in focus; i.e. Project, Process, People. From these weekly meetings students learn meeting techniques and disciplined behaviour. Furthermore, they learn how to write the minutes of a meeting and how to make a good agenda. The oral progress report provides an opportunity for the students to review and reassess their work. This is also a good opportunity to develop presentation skills, including the ability to defend a line of reasoning or a course of action.

7. In order to improve self-confidence, responsibility for the project and the group, communication in English, the students have the support of staff including a communication skills expert. The

evaluation of the Mid-term report (probably the most useful) is done by the staff involved, external evaluators from companies and academic institutions and by the students themselves. The self-evaluation part includes individual self-reflection, peer evaluation and written feedback intragroup. All these components together provide a vehicle for maintaining peer pressure through the need to express regular commitment to achievable objectives within fixed timescales.

8. The ability to listen, discuss and negotiate solutions in place is developed together with aspects crucial for creating the environment which contributes to successful project development such as taking responsibility for the learning process; contributing actively to teamwork; trusting and being trusted; expressing opinions honestly and cogently; taking ownership of their situation, their time and their project; developing a “we-attitude” in their team. The project supervisors provide regular guidance and feedback. At the International Faculty of Engineering (TUL) the above mentioned aspects are included in the agendas of supervisors and Team Building mentors. In order to ensure balanced level of monitoring over group dynamics, groups meet regularly throughout a semester with a team building teacher discussing issues adequate to the stages development of a group into a team as well as issues that naturally arise at a given moment. Those include topics as time management, team contract, organizations of effective meeting, and roles in groups, leadership issues, stakeholder analysis and stakeholder communication strategies, motivation, conflict management.

9. The learning process is iterative and the work must be structured and disciplined if the project and the technical report are to be delivered on time. The students’ work is at an end after delivery of the final written report and after the final oral presentation. The oral presentation, given before an examination board as well as the other students, provides an opportunity to acquire information about other projects related to different problems, thus gaining exposure to diverse fields of study and procure a broader understanding of engineering problems as well as observe alternative presentation methods.

The whole project is described in details in a report, submitted before the final presentation session and graded not only by the project supervisor but also by an external reviewer, which ensures more objective assessment. The report is evaluated considering, among others, the technical quality of the content, depth of the analysis, innovative approach to the recommended solution and its communication value.

10. Not all project results are always directly exploitable. However, their work together with their reports have provided valuable documentation on possible existing solutions, brainstorming developed by students in very short time periods and with limited resources, and of new ideas that might be valuable to exploit, and many have led to working prototypes. Some research units reported positive impacts [5].

3 EPS project examples

3.1 Example: Smart City – a Quest for Innovation

The project titled Smart City – a Quest for Innovation within the EPS Framework at the International faculty of Engineering, Lodz University of Technology, was conducted by five Bachelor engineering students coming from three different countries, France, Spain and Poland and representing the disciplines of industrial engineering, computer science, eco technologies engineering and business and technology. The methodology used within the European Project Semester used problem-based and project organized approach as well as emphasized diversity of disciplines and intercultural approaches. “The initial research on Smart Cities let students define four main areas of possible further activities: (1) accessibility with an emphasis on public transportation, (2) connectivity, including also the broader theme of improving the quality of interpersonal relations and building social capital, (3) green energy and environmental protection and finally a wide range of issues under a common name (4) "culture and innovation" [6]. The initial exploration of the topic and the existing state of the art in the field resulted in choosing citizen focused orientation that were to improve human life, which reflects the approach of Ratti [7] or Boni [8] specializing and researching the field. The developed solution was presented at the conference in Austria followed by the publication of the article written together by the supervisor of the project and the students. The solution is described by the authors as follows:

The U-shape smart phone application has been the result of the project work and may serve as a social platform allowing citizens to express their opinions on various spots in the city. Its functionality uses crowd sourcing methodology to gather the data on urban places, covering both commercial and public locations such as cafes, restaurants, squares and parks. Its objective is to help people to be connected with the city and other citizens. The main phases of the project design have been performed which are: the functional requirement specification, interface design, architecture design, database design and a complete module design. This design stage was preceded by benchmarking, examining similar applications. Also the budget necessary for further steps has been estimated.

The current functionality of the application is simple and easy to manipulate. It allows users to find a desired location, to comment on a place, to add new places and to modify existing ones. Also, the interface remains simple, which is done purposefully to keep it easy to use and attractive form the point of view of young people. The application architecture is conceived as open, so more options are planned if it is developed further such as connection to database on historical heritage and reading of QR codes fixed in historical or other important locations. The functionality has been verified with the data describing the neighborhood of Piotrkowska Street in the Lodz city centre, collected with the use of Quantum GIS. Further the development should also cover other locations. Besides this users should be able to follow both places and other users [6].

3.2 Example: Road Acoustic Screens - Technical Analysis and Promotion Strategy

The project Road Acoustic Screens - Technical Analysis and Promotion Strategy realized at the International Faculty of Engineering, Lodz University of Technology in 2011 joined technical and economical aspects, so it was dedicated to numerous engineering majors especially Mechanical Engineering, Electrical Engineering, Biomedical Engineering and Business studies students. The students represented different cultures: French, Spanish and Polish.

More than 80 million of the EU citizens are exposed to the noise levels that scientists and health experts consider to be unacceptable. Additional 170 million Europeans are seriously annoyed by the noise in their residential areas, especially during the daytime. Excessive traffic noise is one of the most common complaints. In fact, traffic noise impacts more people than any other environmental noise source. This kind of noise can affect the ability to work, learn, rest, relax, sleep, etc. Various methods have been developed that aimed at minimizing the traffic noise pollution and improving the environment. The application of road acoustic screens is one of them. The chosen subject of project was very actual and in the same time very practical.

During this project students made technical and scientific analysis of acoustic screens that can be applied around the roads also in the cities. Students got the possibility to make experimental research in acoustic laboratory (an anechoic room) with the models of screens made from different materials (and of different shapes and dimensions), they also performed data treatment and analysis of the results of experimental studies to choose the most effective and optimal model of acoustic screen.

The producers of acoustic screens should take into consideration their effectiveness, resistance and costs. To be competitive on the market, they should propose attractive and interesting offer. For these reasons, during the realization of the project, students also prepared an economical analysis of chosen acoustic screens application. They prepared a promotion strategy for a producer of acoustic screens taking into account different participants of the buying decision process (from B2B and institutional market).

Thanks to the realization of this interdisciplinary project students could:

- Understand the problem of noise and noise environment, as well the noise classification
- Analyse the economical and social effects of noise
- Comprehend the traffic noise aspects
- Identify different methods and tools of traffic noise reduction
- Know and apply the experimental researches in anechoic room
- Analyse effectiveness of acoustic screens (from technical and scientific point of view)
- Make economical analysis of chosen acoustic screens application
- Prepare promotion strategy for acoustic screens producer (with use of different tools and taking into consideration different public).

This semester a similar project is being performed. This time it is about the noise at the airports and methods of noise protection and reduction (incl. noise measurements at the airport and its surroundings). New group of students consists of 6 students from France, Portugal, Germany, Poland and Turkey representing Food Science Engineering, Public Health Engineering, Mechanical Engineering, Industrial Engineering and Biotechnology.

3.3 Example: 3D printed robot project

The project 3D printed robot project realized at ETSID-UPV in 2013 joined technical and economical aspects, so it was dedicated to numerous engineering majors and Multimedia and Business as well. The team is formed with students who are coming from German, Dutch and Finnish universities.

3D printing is a rapidly developing branch of technology but it is not yet accessible by ordinary consumers. This is due to the high prices of 3D printers and its early stage of development [9]. The aim of the project was to build a 3D printed robot and create a business plan for it. The idea is to go through the path of adopting new kinds of technologies and turn this experience into a guided path to be used by ordinary consumers. Thus, another objective is to develop a concept for a Do-It-Yourself robot kit, which is the actual proposal for solving the problem.

The team divide the project in 8 main task plus reporting: Assemble Printer, Idea Generation, Research, Marketing, Design, Printing, Programming and Testing. Some tasks are developed simultaneously

The team assembled the Prusa i3 (3D printer) and designed the robot parts. The parts were printed and assembled. The team chooses a hexapod to 3D print and improved its design on CAD software. Using virtual robot simulation software the robot was programmed in C++ language. Later on the robot was tested and optimised in 14 weeks.

A concept of a Do-It-Yourself robot kit was created and the team developed a marketing– and business plan for this DIY-kit. On top of that they executed the price definition. To promote the DIY-kit a logo and a promotion video were planned, designed and performed.

4 Future prospects

EPS programme does not only correspond with the European Qualification Framework [10] on the levels of 6 and 7 but it primarily allows the students to acquire all the necessary skills and competences in order to deal with the challenges of the changing international environment, become lifelong learners able to solve complex and unpredictable professional problems, think across disciplines, be creative in making independent decisions and work in cross-cultural settings. With all the above mentioned features EPS can be perceived as an empowerment programme which prepares engineering graduates to successfully operate in the job market of today.

EPS is aligned with Education and Training 2020 and 2011 EU Modernisation Agenda, by narrowing the knowledge/skills gap between employers and graduates and the development of C21st skills within the network. Yet, EPS providers aim to redesign this complex learning package called European Project Semester to promote the professional development of staff in ICT methodologies and innovation, to create an available set of good practices and OER, to establish a solid bridge between different stakeholders in higher education and to disseminate EPS to a wider audience.

In a short term, EPS providers expected:

- Stronger links between the members of the network. The creation of a consistent, sustainable network of universities.

- A proper dissemination of EPS within and outside the network. The creation of a solid bridge between different stakeholders in higher education and the growth of the student mobility (over 3000 students have benefited of EPS).

-The creation of added value at EU level thanks to the development of a learning package carried out in several different countries and easily implemented across the EU. The creation of a set of good practices available for all parties involved.

5 Acknowledgements

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SHOWroom WebTV-Production - Project based Education and Research

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Abstract

The authors of the following production illustrate how it is possible to connect online platforms with TV broadcasts and in what way online social media can influence Live TV productions.

SHOWroom the Live Web TV – Format serves as the starting point for giving the integration of online platforms such as Facebook due consideration, moreover, closely looks at the influence of online social media on Live TV production. Starting with the underlying concept and a general overview, the implementation of SHOWroom based on the specific roles these networks play, as well as, the Live-Streaming setup and LTE (Long Term Evolution) usage are examined. This case sets out to provide evidence that the development of online social media has a positive influence on TV, as integration enables adaptation to the demands of the consumers. Thus the interactivity demanded or expected is made possible.

1 SHOWroom – streaming the future today

SHOWroom is a specifically designed live broadcast, produced by students studying Media Technology at the University of Applied Sciences in St. Poelten [1]. Setting the starting point of implementation by initializing the live broadcast directly from California in the USA of the Solar Decathlon 2013, the students accompanied the Team Austria in October 2013. As a result the audience was given the opportunity to have a glimpse of the competition from behind the scene. Team Austria was represented by the Technical University of Vienna (the Institute of Architecture and Design – the working group for sustainable building, the Research Center for Energy and the Environment), the Salzburg University of Applied Sciences (Campus Kuchl), the Austrian Institute of Technology (the Energy Department) as well as the University of Applied Sciences in St. Poelten (Institute for Creative\Media/Technologies) – working together as well as interdisciplinary [2].

The show was the only Austrian Trimedia production participating as an educational institution. For this reason it received attention on-site as part of an international competition and perceived as extraordinary in comparison to coverage by the other media. Furthermore the participating students were integrated in the program.

The Solar Decathlon is an international competition among universities seeking energy self-sufficient buildings for the homes of the future. The Trimedia production in English (internet, social media, Web TV) was filmed in the video studio of the University of Applied Sciences using Web TV and was streamed live through the Internet.

A personal quote by Marion Haidacher:

“The issue of sustainability in our everyday lives and in the area of building was the focus of attention of the report and included daily events. Studio guests appeared from the areas of design, research, architecture, as well as sport and music.”

The SHOWroom live stream was available at 7pm everyday from October 3 to 12, 2013. A final show was on October 14. Based on the evaluation criteria such as living conditions, affordability, energy efficiency and design our Team Austria was selected as the winner of the competition on October 12, 2013.

2 The Concept

The original idea of LISI's (Living Inspired by Sustainable Innovation) Daily Show to report about the house developed and designed for sustainable living progressed to a multi-layered concept of SHOWroom, the Live – TV – Format in English [3]. Conceptualization and implementation was done by the students of Media Technology, Media and Communications Consulting and Media Management at the University of Applied Sciences in St. Poelten. Originally part of the 11 day interactive Trimedia production with a focus of attention emphasizing interaction, as well as, integration of the audience, the concept SHOWroom has also been implemented in further events such as the Researcher's Night 2014 and the FKTG Symposium 2014.

The ideal scenario to increase the degree of awareness of the Team Austria and the University of Applied Sciences in St. Poelten with this production and with the positive resonance of the audience and the international media by achieving the following aims:

- At least 400 fans on Facebook and Twitter should be acquired by the end of the Solar Decathlon (evaluation: monitoring of social media followers).
- At least 200 fans of the 400 acquired should come from an international audience (monitoring of the location of the followers).
- Increasing media presence of the University of Applied Sciences in connection with the show (media resonance analysis).

The strategy included the integration, which refers to the embedding of the direct and indirect participants of the competition in the program and in the social media activities by establishing and developing loyalty. Thus the resulting social factors connecting the participants should further virally reach the audience:

- The Team Austria, as well as, the other teams participating in the competition should be included in contributions, in order to increase the interest to watch the show, as they are in the show themselves.
- By using Likes and Sharing on Facebook or by using Tweets friends should therefore hear about the show.
- Whoever watched the show, had to automatically stumble across the contest. Participation was restricted to those who entered by indicating Like again in order to attract the attention of friends.

The participating universities and Universities of Applied Sciences were to address the public indirectly by posters, flyers as well as using Internet portals. Integration of the audience of the students with the help of interviews should again be implemented to increase interest in the show.

Online PR activities should include information in the Intranet, trailers and specifically addressing fans on Facebook and Twitter.

1.2 Implementation – Hard Facts

Table 1. Hard Facts of the 11 episodes in October 2013

Production	Trimedia (Internet, Social Media, Web TV) Interdisciplinarity 11 episodes each of a duration of 20-25 minutes
Program	4 categories: SHOW lisi, SHOW team, SHOW guest, SHOW quiz 10 quiz questions / contest questions
Live	Video stream in www Video signal from the USA Social media integration
Facebook	Main age group 18 – 24 450 Likes in 3 weeks finale: 3,163 viewers female: 53% male: 47%
Stream	Total time 6 days 5 hours 5 minutes and 12 seconds 2,000 viewers 160 viewers daily 89% Austria 6.9% USA 2.4% Germany 0.4% England, France, the Netherlands, Turkey, …

The realization of the Live Production as well as the implementation of the Trimedia production is discussed in more detail below.

1.3 Studio Production

The production in the TV studio of the University of Applied Sciences in St. Poelten was done by using the full-equipped High-Definition Video studio as well as ENG-Kameras (Electronic News-Gathering), which was positioned in the USA. A fifth mobile studio camera was installed in the studio setting for special selected frames. Using a MacPro the prepared feature was transmitted, while another MacPro was used to record the show in order to later evaluate the show/broadcast/recording. A further backup recording with a Grass Valley T2 iDDR (intelligent digital disk recorder) was used, should unexpected system errors occur during ongoing studio operations. A MacPro received the live stream from the USA.

The basic setting of the camera, which was positioned centrally by the team of producers, was performed using a remote control panel and for communication with the camera team, an intercom system was implemented during the broadcast. Before the first broadcast, the lighting was set together with the moderator. In addition to the white light the setting also included lighting effects and in some shows the lighting design was changed during the show, for example a party design was used. This specific lighting effect was actually implemented when Team Austria won the competition. Saving and retrieving settings quickly, was made possible by using a light desk.

The microphones used included binaural microphones for the moderators, clip-on microphones for the studio guests, as well as, a backup microphone mounted behind the seats, should a breakdown to the team occur.

2 The Program

The program consisted of two main parts. The first part (SHOW lisi and SHOW team) focused on the competition and on the construction of the house, named LISI (Living Inspired by Sustainable Innovation). The second part (SHOW guest and SHOW quiz) focused on information and entertainment. The recurring themes were woven through the four mentioned categories of the broadcast and adapted to the ongoing events in Irvine (USA). The exactly planned time slots for presentations made it necessary to start presentations precisely. For this reason the presenters received instructions using an in – ear monitoring device. In addition the presenters were provided with moderation cards.

2.1 SHOW lisi and SHOW team

Prepared reports from the USA were shown, as well as, live broadcasts with California focusing on the competition, Team Austria and the house LISI. This included portraits of the team members in interviews using a skype connection for voice transfer.

2.2 SHOW guest and SHOW quiz

A live talk of approximately 10 minutes provided the opportunity for experts to exchange their ideas on the issue of sustainability in a relaxed atmosphere (Fig. 1) and sponsors used the time to present their companies. At the end of every broadcast a prepared video was used, in which the quizmaster "Forester Sepp" placed the quiz question.

The implementation of Like on the Facebook fan page made it possible to allow users to automatically participate in the main prize competition. The results of the previously mentioned daily quiz question were immediately posted on Facebook after the live broadcast. In addition posting Likes for the video and posting the right answer to the quiz question in the comment section, created the opportunity to win the main prize. The sponsors of the prizes were able to place their advertisements on Facebook. In the following live broadcast the correct answer, as well as, the winner were announced.

Fig. 1. SHOW guest

Fig. 2. QR-Code

3 Facebook and Twitter

A strong feedback channel for interactivity was developed over the past years with smart-phones, tablet PCs (so-called Second Screens) and TV sets with integrated Internet function and thus made cooperation with the Internet, social media and TV content possible; thus consumers can participate actively. Corresponding to the spirit of the time, the Zeitgeist, social TV and the aim of marketing to foster strong media presence, Facebook and Twitter were chosen as platforms for this purpose. Moreover, these platforms are known to make fast dissemination of content possible. Due to the synchronization of content, the quiz could be managed via Facebook only.

3.1 Facebook implementation

In addition to the daily announcement of the stream start on Facebook, the link for the stream was accessible through Facebook and Twitter. Business cards, flyers and posters with the QR code (Fig. 2) were directly linked to the Facebook fan page. In this way 450 fans or Likes were generated within a three-week period.

The numbers indicate, that the age group from 18 to 24 could be reached using Facebook. Of the 450 Likes obtained, the most originate in Austria (170 from Vienna, 54 from St. Poelten). Germany, with 17 Likes came in second, whereas the USA with 9 Likes came in third.

The striking scope of the fan page is reflected in the 11,215 people counted on Oct. 6, 2013 as well as the 3,163 people in the final broadcast on Oct. 14, 2013.

The Facebook fan page in general offered entertaining content such as vines and memes (behind the scene photos and videos); whereas the Twitter account provided additional information about the show. In addition, quiz games played an essential role especially regarding interactivity, directly integrating the viewer. Figure 4 shows the Twitter page of SHOWroom.

3.2 Twitter implementation

The implementation of Twitter was not that successful for the target group, whereby the posts were limited to 119 characters (maximum Tweet length of 140 minus 21 characters necessary to generate a short link resulting from the synchronization with Facebook).

Facebook provided a platform for the coordination of the platform, as an installed online working group made it possible to keep all colleagues up to date. Regarding contact to colleagues in the USA, skype was used.

In the Live Show posts as well as questions from the public on Facebook and Twitter were integrated using scripts read and prepared by RSS (Rich Site Summary) feeds. In real time graphics – software Viz Artist an appropriate insert was designed and animated for it (Fig. 5).

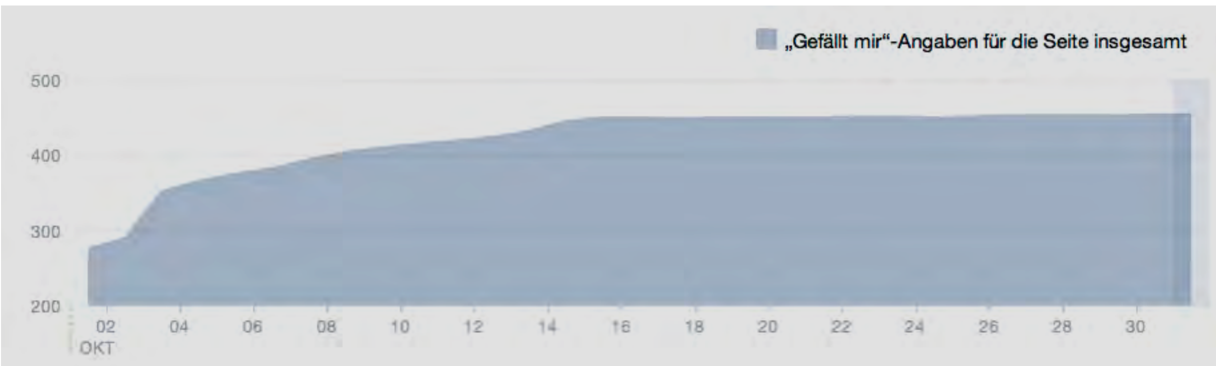

Fig. 3. Likes for www.facebook.com/fhstp.showroom (Oct. 2013)

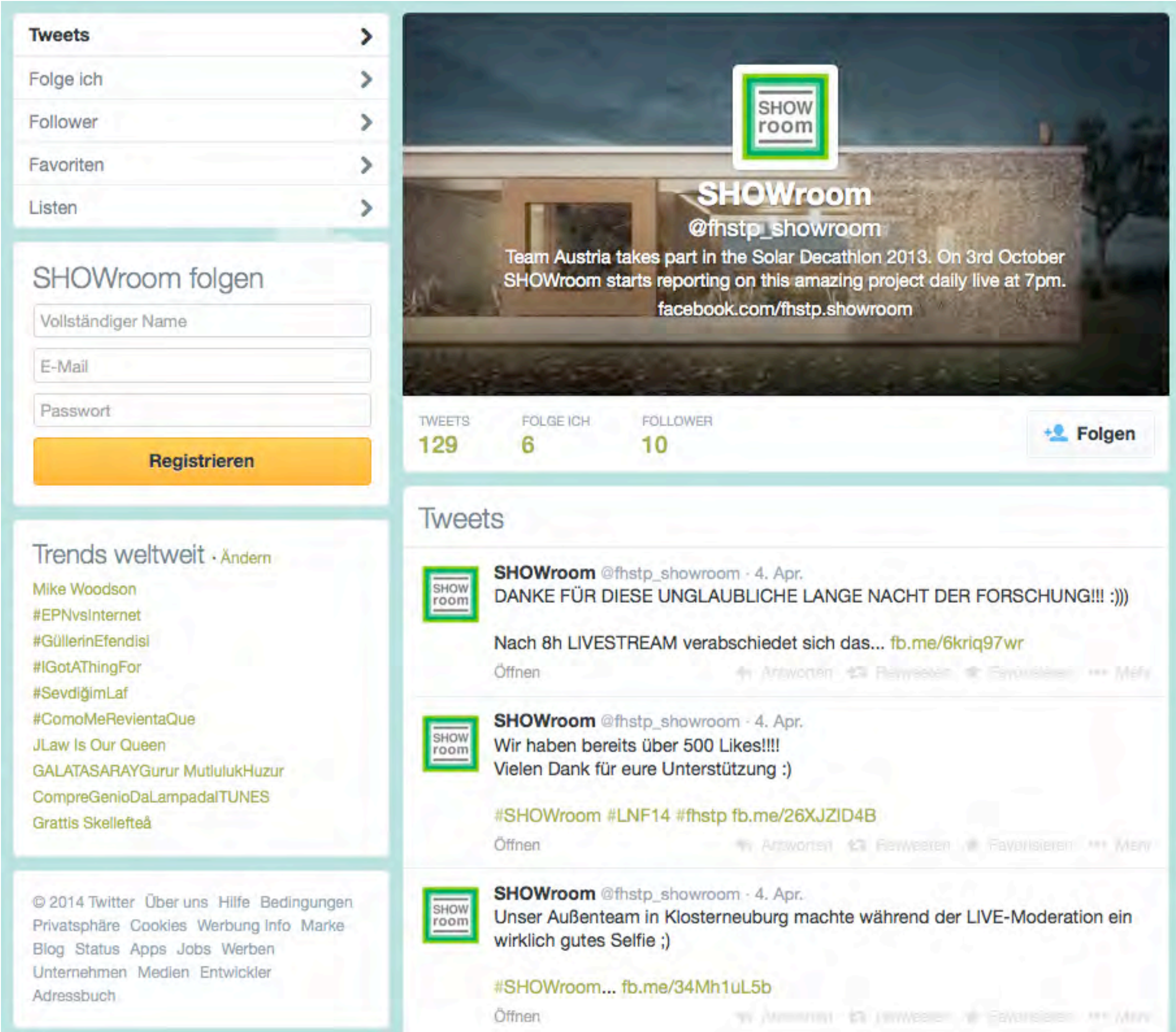

Fig. 4. Twitter page of SHOWroom (April 2014)

Pertaining to RSS it is a code based on XML (Extensible Markup Language), that makes it possible with little effort to show new information and transfer the information to other end devices. As Twitter no longer supports or allows any RSS feeds since June 2013, Google script was implemented, in addition, in order to extract the three most important pieces of information from the Twitter RSS feeds: name of the person posting, content and time. The totally automated process of generating a live insert form current posts was operated by using the Button Load RSS so that control of the list of posts actually sent to the broadcast was possible (Fig. 6).

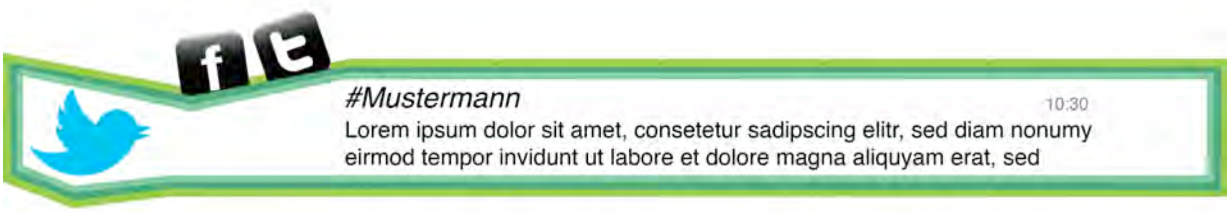

Fig. 5. Facebook and Twitter Insert

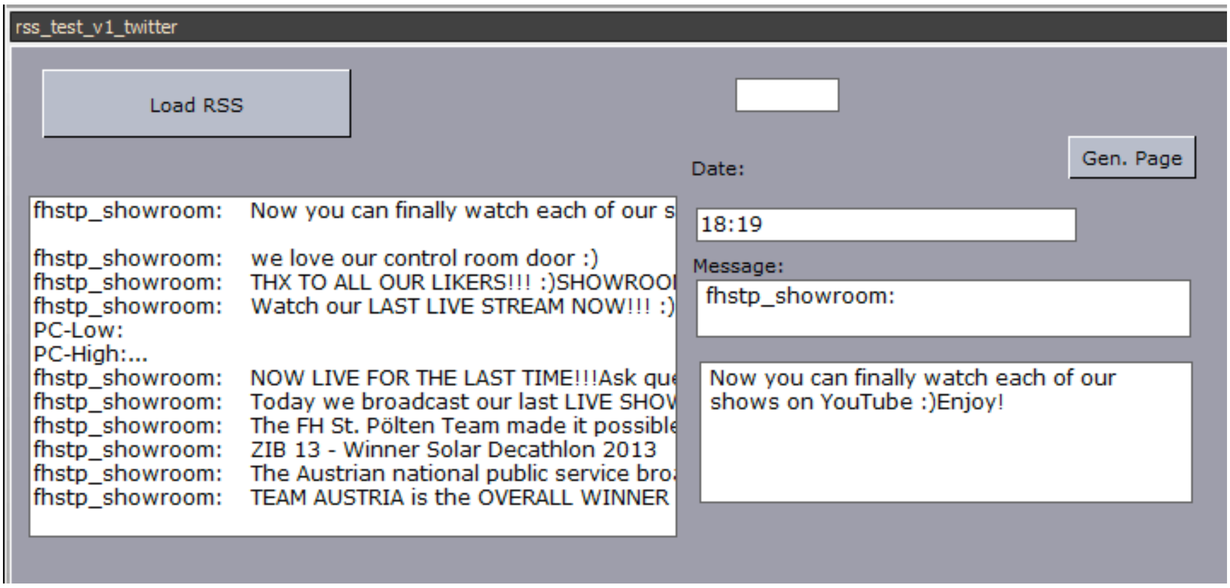

Fig. 6. Viz Trio, Load RSS

4 Live-WebTV Stream

In general SHOWroom was designed for use with the Internet and more specifically with Facebook [4]. The streaming log files were read and evaluated with the help of the software Sawmill Analytics. From October 3 to October 14, 2013 a total of 1,937 streams were accessed – which is equivalent to a daily average of 161 streams. Three different resolutions were possible, whereby the HD stream (1280x720p25) was chosen most often. The stream with the second best resolution of 640x360p25 followed by 37.2% was implemented using Facebook. The resolution 398x224p25 for the mobile end devices such as Android and iPhone were represented by 9.5%.

It is worth mentioning that the number of occurrences reaching 16,012 queries, as well as, the data transfer of over 55 GB was high. It was possible to take the sum of the streams and divide them up into the countries that received them: Austria was clearly on first place with 1,704 received streams (Fig. 7 and Fig. 8). The total cost for the Live Stream using Amazon Web Services was manageable also covering the EC2 Cloud Service by Amazon, the license for Wowza Media Server, as well as, the volume of data transferred.

The importance of streaming for SHOWroom as a Trimedia production is easily understood, based on the number of queries, as well as, the option of integration, referring to the function as reverse channel for interaction with the viewer in the context of social media: streaming made it possible for the viewers to vote on the next show or to challenge the moderators with specific tasks. Thus with the help of the stream the audience highly influenced the show, which corresponded to the concept of loyalty to SHOWroom.

Reihung	Prozent	Streams	Land
1	89%	1.704	Austria
2	6,9%	132	United States
3	2,4%	45	Germany
4	0,4%	7	United Kingdom
5	0,3%	5	(unbekannt)
6	0,2%	4	France
7	0,2%	3	Netherlands
8-16	0,1%	2	Turkey, Czech Republic, Portugal,...

Fig. 7. Evaluation of Streams According to Countries

	↑ Tag	Abspieldauer	Total server-to-client stream bytes	Total client-to-server stream bytes	Ereignisse	unique_client_ids	Streams	Eindeutige Client-IPs
1	03/Okt/2013	17:41:42	7,20 G	842,74 M	2.734	342	353	89
2	04/Okt/2013	1d 02:20:38	11,24 G	2,03 G	2.698	372	403	130
3	05/Okt/2013	11:20:15	4,75 G	840,15 M	826	85	89	40
4	06/Okt/2013	13:32:16	4,01 G	455,37 M	1.076	126	133	58
5	07/Okt/2013	13:31:36	3,85 G	448,50 M	1.644	187	200	69
6	08/Okt/2013	09:32:33	2,97 G	516,19 M	1.030	91	98	41
7	09/Okt/2013	08:13:29	3,20 G	494,44 M	1.046	123	125	52
8	10/Okt/2013	09:10:26	3,49 G	668,91 M	757	75	81	39
9	12/Okt/2013	21:02:00	7,70 G	1,62 G	1.548	162	171	54
10	14/Okt/2013	18:40:17	7,48 G	912,63 M	2.653	362	294	80
	Summe	6d 05:05:12	55,90 G	8,70 G	16.012	–	–	–

Fig. 8. General Overview, Stream Evaluation

Of special interest is the camera implemented for the Live report in Irvine, the JVC GY – HM650 with a built in encoder (Fig. 9). This only had to be connected to the Internet using the WiFi USB-Stick using a 4G/LTE modem.

5 LTE – Long Term Evolution

For the live connection/transmission from Irvine to St. Poelten we trusted in the capacity of the wireless network provider Verizon for the wireless network needed. Using a pre-paid 4G/LTE WiFi modem, a synchronous 15 Mbits wireless network was reached, located on the military airport no longer in use in the Californian desert. A single charge of 40 GB data volume ($300 for the modem including the data volume) sufficed for the three weeks in Irvine, which especially when comparing the costs of such services in the German speaking world represent pure luxury.

Fig. 9. Live connection with the JVC GY-HM650 Camera in the USA

6 Conclusion

The practical experience with SHOWroom proves, that it is possible to realize a Live Web Show using social media integration with a group of motivated students. It must be emphasized that constant presence on various social media platforms is important in order to generate a Buzz, making and keeping viewers interested in the next broadcast. Moreover, it is necessary to give consideration to the aspect of interaction, not to forget that it is essential to provide a way for the inexperienced public to find a way to receive the stream. The number of viewers interested in interactive TV and social media is increasing. Video streaming has experienced an enormous boom and there are more and more opportunities to convey video content to the public. The idea and the current tendency to make it possible for the viewer to directly influence content, for example when and where specific content can be viewed, suggests that social TV is very much future oriented. The content of a specific TV program can be immediately discussed online with friends and acquaintances. By using new programs for smartphones and tablets, such as the synchronization of apps, second screens will soon be a common element of TV.

Social media integration in Web TV shows is currently experiencing a dynamic phase of development, whereby social TV depicts only the beginning of a revolution against traditional TV. The way in which a TV show or WebTV show can be integrated is an issue for the future.

The emergence of a new medium does not necessarily mean competition for the existing model – Mike Proulx and Stacey Shepatin state:

> “The rise of a new medium does not always mean the end of another.” [5, p.4]

Fig. 10. The SHOWroom teams in Irvine (top) and St. Poelten (down)

After the last edition of SHOWroom all the episodes were uploaded to YouTube. All eleven episodes can be seen using the following link: http://www.youtube.com/user/fhTVSTUDIO

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International Collaboration in Teaching Physics in the ETSID

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Conference Key Areas: Education and Research, Innovation in EE, Internationalizing the engineering curriculum.
Keywords: Physics teaching experiments, smartphones, and classroom demonstrations.

Abstract

The collaboration activity in Physics teaching between professors from the School of Design Engineering (ETSID in Spanish) of the Universitat Politècnica de València, Spain, and from two Latin-American universities over the last three years is briefly summarized in this work. The results in three areas: *Computer Simulations*, *Classroom demonstrations* and *Laboratory Experiments*, are commented by means of selected examples.

1 Introduction

The classroom demonstrations and laboratory experiments based on Physics phenomena are two irreplaceable tools in Physics teaching. These activities usually involve the explanation of the Physics phenomenon as well as its consequences and/or applications [1]. They are designed in such ways that capture the attention of the students which allows for a better flow of the teaching-learning process. In the laboratory experiments, besides the visualization of a Physics phenomenon, quantitative proof of Physics Laws can be addressed. With laboratory experiments students not only go deeper into the understanding of the Physics concepts but also develop important practical skills [2]. In all this, computers are playing an important role. The use of computers as scientific tools for performing simulations is wide spread nowadays in all areas of Science and Technology. The contribution to the development of computer-related skills in the students has become a fundamental issue in all the teaching levels.

The development of teaching experiences can enormously benefit from fruitful multilateral discussions related to different sceneries. This is the case of the examples commented in this work. The results of a three-year collaboration in Physics teaching among professors from the Physics Departments of the ETSID at Universitat Politècnica de València (UPV), the University of Pinar del Río, Cuba and the Northern Catholic University, Chile are briefly commented in three areas, *Computer Simulations*, *Classroom demonstrations* and *Laboratory Experiments*. As example of Computer Simulation, the study of the motion of a body in the air is presented [3]. The equations of Newton are solved numerically by using a very simple algorithm based on a subdivision of the trajectory in constant velocity time intervals. Subsequently, the construction of a Ruben´s tube and its use to visualize acoustic standing waves are presented as a classroom demonstration example [4]. Finally, recent Physics teaching experiments using the smartphone´s acceleration sensor for the study of mechanical oscillations are explained [5, 6].

2 Computer simulations

It is usual to find three subjects in the first year of the syllabus of any technical engineering career, namely, *Calculus*, *General Physics* and *Programming*. Being Physics a matter lying on the grounds of any technical engineering, it becomes naturally appropriate to introduce the use of Calculus and Programming as useful tools in the context of a Physics problem. This can be accomplished by moving some Practical Classes of Physics (problem solving) into the computer pool and by reformulating the physics problems in order to make them more appropriate for this kind of approach.

2.1 The motion of a body subject to air drag force

We have turned the problem of the "The motion of a body subject to air drag force" into a computational Physics problem. This is a typical problem that may be present in the first year physics course of any engineering [7, 8]. By means of this example, we emphasize on the skills related to professional schemes of work, such as, comparison between analytical and numerical approaches, graphical analysis, and integrated use of mathematical and computational tools. The statement of the problem is as follow,

> *A body of 2.5 kg is launched to the air with an initial velocity of $v_0 = 150\ \mathrm{m/s}$ and with an initial launching angle of $\alpha = 40^\circ$ with respect to the horizontal direction. This body is subject to the Earth gravity force and to a drag force $F_d = -30v$, where F_d is expressed in N (Newtons) and the velocity of the body v in $\mathrm{m/s}$ (meters per second). The question is: Solve numerically the Newton equations of motion to obtain the trajectory of the body given by $x(t)$ and $y(t)$. The initial time is $t = 0\ \mathrm{s}$ (moment of the launch) and the final time, $t = 20\ \mathrm{s}$. Increase the time interval in $\Delta t = 0.01\ \mathrm{s}$ and get an output $x(t)$ and $y(t)$ every $0.5\ \mathrm{s}$. We suggest the use of a programming code although it can be performed using a Microsoft Excels worksheet.*

For simplicity, we have shortened the statement of the problem with respect to our published work in Ref. [3]. The numerical procedure that has been used here is very simple and is based on considering small intervals where the velocity is assumed to be constant. This approximation gives better results as smaller time intervals are used. The constant velocity motion (uniformly accelerated motion) is studied in the levels previous to the university. In this respect, a numerical procedure based on it would help in the smooth transition to the university level. The detailed steps of this algorithm can be found in Ref. [3].

In Figure 1, the numerical and analytical trajectories are shown. The overlap of the curves indicates the capability of the numerical algorithm to compute the trajectory. The values of times and distance for the critical points of the parabolic trajectory are included in the Figure. As for comparison, the curve for the body in the air is plotted along with the curve for the body in vacuum (Figure 2). One distinctive feature of the curve of the projectile in the air is that it is not symmetric with respect to a vertical line passing through the point of maximum height.

By means of this simple Physics problem, students can put together, for instance, programming tools and numerical methods, along with the physical laws in order to address more realistic models, different from those which can usually be treated on the blackboard. This kind of computational physics problem increases the motivation of the engineering students by embedding them into sceneries whose models are closer to the real problems they will be facing later in their professional and scientific life. This is particularly relevant for the first year of engineering when the development of this kind of professional skills is usually skipped.

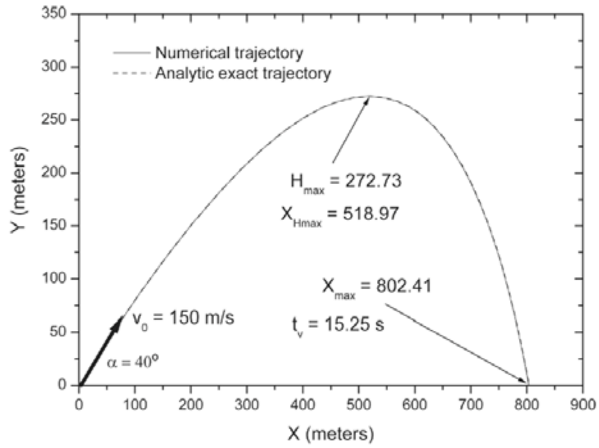

Fig 1. Curves of $y(t)$ *versus* $x(t)$ for the analytical and the numerical trajectory.

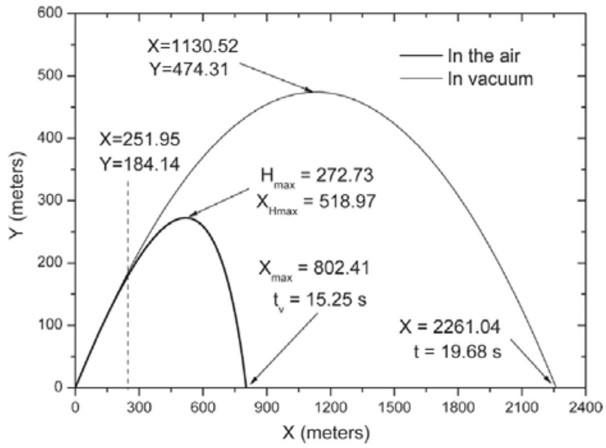

Fig 2. Trajectories of the body, with and without air drag force.

3 Classroom demonstrations

In this section, the example a propane equalizer used to visualize stationary waves is illustrated [4]. This work includes not only the classroom demonstration, but also the construction of the Ruben´s tube from materials which can be found in typical shops.

3.1 A propane equalizer to visualize standing waves

The different elements used for the construction of the Ruben's tube used in Ref. [4] are shown in Figure 3. As can be seen, all materials and components can be easily found in normal shops. The Ruben's tube consists basically of a tube with an entrance for the propane gas at one of the ends [4] . The other end is coupled to a speaker which produces the acoustic wave. By selecting a resonant frequency at the speaker, a standing wave is formed inside the tube. The amplitude of the wave can be visualized by the shape of the flames coming out from the small holes opened along the upper part of the tube.

In Figure 4, a photograph of the Ruben's tube for different standing waves is shown. The wave nodes are visible in the shape of the flames. It should be mentioned that this classroom demonstration needs precautions to prevent accidental fires.

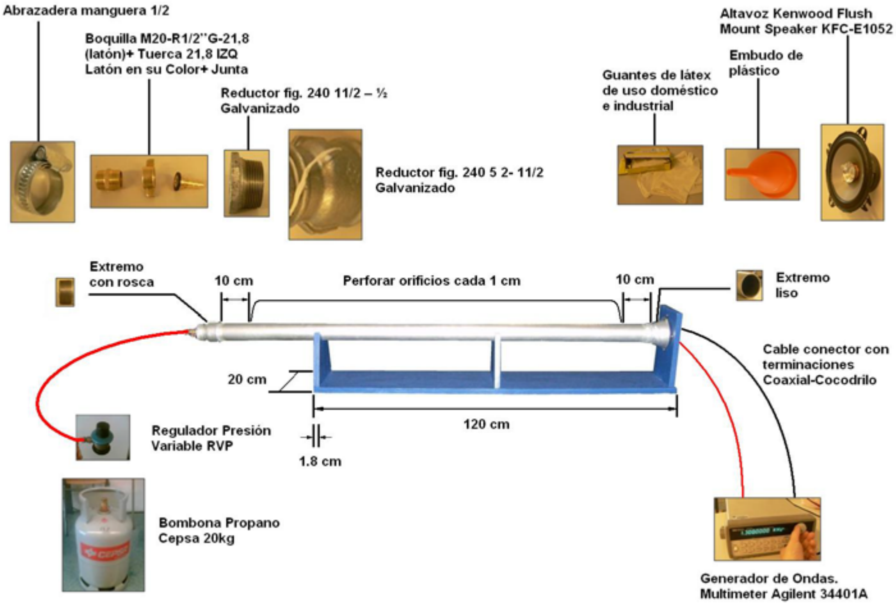

Fig 3. Set up of the demonstration.

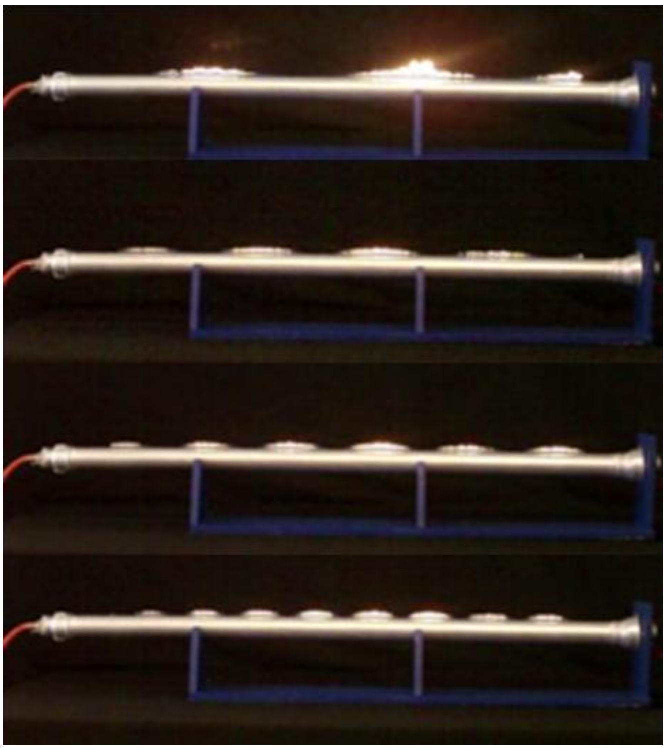

Fig 4. Standing waves in the Ruben´s tube for different resonant frequencies.

This work was part of the graduation thesis of a Design engineering student of ETSID, UPV. The Ruben's tube constructed in this work is being currently used in Physics classroom demonstrations at ETSID, UPV. This prototype of tube will be also used to construct similar tubes in the University of Pinar del Río, Cuba.

4 Laboratory experiments

Smartphones are very familiar devices for the students. In the following, we will comment on recent Physics experiments using the smartphone´s acceleration sensor to study mechanical oscillations on an air track.

4.1 Study of Free and damped harmonic oscillations

In Ref. [5] we studied the free and damped oscillations of a smartphone with its acceleration sensor. In Figure 5, a photograph of the experimental setup is shown. In this Figure, the following elements are present: (1) the smartphone, (2) cart, (3) air track, (4) spring, (5) photometer and (6) fixed end. The smartphone used in the experiments was an LG-E510 bearing an Android version 2.3.4. The mass of the phone and the cart were $124\,g$ and $180.6\,g$, respectively. The data were collected with the Accelerometer Monitor application version 1.5.0 whose features were commented above in this document (figure 1b). The force constant of the spring was $(189 \pm 7)\,N/m$. To initiate the free oscillation experiment the air supply of the air track is switched on. This allows a layer of air between the cart and the air track to decrease the friction. Under these conditions the motion of the cart is started with almost no friction. The acceleration versus time can be represented in terms of a sinusoidal function,

$$a(t) = A\sin(\omega_0 t + \varphi_0)\,, \tag{1}$$

where A is the acceleration amplitude, ω_0 is the angular frequency, and φ_0 is the phase constant. The smartphone in Figure 5 (a) is moving with harmonic oscillations. The sinusoidal signal can be seen on the display. In figure 6, the experimental data of the acceleration are shown along with a fit to equation (1).

(a)

(b)

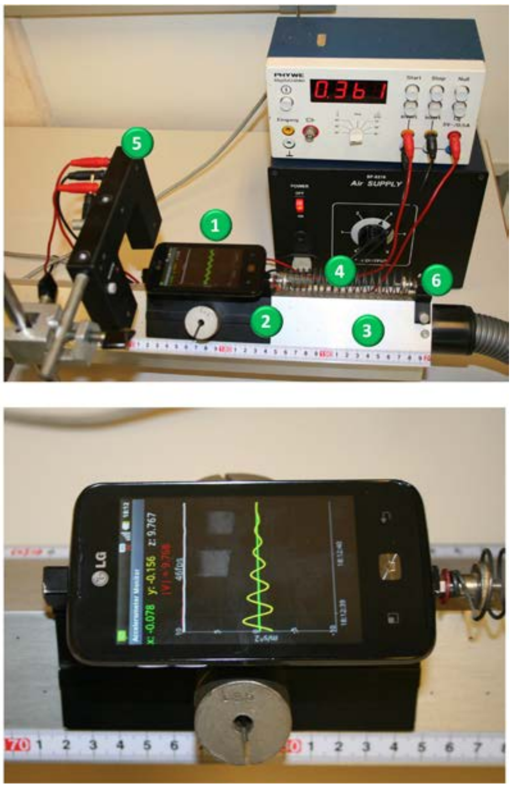

Fig 5. Photograph of the experimental set up with the smartphone moving with free oscillations (panel a) and of a close-up of the smartphone moving with damped oscillatons (panel b).

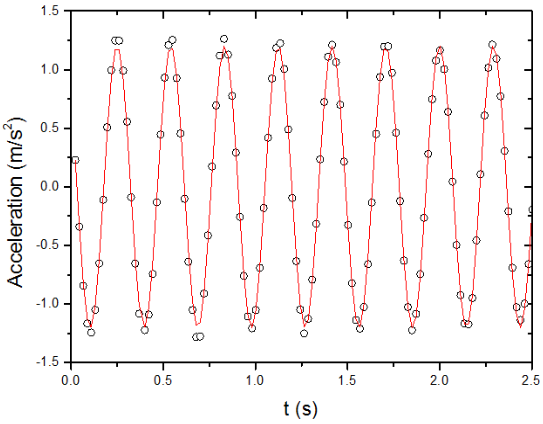

Fig 6. Experimental acceleration data (open circles) and fitted curve (solid red line) for the free harmonic oscillation

In order to study damped harmonic oscillations, the air supply was decreased in the air track. This causes some friction to appear between the glider and the air track. In figure 5 (b), the damped oscillation can be observed on the smartphone´s display. In Figure 7, the experimental data are shown along with the fit.

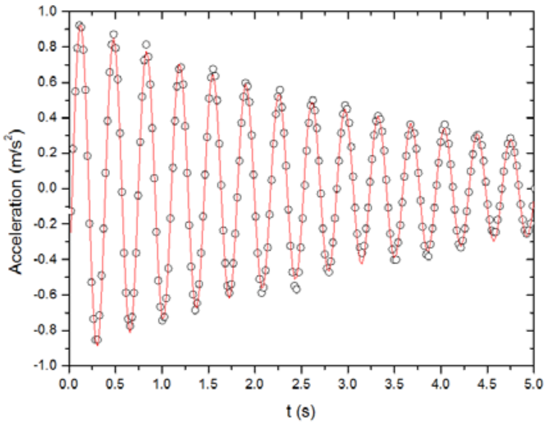

Fig 7. Experimental acceleration data (open circles) and fitted curve (solid red line) for the damped harmonic motion

4.1 Study of coupled oscillations

In order to study coupled oscillations in Ref. [6], we have used an air track and two smartphones coupled by springs. In figure 8, the elements of the setup are shown as follow, (1) and (2) are the smartphones, (3) the photometer, (4) digital counter of the photometer, (5) air supplier, (6) the connecting spring, and (7) the right-hand fixed end.

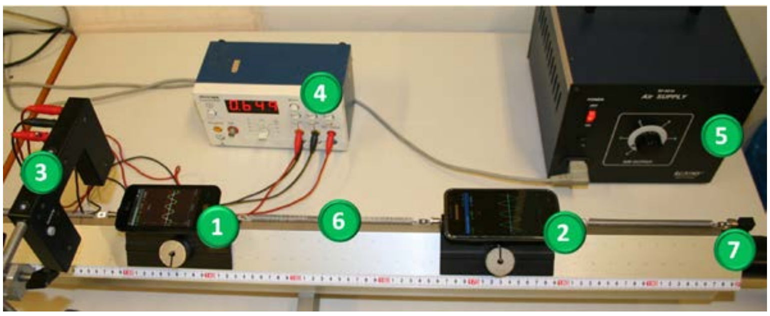

Fig 8. Experimental setup to study coupled oscillations

For this purpose, a smartphone was mounted on each cart. The mobile (1) is a Smartphone LG-E510 bearing an Android version 2.3.4 and the mobile (2) is a smartphone Samsung Galaxy S1GT-i9000 bearing an Android version 2.3.5. The mass of each cart was $m = (500.5 \pm 0.1)\,g$. The force constant of each of the three springs was $k(t) = (47.1 \pm 0.2)\,N$. The sensor data were collected with the Accelerometer Monitor version 1.5.0.

The acceleration oscillations of carts 1 and 3 can be described by the sum of the symmetric and anti-symmetric oscillations,

$$a_1 = -\frac{1}{2}\left[A_1\omega_1^2 \sin(\omega_1 t + \varphi_1) + A_2\omega_2^2 \sin(\omega_2 t + \varphi_2)\right], \qquad (2)$$

$$a_2 = -\frac{1}{2}\left[A_1\omega_1^2 \sin(\omega_1 t + \varphi_1) - A_2\omega_2^2 \sin(\omega_2 t + \varphi_2)\right], \qquad (3)$$

where A_1 and A_2 are the amplitudes, ω_1 and ω_2 the normal frequencies, and φ_1 and φ_2 the phase constants, for the symmetric and anti-symetric modes, respectively. The above equations reduce to the symmetric and anti-symmetric cases for $A_2 = 0$ and $A_1 = 0$, respectively. More details on the derivation of Eq.(s) (2) and (3) can be found in Ref. [6].

In Figure 9, an arbitrary oscillation of the carts is shown. The open circles indicate the experimental acceleration data and the red solid line, the fit to Eq.(s) (2) and (3) using the Levemberg-Marquardt algorithm [9, 10]. A very good fit is observed.

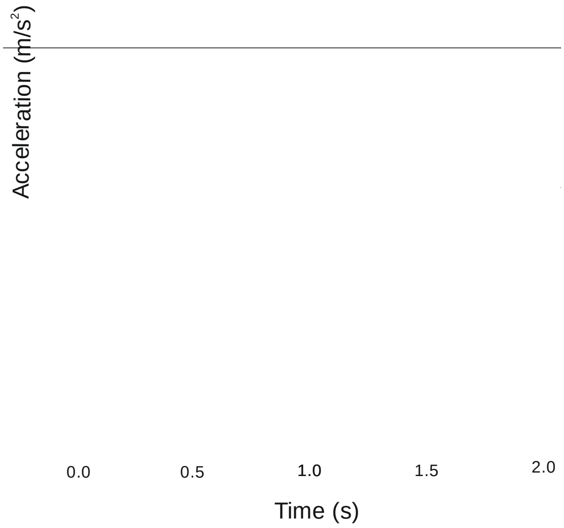

Fig 9. Acceleration of the carts 1 (panel a) and 2 (panel b) for an oscillation resulting from the combination of symmetric and asymmetric modes.

5 Summary

Results from the collaboration in Physics teaching between professors from ETSID (UPV) and from two Latin-American universities collaboration have been briefly commented. Feasible examples of *Computer Simulation*, *Classroom demonstrations* and *Laboratory Experiments*, have been presented. The use of computers to perform simulations, the easy construction of laboratory equipment and smartphones in Physics experiments were the central issues emphasized in this work.

6 Acknowledgements

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Urban green thinking: implementing green technologies in a product of public use

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Abstract

Environmental sustainability is a topic of social commitment that has to gather all the agents involved in the economic and productive system. Users also have to assume values and attitudes that give priority to an appropriate and innovative use of technology and design towards the environment and management of resources.

The engineering discipline dedicated to sustainable design employs numerous initiatives, mainly life cycle analysis (LCA) including product life cycle, pollution prevention and design for the environment, new concepts like the cradle to cradle model, and environmental problems focusing on the energetic management.

This article presents the design of an urban services and information booth that adopts the green technology implemented at the BIQ house, located in Hamburg. The project inquires in the combination of new technologies as the augmented reality (AR), in a product of public use designed as an ecological, attractive and functional solution for the recent “Smartcity”. A symbiosis between different sort of technologies in an element of street furniture that reduces environmental impact and has as aim the communication of these values.

1 Introduction

The concept of eco-design and the multiple approaches that gathers the so-called green design are intended to improve and, as far as possible, repair the aggressions and deterioration of the natural environment. The commitment with nature and environmental sustainability is a nowadays necessity since the last century's last decades left a problematic trace characterized by the depletion of natural resources and the imminent need for sustainable energy sources.

In this context is placed the concept of “sustainable development”, settled down in the whole international scientific community by the Brundtland commission [1] as the human ability to ensure the satisfaction of the present needs without compromising the ability of future generations to meet their own needs. Liverman et al. [2] delve into this definition, and defined “sustainability” to be the indefinite survival of the human species (with a quality of life beyond mere biological survival) through the maintenance of basic life support systems (air, water, land and biota) and the existence of infrastructure and institutions which distribute and protect the components of these systems. The sustainable development encompasses three concepts, ecological, economical and social sustainability that, in turn, are related to one of the four following areas: 1. Conservation, 2. Development not affecting ecosystems, 3. Peace, equality and respect for human rights and 4. Democracy.

As a result, the first decade of the XXI century was characterized by the origin of a social and environmental thinking that promotes values such as awareness of the economic and productive model, the importance of humanizing technology and ethical consumerism [3].

From the design activity many contributions have been made [4] trying to tackle ecological issue from the creativity at different levels of complexity: waste materials and components reuse, application of recycled materials, the implementation of energy solutions in consumer products, etc. From the perspective of the market and user-oriented design trends [5], in recent years a persistent trend showing a relationship and commitment to the environment is found. The clients are involved in caring for the environment and expect to have influence with regard to decisions on the quality of the future. But also they consider vital to represent all these at home and surround themselves with materials and items that show the survival and reuse of raw materials and objects that relate them to nature and provide their own oasis of relaxation and energy. Although, elements of public use are consumer products characterized by not being selected and purchased by users, the so-called consumption choice these days means approaching user penchant for products, in this case the citizen.

On the other hand, approaches linked with engineering are developed recommending the appropriate and innovative use of technology for energy management, products life cycle and new concepts such as cradle to cradle model that calls for a radical change in industry (it suggests that the "reduce reuse recycle" methods perpetuate the cradle-to-grave strategy, and that more changes need to be made) [6]. Engineering discipline involved in sustainable design employs numerous initiatives such as setting and planning projects to reduce environmental and social impacts, restoring natural environments or improving industrial processes to eliminate waste and reduce consumption.

As architecture-engineering-design mid-point or even better in an inclusive sense, we can find proposals like the one implemented in Hamburg (Germany) in the BIQ house [7], which develops the latest technology in its design and energetic efficiency management.

From the social view of the product that involves with the community and the public space, sustainable design gains added interest: The street furniture can be an active support in public and political life of the community enabling new forms of participation and civic engagement.

In this direction this work is a research focus on looking for new solutions to be incorporated in elements of collective use, making use of current and low cost communication technologies, which are materialized in a self-sufficient infrastructure that also clearly demonstrate this vocation.

2 Background. Urban elements and green design

There are many examples of the implementation of recycled materials in the production of street furniture, among which steel and plastic materials are the most common. Progress has also been made in the use of sustainable raw materials of natural origin like wood, guaranteeing their origin from controlled reforestation.

However, one of the greatest environmental impact issue in product design for the public space is the management of energy consumption and its operating in the urban environment conditions. In this direction steps have also been taken towards the development of control systems and to a lesser extent, elements that become self-sufficient from the use of renewable and clean sources of energy. Common examples of this are the installation of solar panels at bus stops and telephone booths. Although much remains to be done, the research and experimentation of green engineering in the field of technology and nature, establishing an unprecedented relationship from which multiple applications are expected. Some of them are at the moment, sophisticated and high-priced exclusive projects, it is noteworthy some of these contributions since they constitute precedents for our proposal.

Philips's *Light Blossom* [8] is an urban street lamp prototype (2008) that harvest energy from the sun and the wind and attempts to reduce light pollution. It is a very figurative design inspired by the functioning of flowers; it opens its "petals" to collect solar energy through its photovoltaic cells. As sunflowers, "petals" are reoriented according to the position of the sun for enhanced performance. On cloudy days, they act as blades transmitting its movement to a rotor, which in turn generates electricity. As far as lighting is concerned, particularly through the use of LEDs the power consumption is reduced by 50%. To reduce light pollution and power consumption Blossom Light automatically turns on and joins its petals in upright position to gather the irradiated light, whose intensity varies through proximity sensors.

Pavegen is a 45 x 60 cm decorative tile designed for obtaining energy from the footsteps of individuals [9] and it has been implemented in some projects developed in the UK and Europe, mainly malls, stations and places with high pedestrian movement. Each step pushes the tile 5 mm down producing an average of about 7 watts, depending on the weight of each individual. Most of the energy gained is stored for later use and just 5% of it is used for lighting the tile itself and give feedback to the passer-by. It is made from recycled rubber tires and 80% of the used polymers are recyclable. They are also resistant to water and have an average life of 5 years.

Lumix Company is responsible for creation of a new model of bulb: light emitting plasma [10]. The lamp consist of a bulb with a size of less than 15 mm and it is significantly more light efficient compared to any other product on the market. The life of the plasma lamp is beyond 50,000 hours that allows for economic and energy savings. The latter consumption is cut on average 47% compared to standard street lighting, requiring just 280 watts while the quality of the light is improved by a higher brightness. The bulb only contains argon inside, which after the application of a certain frequency is heated to 6000 Kelvin in less than two minutes time, thus achieving a very similar daylight illumination.

3 Objectives

After a first analysis of street furniture [11], their roles, contributions and major opportunities, two aspects were considered premise in order to progress in this difficulties: one of them would be to offer extremely topical and demand features such as those associated with real-time information, augmented reality and availability of energy. Another aspect should be plain in the design of the element, which should show its energy performance giving prominence to biological generating process that improves the quality of the environment.

The objectives of this proposal are two:

- Suggest an ecological solution for an innovative public use product, owing to the offered services, in which will be determining the optimum implementation of materials and sustainable processes.

- Design a product of public use evidencing this ecological efforts contributing to ecological social awareness.

Assuming the range of available technologies allow to create truly “ecofriendly” products that actively contribute in a responsible and respectful use of the community environment. This raises interest in technology, renewable energy and design, as key aspects for generating futuristic, attractive and fully viable street furniture.

3.1 Services booth for the urban environment

Services booths are more or less enclosed structures placed in the public space with the purpose of enabling the use of different types of facilities; electricity, voice and data are the most common. It is important to know that these are complex street furniture that have close contact with the end user and require some interactivity in so far as they have to perform a number of actions for their operation and their usefulness and effectiveness arise from them. Accordingly, requires immediacy of understanding by the user. This product is a direct predecessor of phone booths and shares some characteristics: minimum space for an individual, exterior and interior lighting for its use and location at night time; closure system or partial protective cover; certain soundproofing to ease their possible function as auditory-oral communication station. It must be noted that urban environment, in certain contexts, could be very noisy and presents luminosity variations that are difficult to control and could complicate communication.

Other aspects relating to their economic management are no less important, as in most cases immediate or prior payment systems by credit card or in cash are needed. In our case, it has been taken as a starting point the services offered by the design of a stand of services (phone, consult, WiFi, photo booth, weather station, battery charger).

At the same time, must be taken into account the dimensions of these products have to adjust to the urban space restrictions as well as measurements of users so as to provide a product that ensures accessibility and ergonomics needed. Furthermore, as is common for other urban furniture, it will be important for them to be resistant in open environments and to possible vandalism.

4. Materials and methods

This project, which is a final degree project in Industrial Design Engineering and Product Development. Came up from the issue raised in Public Use Products specialty [12], where was proposed to design a services booth for the urban environment, that would resolve new features and demands of current users in a sustainable way and integrating new technology of information and communication.

This design focuses on the possibility of implementing the energy system of BIQ house, based on micro-algae in a sustainable microarchitecture, for the use of general public. This street furniture provides content and utilities for the supply of personal devices, contributing to the city with accessible, practical and intelligent services.

As has already been pointed out during the first phase of documentation, since there were not similar products in market at the time, a study on related objects or sources able to make contributions was carried out; different materials, renewable energy and the latest proposals put forward in competitions and other investigations. In this way, information was obtained in order address the labor from the balance ecological-aesthetic-social values balance upon which this project is based. During ideas generation phase some creative techniques were applied like list of attributes or mental maps that have been decisive in the image of the product. The various proposals were reviewed and evaluated by the techniques of weighted sum and sum of ratios.

4.1 Criteria and design parameters

The requirements were set according to the three approaches outlined above: ecology, social value and aesthetic.

These are:

- Sustainable and self-sufficient.
- Ecofriendly; its appearance should contribute with a refreshed, clean and dynamism appearance that encourages the approach and experience of citizens.
- Adequate materials to atmospheric conditions at the location.
- Micro-climate generation and relative isolation in the immediate proximity.
- The product should be aesthetically attractive and innovative.
- Present the latest AR technologies
- Simple and intuitive use for any user.

In order to guarantee better acceptance by users, the design should have a simple, digital, and technological aspect within current tendencies, with an interface that is close to other hand-held devices. The simplicity of the design is offset by its multi-functionality and the incorporation of different communication and AR technologies.

With regards to ecology, as has been previously explained, it was a condition that the design was sustainable and not based on the reproduction of an established cliche. Using the concept of biomimicry, the science of innovation inspired by nature [13] as a main reference in the research, different natural resource application possibilities that would provide energy were observed, with the goal of identifying a concrete model to apply in this project; planning and management of renewable energy use and resources using precise energy models is essential to reach sustainability. Following the idea that ecology offers optimal results for the media and efficiency economy (the ecological standard is always the best solution in terms of 'rightness' or efficiency) we have been particularly interested in the use of natural and renewable energy sources without limits.

Finally, we bank on an energetic solution that is booming, although, at the moment, it has been scarcely applied in product design: algae's biomass. We asked ourselves if it was possible to base the design of a street furniture on this type of energy resource and also be self-sufficient throughout its useful life.

4.2 Algae suitability

Until very recently, the obtaining of fuels from plants was a controversial topic, since it was based on the use of land plants that required, in turn, resources that should have been used for the cultivation of food. However, on the basis of algae, a generation of bio-fuels was developed that seemed to have great usage possibilities.

Some of the bio-fuels obtained from determined algae varieties present an energy density comparable to fossil fuels. In addition, these bio-fuels are characterized by not containing sulfur, are non-toxic and biodegradable.

Regarding their cultivation, until recently, the problem of low yield existed when produced in open tanks and with varieties that were resistant to atmospheric contamination, viruses and fungi. Now, with the closed tanks, this problem has been resolved, and one can have control of growth factors. And with their evolution, photo-bioreactors, have been able to maximize photosynthesis making the process for obtainment of bio-fuel of great interest.

There are multiple factors that make algae and biomass a prime material, suitable as energy fuel sources. The most important [14] for this project are:

• Great reproduction capability.

• High productivity: 2000-5000 liters of bio-fuel per acre per year.

• Their photosynthesis requires the consumption of CO_2, freeing O_2 to the atmosphere. The yield increases with a greater concentration of available CO_2.

• Their cultivation can be carried out with water that is unusable for growing, like sea water, salt water, and sewage.

• They have a high protein, oil, and micro-nutrient content: interesting for the production of bio-fuel, fodder or even as a dietary supplement for human consumption.

• Macro-algae can be cultivated in the sea and bio-fuels and chemical products can be obtained from their sugars.

• 100% profitable. Through the extraction of oil, algae can be dried and can undergo a granulating process for later use as an energy source, via combustion.

An interesting example is its new application as insulation. It has been demonstrated that algae are capable of keeping buildings well-insulated and, through the joint work of the industry and research a viable product has been achieved. A very abundant algae in the Mediterranean that normally used to be considered as waste, and ended up in the sewers was used: Posidonia Oceanica. Thanks to its intrinsic characteristics, it is practically inflammable, mold-resistant and due to its low salt content it doesn't decompose, making itself useful insulating material without the need for chemical additives. As insulation, it can contain 2502 J/kg*K, that is, 20% more than wood. The NeptuTherm E.K Company is responsible for of manufacturing, commercialization, and distribution.

5 Description of the design: booth Algy

The proposed design was conceived as a multi-use, multi-purpose and ecological element, with a lively and fresh appearance. A self-sufficient design that employs the developed technology for the BIQ house.

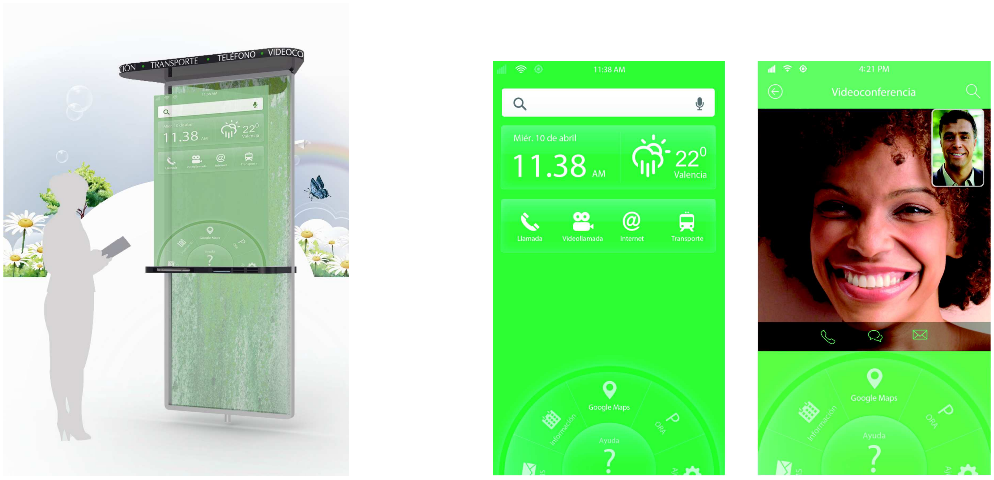

Figure 1. Algy services booth

The technology implemented in this building has been developed by three companies: SSC Strategic Science Consult of Germany (bio-reactor technology), the international consultant Arup (concept, coordination, and engineering) and Colt International (reactor) [15]. The facade is made of bio-reactors with micro-algae (3-5 microns) that capture solar light and carbon dioxide for making photosynthesis. Thanks to this as much biomass of high value as heat is generated, which is collected by flotation and a heat interchange respectively, for the later generation of bio-gas through its fermentation, as well as thermal energy that supplies energy to the whole building. At the same time, micro-algae are the organic motif that decorates and is so characteristic of the building.

The bio-reactors, through the control of different parameters like cellular density of algae, flow speed of the CO2 obtained from the process of bio-gas, the pressure and the dimensions of it amongst other, the reduction of resource consumption and energy is achieved, with a high production of biomass per unit of surface. To this end, a constant flow of pressurized air bubbles is required in order to stimulate growth and avoid sedimentation and decomposition of the micro-algae. In this concrete case, a bio-reactor of 1 m^2 generates 15g of dry material per day, which then generates 345 kJ/m^2/day. The building, as a whole, generates 4,500 kWh per year, able to satisfy the annual needs of a four person family whose consumption is in the order of 4,000 kWh. The efficiency of conversion of bio-gas is around 10% and from heat 38%, giving a total of 50%, a value widely superior to the 15% obtained by photovoltaic plaques.

So that this yield is also reflected in the appearance of the booth, a design has been proposed in which the central element is the bio-reactor itself. In this way the booth is a vertical element of simple geometric shapes that works independently or accompanied by other strategically located, generating a comfortable micro-climate that provides certain soundproofing and insulation, suitable for some of its functions. Thus a self-sufficient product that is interesting, different and with a characteristic and futuristic aesthetics is obtained.

Although, due to extension limitations it is not described in detail in this article, to make the element more attractive and contemporary, the technology contribution was not limited to the environment of self-sufficiency. As a street furniture, at dimensional level a universal and ergonomic design was chosen that incorporates a floating screen that adjusts to the height of each individual with a sensor, without the need for direct tactile contact. This technology, developed by Asukanet, is known as Aerial Imaging Plate [16]. Also, one can interact with the booth by voice. All of this with all the necessary accessories to fulfil the offered services satisfactorily, highlighting among them AR applications, and supported by intuitive and very accessible interface (Figure 2).

The offered services are:

- Calls and SMSs
- Camera for videoconferencing
- Energy charger for different devices
- Citizen information
- Connection to emergency services
- WiFi
- Google maps and public transportation
- ORA

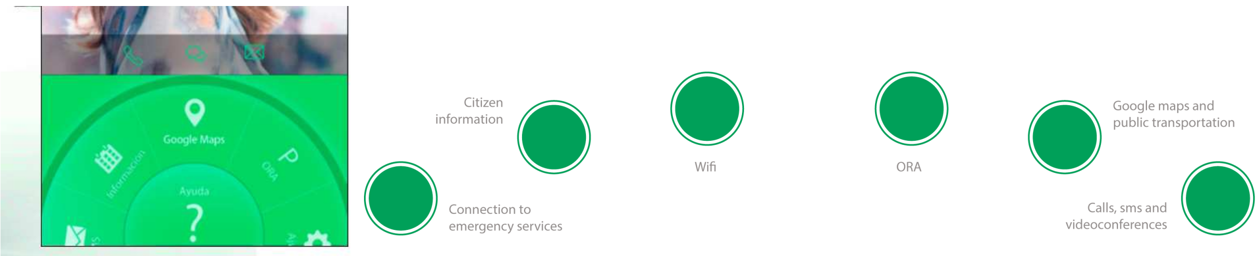

Figure 2. Main interface of the booth Algy

The booth is made up of a structure whose interior lodges the micro-algae bio-reactor. This is composed of a stainless steel frame and glass security enclosures with 6mm thickness, that can turn on its own axis. The ensemble shows a configuration and an aesthetic very close to the current urban MUPIs. The characteristics of the aforementioned materials offer great resistance to acts of vandalism and the environment that, allow at the same time easy maintenance. Using the frame as a support structure, the cover is found, an extruded aluminum hollow element, responsible for housing and protecting the CPU, the lighting system and other delicate electronic devices, like the video camera, the microphone and the screen components. It also offers protection to the user against climate conditions as well as making the identification of the service booth easier. The shelves, at halfway up, are also made from extruded aluminum that serve as bearing surface and house the everyday items and connections that were already described. Under the pavement the reactor is located, together with the necessary components for the proper functioning of the system and the infrastructure connections that are needed such as water supply, electricity and multimedia of the city.

The service booth thanks to its biological character offers dynamic shade and insolation, in other words, the more light better growth of algae and as a consequence, varies the opacity degree of the bio-reactor. Also, thanks to the pressurized air flow, a background babbling is generated that provides soundproofing. In addition, if two modules are installed like those shown in Figure 3 and are pivoted, forming a semi-closed booth, the yield of the installation as well as insolation and soundproofing are optimized.

Figure 3. Algy service booth in context

5 Summary

Thanks to the great versatility of technology and its continued progress, creativity and multi-discipline, viable projects can be developed that are not just of scientific interest, but also social. This project enables the observation of how good pairing are the implementation of new technologies and sustainability, which may lead to very interesting products with applications that today are still unimaginable.

Additionally, if until recently renewable energies had a low percentage of efficient, with the new biotechnological lines of research as in the case in point with micro-algae, this phenomena can be reversed, and in short term, return on investment made in this type of products.

Finally, the project takes in 5 of the 12 principles of Green Engineering, with emphasis on the first principle that defends that all material and energy inputs and outputs are as inherently nonhazardous as possible, the second which says that it is better to prevent waste than to treat or clean up waste after it is formed and the fourth, which defends that products, processes, and systems should be designed to maximize mass, energy, space and time efficiency. The ninth and twelfth principles are also reflected: material diversity in multi-component products should be minimized to promote dis-assembly and value retention, and material and energy inputs should be renewable rather.

Society is increasingly receptive to ecological policies, therefore it is of great interest to take maximum advantage of the opportunities that technology can bring, to be able to create really competitive and functional products for the current market.

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Thanks to the ETSID for the support for the realization of the Smartcity Exposition: Design, Technology, and Services for Public Use. This exhibition has showed the interest of the public in the

practicality of these proposals and has encouraged the project in detail of this particular solution, as degree final project, as well as its submission to different forums.

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Economic feasibility of energy-efficient solutions: an Italian case study towards green engineering

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Abstract

Global energy is still increasingly supplied by the use of fossil fuels, which are finite and harmful resources to the environment. Since their shortages are predicted for the near future, the use of renewable energy sources is becoming of fundamental concern. In order to ensure sustainability for the forthcoming generation, green engineering is playing a growing role, since it is a combination of science, technology, and engineering practice by means of environmentally conscious attitudes, values, and principles. It is aimed at defining feasible and economic processes by means of 12 basic principles.

The present paper carefully describes and evaluates the economic feasibility of energy-efficient solutions in a standard residential building in the Province of Viterbo. This is to improve its energy and thermal behaviour, simultaneously complying with the requirements defined by principle 4 and 12 in the Green Engineering principles' list. The financial indicators, i.e. the discounted cash flow, the cash flow, and the pay-back time, will be calculated, taking into account the current Italian incentives and complying with the national regulations.

1 Introduction

Nowadays the largest portion of global energy supply is covered by fossil fuels employment. Nevertheless, they are finite resource and their combustion is harmful to the environment because of Greenhouse Gases (GHGs) and pollutants emissions which contribute to the global warming problem. Moreover the energy demand is increasingly growing and the fossil fuels shortages are predicted for the future. Thus, the use of alternative/Renewable Energy Sources (RES) for heating and cooling buildings is encouraged by the above mentioned reasons and by the resulting regulations adopted at European level [1, 2].

The negative human impacts on the planet have been a lot discussed in recent years and specific goals have often emerged, such as minimizing waste and increasing recycling. In this scenario, green engineering is playing a growing role and can be seen as a combination of science, technology, and engineering practice by means of environmentally conscious attitudes, values, and principles. It is aimed at defining feasible and economic processes [3].

Moreover, green engineering is one facet in the discussion concerning sustainability and is based on twelve principles, providing a general framework to engage in when designing new materials, products or processes, and systems (figure 1) [3, 5]. The present paper focuses the attention on the application of principle 4 and 12 to an Italian case study, i.e. the idea of maximizing mass, energy, space, and time efficiency, and the concept of renewable rather than depletion.

Processes and systems often use more time, space, energy, and material than required and hence result as inefficiencies. For instance, if a system is designed, used or applied at less than maximum efficiency, resources are being distributed and wasted throughout the entire life cycle. Thus, the use of a specific system needs to be optimised, by applying more energy-efficient solutions. Moreover, according to principle 12, the energy inputs and the origin of materials can influence the sustainability of products, processes, and systems. Actually a substance or energy source may vary its effects depending on whether it is renewable or depleting [3,4, 5].

The 12 Principles of Green Engineering

Principle 1: Designers need to strive to ensure that all material and energy inputs and outputs are as inherently nonhazardous as possible.
Principle 2: It is better to prevent waste than to treat or clean up waste after it is formed.
Principle 3: Separation and purification operations should be designed to minimize energy consumption and materials use.
Principle 4: Products, processes, and systems should be designed to maximize mass, energy, space, and time efficiency.
Principle 5: Products, processes, and systems should be "output pulled" rather than "input pushed" through the use of energy and materials.
Principle 6: Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse, or beneficial disposition.
Principle 7: Targeted durability, not immortality, should be a design goal.
Principle 8: Design for unnecessary capacity or capability (e.g., "one size fits all") solutions should be considered a design flaw.
Principle 9: Material diversity in multicomponent products should be minimized to promote disassembly and value retention.
Principle 10: Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flows.
Principle 11: Products, processes, and systems should be designed for performance in a commercial "afterlife".
Principle 12: Material and energy inputs should be renewable rather than depleting.

Fig. 1. Twelve principle of Green engineering [3]

The aim of the present paper is to carefully describe and evaluate the economic feasibility of energy-efficient solutions in a standard residential building of the Province of Viterbo. They are addressed to improve its energy and thermal behaviour, simultaneously complying with the requirements defined by principle 4 and 12. The financial indicators, i.e. the discounted cash flow, the cash flow, and the pay-back time, will be calculated, taking into account the current Italian incentives and complying with the national regulations.

2 Materials and methods

2.1 Legislative framework

Energy efficiency improvements in Italian buildings is an extremely important aspect to ensure energy saving and GHG emissions reduction. According to ENEA, most of the dwelling in our country were built before the first law on reducing building energy consumption (Legislative Decree 373/76) came into force. Italy accounts for more than 2.7 million of residential buildings, heterogeneously distributed in the whole territory and mostly belonging to the coldest climatic areas and having a low-thermal performance building envelope. This is even confirmed by the fact that the residential sector is characterised by the highest energy consumptions corresponding to 36% (48262 ktoe) of the national demands and whose mean value is equal to 150-200 kWh/(m^2 x year). The thermal utilisation represents 85% of the building energy demand, including space heating (70%) and domestic hot water (15%) [6, 7].

Hence, the Italian Supporting Measures - the so-called "Renewable Energy for Heating and Cooling Support Scheme"- were established on 28th December 2012 in order to speed up the transition from existing heating systems towards more efficient alternatives. This policy strongly encourages the use of heat pumps. In more detail, the current regulation implemented the previous Legislative Decree no. 28 of 3rd March 2011 and is addressed to achieve the ambitious targets set by the European Directive 2009/28 [8, 9].

The Italian incentive mechanism carefully defines the supporting scheme for small-scale projects concerning energy efficiency improvements in existing buildings (called “category 1”) and thermal energy production by the use of RES and high efficiency systems (“category 2”), as shown in table 1 and 2 [8].

Table 1. Eligible Projects included in Category 1, according to Legislative Decree 28th December 2012 [8]

Identification Code	Eligible Projects
1.A	Thermal insulation of opaque enclosures
1.B	Replacement of transparent enclosures
1.C	Replacement of existing winter heating systems with condensing heat generator
1.D	Shadowing and shielding systems for transparent enclosures

Table 2. Eligible Projects included in Category 2, according to Legislative Decree 28th December 2012 [8]

Identification Code	Eligible Projects
2.A	Replacement of existing winter heating systems with heat pumps, whose thermal capacity must be less than 1000 kW
2.B	Replacement of existing heating or cooling systems for greenhouses or agricultural buildings with heat generators supplied by biomass, whose thermal capacity must be less than 1000 kW
2.C	Solar thermal collector, whose total area must not exceed 1000 m^2
2.D	Replacement of electrical boilers with heat pump boilers

“Gestore dei Servizi Energetici” (GSE) is recognized as the body in charge in managing the supporting scheme, awarding the incentives and monitoring technical requirements fulfilment. According to the national regulation, two different parties are eligible, namely Public Administrations (PA) and Private Parties (PP) [8].

In order to further improve the energy efficiency in new or existing buildings -both for thermal behaviour and heating/cooling systems- it is fundamental to analyse the thermal and electrical needs. This goal is successfully reached by carrying out the so called Energy Performance Certificate (EPC) which was laid down by the European Directive 2002/91. With regard to the regulation, “Energy Performance of a building” is meant as the amount of energy actually consumed or estimated to meet the different needs associated with a standardised use of the building itself, which may include heating, hot water heating, cooling, ventilation and lighting. This amount shall be reflected in one or more numeric indicators which have been calculated taking into account insulation, technical and installation characteristics, design and positioning in relation to climatic aspects, solar exposure and influence of neighbouring structures, own-energy generation and other factors, including indoor climate, that influence the energy demand. When buildings are constructed, sold or rented out, the EPC is made available to the owner or by the owner to the prospective buyer or tenant, as the case might be. The validity of the certificate shall not exceed 10 years [10].

The above-mentioned regulation was repealed by the European Directive 2010/31 with effect from 1 February 2012. Since buildings account for 40% of total energy consumption in the Union and the sector is still expanding, Member States shall ensure that all new buildings occupied and owned by public authorities are nearly zero-energy buildings, by 31 December 2020 and 31 December 2018 respectively. In more detail, a “nearly zero-energy building” is referred to a very high energy performance structure as determined in accordance with Annex I. A very limited amount of energy required should be covered -to a very significant extent- by energy from renewable sources, especially on-site or nearby [11].

The European Directive 2012/27 establishes a common framework of measures for promoting energy efficiency within the Union in order to ensure the achievement of the Union’s 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date [12] .

With specific regard to Italy, the concepts of energy savings in buildings, rational utilisation of energy and sustainable use of RES were introduced by the National Law 10/91 [13]. In the recent years, the legislative framework has been further developed and still changing in order to comply with the above-described European Directives. The following national regulations must be taken into account to carry out the Energy Performance Certificate [14, 15, 16, 17, 18]:

- Legislative Decree 192/05 on energy efficiency of buildings;
- Legislative Decree 311/06 which encompasses corrections and integrations to the Legislative Decree 192/05;
- Presidential Decree 59/09 which enforced Legislative Decree 192/05;
- National guidelines for energy performance set by the Ministerial Decree 26/06/2009;
- Ministerial Decree 22/11/2012, including corrections and integrations to the Ministerial Decree 26/06/2009.

In order to benefit the incentives laid down by the Renewable Energy for Heating and Cooling Support Scheme, the EPC must be carried out in case of replacement of existing winter heating systems with heat pumps if the renovation is applied to the whole building, having a nominal power more than 100 kW. With specific regard to the case study described in paragraph 2.2, the EPC is not needed. However, it has been carried out since it is fundamental to understand the current energy class of the dwelling and the future and possible improvements by modifying the building envelope and the energy supply plants [8]. As it is commonly known, the energy efficiency is given on a scale from A^+ - the most efficient homes - to G - the most energy consuming one. According to the national regulations, the EPC can be successfully carried out by using the software DoCeT in case of existing residential buildings whose total area does not exceed 3000 m^2 [14, 15, 16, 17, 18, 19].

Furthermore, PP might benefit supporting measures to improve energy efficiency in existing residential buildings by accessing the so called “65% Tax Deduction”, laid down by the recent Legislative Decree no. 63 of 6th June 2013. The latter awards incentives for those projects which will be carried out until 31st December 2012 or 30th June 2014 in case of block apartments and involving the building envelope (both opaque and transparent enclosures), the installation of solar collectors or the replacement of existing heating generators by means of a condensing boiler [20].

2.2 System description

The system considered in the present study consists of a single standard building located in Viterbo (northern Latium, Central Italy). The structure is a 2 story, rectangular shaped building, with external gross dimensions of 6 m x 10 m. The total footprint area is 102 m^2, leading to a total heated volume of 275.4 m^3 since each floor is 2.7 m high. External walls are made of 28 cm of brick elements, without any insulation cover. Moreover, an internal and external layer of plaster - whose thickness is equal to 20 mm in both cases - is added. Table 3 shows the main thermal parameters of the wall layers in the building. The roof and the ground floor consists of ordinary concrete structure. Windows are 1 or 2 double glass panes-solutions with wooden frame and are located in the eastern, southern and western side of the considered dwelling. The overall thermal transmittance of the transparent enclosures is equal to 2.8 $W/(m^2 \times K)$. Windows account for 19.48 m^2, corresponding to 10% of the external wall surface. Space heating and Domestic Hot Water

(DHW) are supplied by means of a 24 kW methane-traditional heat generator, whose parameters are summarized in table 4. The heat distribution system is ensured by traditional radiators.

Table 3. Main thermal parameters for the current wall stratigraphy of the building (ante operam)

Materials	Thickness (mm)	Thermal conductivity (W/m x K)	Density (kg/m^3)	Specific heat (J/kg x °C)	Thermal resistance (m^2 x K/W)	Overall thermal transmittance (W/ m^2 x K)
Internal plaster	20	0.35	1 200	835	0.057	1.642
Brick	280	0.777	1 800	835	0.36	
External plaster	20	0.9	1 800	835	0.022	

Table 4. Main parameters of the traditional heat generator

Parameters	Values
Nominal power for heating (min/max)	11.0/24.6 kW
Nominal power for DHW (min/max)	11.0/24.6 kW
Useful power output (min/max)	9.6/22.9 kW
Temperature range for heating	82/40 °C
Temperature range for DHW	60/36 °C
Efficiency considering the nominal power	93.0 %
Efficiency considering 30 % of the nominal power	92.8 %

Since the dwelling is represented by a residential building (belonging to category E1 according to the Presidential Decree 412/93), the set point for indoor temperature is assumed equal to 20 °C to ensure thermal comfort [21].

Broadly speaking, the working period of the heating systems depends on climatic conditions and on the so called Heat Degree Days (HDD). The heating requirements for a given structure at a specific location are considered to be directly proportional to the number of HDD at that location. HDD are defined relative to a base temperature which is the outside temperature above which a building does not need heating. In order to evaluate HDD, an approximation method is to take the average temperature on any given day and to subtract it from the base temperature. If the value is less than or equal to zero, that day has zero HDD; if the value is positive, that number represents the number of HDD on that day. According to the value given by (1), Italy is divided into six different areas –from zone A (the hottest one) to zone F (the coldest one)- as shown in table 6. More precisely, HDD increase when the climate becomes colder. Viterbo belongs to zone D , having 1989 HDD [19, 21].

Considering all the input data mentioned in table 3 and 4, the software DoCeT has led to calculate the total primary energy consumption for space heating, DHW and electrical purposes, and, as a consequence, the energy class of the building, as summarized in table 5 [19].

Table 5. Output data generated by DoCeT for the residential building (ante operam)

Output data	Values
Primary energy for space heating	299.5 kWh/m^2
Primary energy for DHW	21.8 kWh/m^2
Primary energy for electrical uses	4.1 kWh/m^2
Total primary energy consumption	325.4 kWh/m^2
Thermal need for space heating	204.9 kWh/m^2
Thermal need for DHW	17.1 kWh/m^2
Cooling need	18.6 kWh/m^2
Global energy class (space heating and DHW)	G
Partial energy class with regard to heating and cooling	G
Building envelope performance	II
Partial energy class with regard to DHW	E
CO_2 emissions	88.2 kg/m^2

In order to improve the energy and thermal performance of the building, the following actions can be carried out:

- insulation layer within the external wall;
- supplying DHW demand by installing solar collectors on the roof;
- providing space heating by means of a single geothermal heat pump.

With specific regard to the first stage, the table 6 shows the main thermal parameters of the building in case of insulating the external wall: the improvements of the building envelope in term of thermal behaviour is represented by the overall thermal transmittance reduction, which reaches 0.36 W/m^2 K. In order to access the 65% Tax Deduction regulation, the overall transmittance of the wall must not exceed the limit values reported in the Ministerial Decree 59/09, if the project is carried out in climatic areas belonging to class C, D, E and F [16].

Table 6. Main thermal parameters for the post operam wall stratigraphy of the building

Materials	Thickness (mm)	Thermal conductivity (W/m x K)	Density (kg/m^3)	Specific heat (J/kg x °C)	Thermal resistance (m^2 x K/W)	Overall thermal transmittance (W/ m^2 x K)
Internal plaster	20	0.35	1 200	835	0.057	0.359
Brick	280	0.777	1 800	835	0.36	
Insulating layer	50	0.023	38	1 392	2.174	
External plaster	20	0.9	1 800	835	0.022	

The transparent enclosures may be replaced by double glass panes-solutions with PVC frame, whose overall thermal transmittance is given by 1.1 W/m^2 x K.

The solar collectors to be located on the roof have been preliminarily designed assuming 4 occupants and 50 l/person as water demand. This leads to calculate the collector surface (3 m^2) and the diameter of the pipe within the collector (16 mm). The tank volume is equal to 220 l.

With specific regard to the geothermal heat pump, two methodologies can be successfully followed:

a. German Regulation (VDI 4640), leading to calculate the thermal power (5.19 kW), the power directly absorbed from the ground (3 999.97 kW), the specific power extracted from the ground (40 W/m) and, as a consequence, the total length of the probe (100 m) [23];
b. Analytical Method according to RSE, whose flow chart is reported in Fig. 1. In this case too, the total length of the probe is equal to 105 m, confirming the previous result coming from design a) [24].

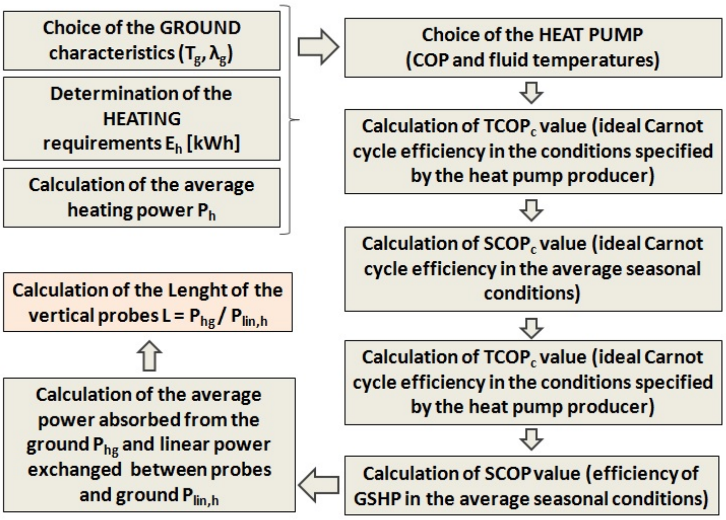

Fig. 2. Flow chart of the Analytical Method [24]

The chosen solar collectors and GSHP system fulfil the technical requirements set by the Renewable Energy for Heating and Cooling Support Scheme. Considering all the input data mentioned in the previous tables and the results coming from the design procedures, the software DoCeT has led to calculate the total primary energy consumption for space heating, DHW and electrical purposes, and, as a consequence, the energy class of the building, as summarized in table 7.

Table 7. Output data generated by DoCeT for the residential building (post operam)

Output data	Values
Thermal need for space heating	102 kWh/m^2
Thermal need for DHW	17.1 kWh/m^2
Cooling need	19.7 kWh/m^2
Global energy class (space heating and DHW)	C
Partial energy class with regard to heating and cooling	C
Building envelope performance	II
Partial energy class with regard to DHW	A
CO_2 emissions	5.5 kg/m^2

According to the Italian supporting measures, the incentive for GSHP is shown in table 8 and is calculated as follows [9]:

$$I_{a,tot} = E_i \cdot C_i \qquad (2).$$

where $I_{a,tot}$ is the yearly awarded incentive (Euros/year) , E_i is thermal energy (kWh) supported by the incentive and C_i is a coefficient depending on the thermal power of the heat pump. E_i is given by [9]:

$$E_i = Q_u \cdot (1 - 1/COP) \qquad (3).$$

where Q_u is the total amount of heat generated by the system (kWh) and is linked to the nominal thermal capacity of the heat pump (P_n) and to utilisation coefficient (Q_{uf}) which is listed in the regulation depending on the climatic zone of the building. COP is the Coefficient of Performance and is equal to 4.34 in the present case study.

Table 8. Incentive calculation for GSHP

Parameters	Values
$I_{a,tot}$	473.20 Euros/year
C_i	0.072 Euros/kWh
E_i	6527.26 kWh/year
Q_u	8540 KW
P_n	6.1 KW
Q_{uf}	1400

The yearly incentive ($I_{a,tot}$) awarded for the installation of the solar collectors on the roof is is reported in table 12 and is defined by the following formula [9]:

$$I_{a,tot} = S_l \cdot C_i \qquad (4).$$

where S_l is the gross surface of the solar collectors (m^2) and C_i is a coefficient depending on the total surface of the system.

Table 9. Incentive calculation for solar collectors.

Parameters	Values
$I_{a,tot}$	510 Euros/year
C_i	170 Euros/m^2
S_l	3 m^2

3 Results

The total costs for energy consumption before and after the GSHP installation and the annual cost saving are shown in Tables 10.

Table 10. Total costs for energy consumption before and after the GSHP installation

Energy consumption before installing GSHP and solar collectors			
	Consumption (kWh/year)	Cost of methane (€/kWh)	Total (€/year)
Heating	20899.8	0.093	1943.68
DHW	1744.2	0.093	162.21
Energy consumption after installing GSHP and solar collectors			
	GSHP consumption (kWh/year)	Electricity cost (€/kWh)	Total (€/year)
Heating	7759.82	0.020	559

All the above-listed costs are useful in order to calculate the cash flows (Ct*) which is obtained by adding all the costs (Ci,t) and all the Profits (Pi,t) related to the generic t-th year, as shown in the Eq. 5 [25]:

$$C_t^* = \sum_i P_{i,t} - \sum_i C_{i,t} \quad (5).$$

The cash flows are successfully annualized by the Eq. 6 [25]:

$$C_t = C_t^* / (1+r)^t \quad (6).$$

where r represents the Weighted Average Cost of Capital (WACC). It refers to the index which defines the average expected return considering the assets of the plant's owner. The discounted cash flow is reported in figure 3. It can be easily seen that the Payback Time (PT) of the investment is 24 years.

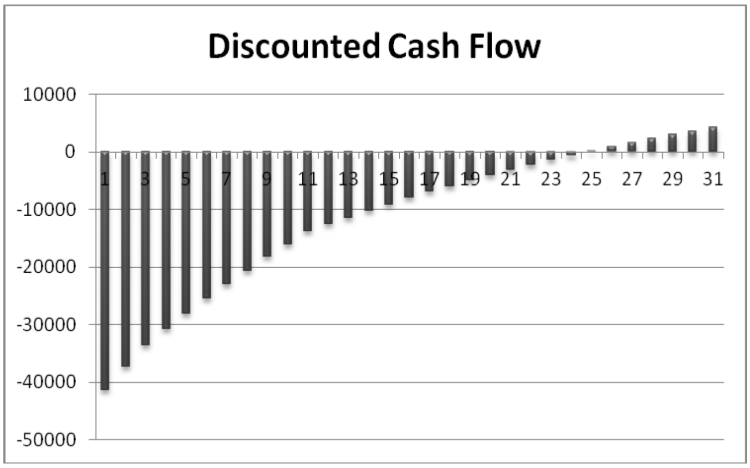

Fig. 3. Discounted Cash Flow and cash flow

1 CONCLUSIONS

The present paper is aimed at assessing the economic feasibility of actions involving energy efficiency improvements in a standard residential building in the Province of Viterbo, complying two of the principles of green engineering. The results clearly show that any project needs supporting measure in order to become more affordable. Even if the economic convenience seems to be limited in the case study, it has to be underlined that the most significant advantage is given by the bills reduction every year. The incentive hence represents an important tool to decrease the PT, which otherwise will be reached even further (after 34 years).

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A case study: Research collaboration among UPV and two Indian universities through international cooperation programs

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Conference Key Areas: International Cooperation Programmes, International Networking, Education and Research.
Keywords: International Cooperation, Third Countries.

Abstract

The development of research infrastructure plays a vital role in the advancement of knowledge and technology. They are significant in addressing grand challenges on all scales, i.e., national, regional, continental and global. The sharing of research infrastructure facilities at national or international level is desirable for international research co-operation for education, innovation and technology development on one hand and generation of goodwill and peace on the other. The details of research cooperation of Universitat Politècnica València (UPV) with M. D. University (MDU), Rohtak and Gurukul Kangri University (GKU), Haridwar, India, are presented in this article. The cooperation was initiated nearly five years back with a simple e-mail asking for characterization of a crystalline material for which, the facility was available at UPV. There are joint research projects, joint research publications and inter university visits of faculty members during this period. This type of collaboration is not only dependent on the willingness of partners but also on the various international programmes operating in UPV, Spain, Europe Union and India. We expect the cooperation will not stop here but it will grow further in near future

1 Introduction

There are three major parameters to be taken into consideration while evolving an international cooperation between two or more research institutes of different countries. The first and most important aspect is the complementary and supplementary nature of research expertise of research groups or persons involved so that the synergistic approach leads to generation of new knowledge and scientific excellence. The second aspect is the availability of research infrastructure at each other's premises. This will speed up the progress of joint venture that could have otherwise been hindered due to the non-availability of research facility at one of the institute. The third parameter is the availability of various international cooperation programmes for scientific communities in universities, institutes and industries. Within this framework, we will discuss briefly all the three aspects to show the level of cooperation between Universitat Politècnica València of Spain, Maharsi Danayand University of India and Gurukul Kangri University (GKU) of India for the last five years.

2 People

Highly trained researchers are needed for advancement of science, underpinning the innovation, and to attract and sustain public and private investment in research. With growing global competition, the development of an open market for researchers and the diversification of skills and career paths of researchers are crucial. In addition, the mobility, both transnational and inter-sectorial, is a key component of the Research excellence. The FP7 'People' programme [1] by European Union aims at improving the quality of the human resources in European R&D and increasing the number of employees working in the European R&D sector. It aims to achieve its goals by promoting a career path in research, encouraging European researchers to stay in Europe and making Europe more attractive to the best researchers from around the world. At the same time, training and career development of researchers will be actively supported. The activities under FP7 programme, will be based on the long and successful experience of the Marie Curie actions and will cover all stages of a researcher's professional life, from initial research training to life-long learning and career development. Thus a research conductive environment is already available for scientists of underworld or developing countries in Europe.

3 Development of Research Infrastructure

The second International Conference on Research Infrastructure (ICRI-2014) was held in Athens, from April 2-4, 2014. ICRI -2014 offered a high level international forum where key stakeholders could meet, discuss and contribute to bringing forward the global issues related to research infrastructures. It was co-organized by the European Commission and the Greek EU Presidency of the European Union [2]. The conference attracted more than 800 international participants during three days deliberations and included an exhibition of demonstrations and videos of international research infrastructure projects. In her launching keynote speech, the European Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn ***stressed the importance of Research Infrastructure as centre of innovation and of knowledge transfer to industry and society at large***. Research infrastructure plays a vital role in the advancement of knowledge and technology. Scientific progress can be accelerated by presenting the main characteristics of global research infrastructure and identifying the challenges and drivers for collaboration at an international level [3].

A major difficulty in setting up such research infrastructure between EU countries and non-EU countries is the lack of an adequate legal framework allowing the creation of appropriate partnerships. Existing legal forms under national law do not fulfill the needs of new European infrastructure. The same applies to legal forms under international or EU law. It is in this context that the European Commission, responding to requests from EU countries and the scientific community, proposed a legal framework for a European research infrastructure (ERI) adapted to the needs of such facilities. In August 2009, the community legal framework for a European Research Infrastructure Consortium (ERIC) entered into force [4]. This specific legal form is designed to facilitate the joint establishment and operation of research infrastructure of European interest. Member States, Associated Countries, third countries and inter-governmental organizations can be members of ERIC. However, a state may decide to be represented by one or more public entities or private entities with a public-service mission, e.g. research organizations or research councils. Following the application to the European Commission, the typical timing for the decision could be between 4 to 8 months.

4 Infrastructure International cooperation programmes

There are various international cooperation programmes running in Europe in general and Spain in particular, of which a few are described below in brief.

4.1 The European Union's 7th Research Framework Programme (2007-2013)

The broad objectives of FP7 have been grouped into four categories, **Cooperation, Ideas, People and Capacities** [1]. For each type of objective, there is a specific programme corresponding to the main areas of EU research policy. All specific programmes work together to promote and encourage the creation of European poles of (scientific) excellence.

Under the programme “Cooperation”, research support will be provided to international cooperation projects across the European Union and beyond. The Cooperation programme has a budget of 32.413 billion €. It is subdivided into 10 thematic priority areas, which reflect the most important fields of knowledge and technology where research excellence is particularly important to address the European social, economic, public health, environmental and industrial challenges, and to serve the people better besides providing support to the developing countries.

The 10 thematic priority areas are*, Health, Food, Agriculture & Fisheries, Biotechnology Information & Communication Technologies, Nanosciences, Nanotechnologies, Materials & new Production Processes, Energy & Environment, Transport and Space & Security*.

Under seventh framework programme, Marie Curie Actions People International Research Staff Exchange Scheme entitled “Development of a new generation of CIGS-based solar cells Acronym: NanoCIS Proposal Number: 269279, Scientific Panel: Physical Sciences, Condensed matter properties Grant Agreement Number: PIRSES-GA-2010-269279” has been sanctioned by the Europe Union w.e.f. 1st May 2011 to 30th April 2015 to the authors.

4.2 India-Europe cooperation

On a new website on INDIGO family, the two on-going INDIGO projects, i.e. INNO INDIGO and INDIGO POLICY is up and running: These two project will continue the fruitful cooperation and further foster the multilateral science, technology and innovation (STI) cooperation that New INDIGO (2009-2013) started. On the one hand, INNO INDIGO will focus on the actual scientific collaboration by bringing together funding agencies in order to implement calls for proposals.

On the other hand, INDIGO POLICY can support the policy dialogues going on between European Member States / Associated Countries, Indian stakeholders and the European Commission, and support as well as feed with necessary analysis and activities. Both projects work closely together in order to maximize the results and applicability of both projects synergistically [5].

4.3 Marie Skłodowska-Curie actions Co-funding of Regional, National and International Programmes (H2020-MSCA-COFUND-2014

The COFUND scheme aims at stimulating regional, national or international programmes to foster excellence in researchers' training, mobility and career development, spreading the best practices of Marie Skłodowska-Curie actions.

This will be achieved by co-funding the new or existing regional, national, and international programmes to open up to, and provide for, international, inter-sectorial and interdisciplinary research training, as well as transnational and cross-sectoral mobility of researchers at all stages of their career.

Each proposal funded under the COFUND scheme shall have a sole participant that will be responsible for the availability of the necessary matching funds for executing the proposal.

Participants submit multi-annual proposals for new or existing doctoral programmes or fellowship programmes that may be run at regional, national or international level. The evaluation is organized in two different panels: A) Doctoral programmes and B) Fellowship programmes. Support cannot be awarded to researchers who are already permanently employed at the host organization

5 Impact

The COFUND scheme will, on a voluntary basis exploit synergies between European Union actions and those at regional and national level, as well as with other actions at international level. The scheme will have a leverage effect on regional, national or international funding programmes for early-stage researchers as well as the experienced researchers. This impact is expected to extend to,

1. Enabling the relevant regional, national and international actors to contribute significantly to the development within their own setting of high quality human resources, by introducing and/or further developing the trans-national dimension of their offers,

2. Increasing the numerical and/or qualitative impact, in terms of supported researchers or working/employment conditions,

3. Combating fragmentation in terms of objectives, evaluation methods and working conditions of regional, national or international offers in this area.

6 India – Spain cooperation

On June 12, 2007 a Memorandum of Understanding (MoU) for co-operation in the field of Science and Technology was signed between the Ministry of Education and Science (MEC) and the Ministry of Industry, Tourism and Trade (MITyC) of Spain, with the Ministry of Science and Technology (MST) of India, whereby the Parties committed themselves respectively to promote direct scientific and technological co-operation between Government agencies, universities, public research bodies, academies of science, research institutions, institutes of higher education, enterprises and scientific societies. Within the frame of the India-Spain S&T Agreement, the Department of Science and Technology (Ministry of Science and Technology, Government of India) and the Centre for the Development of Industrial Technology (Secretariat of State for Research, Development and Innovation, Ministry of Economy and Competitiveness, Spain) signed, on January 30th, 2013, a Programme of cooperation in order to develop a joint mechanism to promote and fund innovation driven research and technology development between S&T stakeholders of both countries as well as to encourage partnerships and business-led R&D&I projects in areas of mutual interest. Companies and other R&D-performing organizations may seek support for joint India-Spain R&D projects and other activities intended to generate new or expanded research and technology-based partnerships between the two countries. For India, funding and other services will be provided through the Global Innovation & Technology Alliance (GITA), a not-for-profit section 25 Company, promoted by the Confederation of Indian Industry (CII) and Technology Development Board of the Department of Science & Technology, and engaged by the Department of Science and Technology (DST), Government of India for this purpose. For Spain, funding and other services will be provided through the Centre for the Development of Industrial Technology (CDTI) under the Secretariat of State for Research, Development and Innovation, Ministry of Economy and Competitiveness, Government of Spain. CDTI, Spain's National Innovation Agency, is a public entity charged to promote business R&D and foster the technological level and innovation capacity of Spanish companies. CDTI is the Spanish public entity that channels and supports applications for national and international R&D&I projects of Spanish companies. This India- Spain program aims to foster and support the development of collaborative Industrial R&D projects consisting of the joint development of innovative products, processes and services, as well as bringing together companies, research organizations, academic institutions and other collaborators from both countries. The referred R&D projects (engaging small-to-medium-sized companies and/or larger, well established companies) must address specific market needs or socio-economic challenges, demonstrate high industrial relevance and commercial potential and be of mutual interest to all the participants in particular and to both nations in general. Participation in such industry-driven and market-oriented collaborative R&D projects strive to enhance global competitiveness and increase market access of Spanish and Indian companies.

International cooperation by UPV

There are number of research projects sanctioned to the faculty members from time to time by various agencies of Spain to invite and visit the other research institutes, universities and industries. A short visit of two/three months per year can be made by an experienced faculty from outside Spain to work with a particular research group of the university. The one of the authors has been benefitted by this programme. But unfortunately, this programme has been suspended for sometime due to the economic crisis in the country.

Research and Development in India

The Research & Innovation Performance of the G20 report (2003-2012) by Thomson Reuters has been released in April [6]. The findings confirm that many developing nations, such as India, are improving their performance and closing the citation impact gap between themselves and the traditional research leaders of Europe and North America.

According to the report, India is rapidly enhancing its research presence globally. Its research output expanded nearly **two** times the world average over the last decade, **some 146%**, from 21,269 Web of Science papers in 2003 to 45,639 in 2012. Only in comparison to China does this look like underperformance – it is in fact impressive growth and gained for the nation an increase in world share of 1.1% (from 2.5% to 3.6%). For 2008 to 2012, India captured its greatest world share of papers in chemistry, **(about 6.3%)**. Second was agricultural sciences followed by engineering and technology, at 5% and 4.8%, respectively.

Concerning Intellectual Property Rights, over the eight years from 2005 to 2012, the published patent applications maintained an average of around 5,900 p.a., which is almost the same as in Australia and Great Britain. However, with a population of over 1.2 billion compared to 22 million for Australia and 62 million for Great Britain, this level of patenting is particularly low. Domestic innovation has remained stable from 2005 to 2012 at around 29%. Nearly two third of all Indian patent applications in 2012 are from foreign concerns seeking protection for their innovations in the Indian market. Globally, India's share of the top 10 technologies is predominantly weighted towards natural products with little relative share in high-tech fields of computing and communications and less in lighting and semiconductor materials. Indian innovation relative to global patenting is focused on fused ring heterocyclics (a key component of pharmaceuticals) and other agrochemical and pharma-related technology sectors.

What ails Indian science?

According to R. Prasad [7], Indian science's bureaucratic mentality values administrative power over achievements April 2014 "Getting funding [for research] is easy in India," said Dr. Mathai Joseph "because there is no competition here. Money is not scarce [though R&D spending is less than 1 per cent of GDP]. But money comes with the same bureaucratic restrictions that apply to all government expenditure." Dr. Joseph is a computer scientist and a consultant, and was earlier a senior research scientist at TIFR, Mumbai. For instance, while research students get no funding support to travel abroad to participate in conferences, scientists are constrained by "limited foreign travel."

These restrictions on foreign travel prevent students and scientists from gaining in terms of networking, exchanging ideas and being exposed to the kind of work being done by their peers in other countries. "Science does not happen like that-by not allowing them to travel abroad," he said.

Collaboration among UPV and MDU/GKU

It has been clearly stated that under international cooperation programmes of Europe Union, the European Community needs a strong and coherent international science and technology (S&T) policy. This policy has three main objectives: (i) to support European competitiveness through strategic partnerships with non-EU countries in selected fields of science and by engaging the best scientists from such countries to work with and within Europe, (ii) to enhance the production of knowledge and scientific excellence by enabling European universities, research institutions and firms to establish contacts with their partners in such third countries, thereby facilitating access to research environments outside Europe and promoting synergies on a global scale, and (iii) to address specific problems that third countries face, or that have a global character, on the basis of mutual interest and mutual benefit.

One of the authors (KCS) was known of but not fully aware of the various cooperation programmes of EU, Spain and UPV. He came to know, through the research publications of Prof. Bernabé Marí, the availability of research infrastructural facilities in UPV. When he wrote to Prof. Bernabé Marí to avail them for his research programme, he agreed happily. This was the start of the collaboration of UPV and MDU in 2009, later on it was extended to another Indian university namely GKU. Two scientists from UPV and one from MDU visited each other's universities to explore the possibilities of cooperative research and to interact with other members of faculty in 2009. After that there was no looking back, as both the partners were willing to share and contribute to the joint research efforts. There were many research cooperation programmes operative (few of them are mentioned above) at that time. They tried to avail them. During the last five years, they have jointly published number of research papers in journals of international repute, participated in international conferences in each others' countries, and many faculty members of both universities visited and worked in collaboration. Table 1, shows the achievements of this collaboration.

Table 1. Statistics of UPV/MDU/GKU collaboration.

S. No.	Item	UPV	MDU	GKU
1	Research publications	11	11	2
2	Participation in conferences	2 (In India)	4 (In Spain)	1 (In Spain)
3	Number od researchers involved	8	8	3
4	No. of persons from UPV visiting India	-	4 (for 6 months)	2 (for 2 months)
5	No. of persons from MDU visiting UPV	4 (30 months)	-	-
6	No. of persons from GKU visiting UPV	1 (3 months)	-	-
7	Funding agencies	4	1	1

It is hoped that the collaboration will be continued and it will be extended further at the student level. There will be exchange of students on mutual basis for some period of time each year to interact and learn from the expertise of faculty of both universities. They will also be familiarized with the culture and ways of life of India and Spain.

Conclusion

There are various international cooperative programmes for research and development that are being run by various funding agencies in Europe. The third world and developing countries like India can be benefitted from such programmes. Though funding is available in India, it lacks infrastructural facilities. With international collaboration, making use of research infrastructure, which is already established in Europe, benefit Indian scientific community. On the other hand Spanish universities benefit from experienced people working in their laboratories and collaborating in research projects and research publications.

5 Acknowledgements

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Decision Making Framework in Life Cycle Assessment for Sustainable Packaging Design

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Keywords: design making, life cycle assessment, sustainable design, multi-criteria optimization

Abstract

Packaging industry is one of the largest industries in the world and is also associated with many environmental concerns. To reduce the environmental impacts, designing sustainable packaging has been one of the top priorities in packaging industries. One of the common tools for evaluating the environmental impact of a package design is the Life Cycle Assessment (LCA). The LCA provides the information on the environmental impacts on different indicators. However, the LCA has two major issues, different design options may excel on different indicators and results from environmental indicators often involve uncertainties. A ranking based decision making framework is proposed in this paper. In the framework, the Probabilistic Pareto Selection method is introduced to select the Pareto Front with uncertainty first. Then, the Ranking based Rate of Substitution is implemented in the decision making process in order to select the best design options based on the trade-off of each Pareto design. One case study is presented to demonstrate the function of this framework.

1 Introduction

Packaging industry is one of the largest industries in the world because almost every product has packages. However, packaging industry is also associated with many environmental concerns such as waste creation, natural resources consumption, pollution and toxicant. To reduce the environmental impacts, designing sustainable packaging has been one of the top priorities in packaging industries [1]. One of the common tools for evaluating the environmental impact of a package design is the Life Cycle Assessment (LCA) [2]. The LCA provides the information on the environmental impacts on different indicators, such as climate change, human health, ecosystems, water depletion and energy demand. Designers need to compare environmental impact indicators of possible packaging options to select the best packaging design in order to enhance the packaging sustainability. However, the design decision simply based on the LCA results can be very challenging due to two important factors: (1) different design options may excel on different indicators that results in conflicting design solutions; (2) evaluation of environmental indicators often involve uncertainties.

To address these challenges, a ranking based decision making framework is proposed in this paper. In the framework, the Probabilistic Pareto Selection method is introduced to select the Pareto Front with uncertainty first. Then, the Ranking based Rate of Substitution is implemented in the decision making process in order to select the best design options based on the trade-off of each Pareto design. The remainder of the paper is organized as follows. First, the challenges of sustainable design selection are described. Next, the proposed decision making framework including Probabilistic Pareto Selection (PPS) and Ranking based Rate of Substitution (RRS) is presented. Finally, case studies using the proposed method are demonstrated and discussed.

2 Challenges of Sustainable Design Selection

Although the LCA tools have been used widely in the packaging industries for evaluating the design options, it still has two major challenges. First, a LCA tool always generates multiple output indicators associated with different environmental impacts, such as climate change, human health, ecosystems, water depletion and energy demand. Therefore, it is sometimes unavoidable that one packaging design may be better than the other option on one indicator while is worse than the same one on a different indicator. For example, as shown in Figure 1, four packaging design options are analyzed by the LCA tool with six environmental impact indicators: climate change (f_1), energy demand (f_2), ecosystems (f_3), human health (f_4), resources (f_5), and water depletion (f_6). Lower values of each indicator represent less environmental impact and redeem better. From the chart, design S_4 will not be selected because all indicators have higher values than other designs. However, the selection of the best packaging design options among rest of designs (S_1, S_2 and S_3) is challenging. In case of design S_1, all environmental impact indicators are better than other designs whereas the indicator f_1 of design S_1 is the worst. The selection between S_2 and S_3 maybe even more complicated [3].

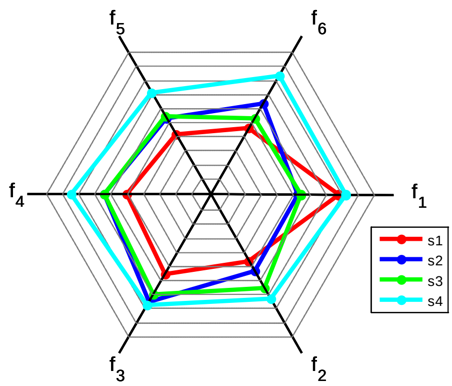

*Figure **1***: Radar Plot from the LCA Analysis

Second, the environmental impact results from LCA may not be able to represent the accurate measurement of a design option because of uncertainty from data collection, modeling and measurement in the LCA tool. Once these uncertainties are considered during the decision making process, design selection becomes very challenging [4]. In Figure 2, normal distributions of the water depletion indicator of two different design options (S_1 and S_2) are plotted. Although the mean value (μ^{s1}) of S_1 shows lower water depletion than the mean value (μ^{s2}) of S_2, we cannot simply conclude that design S_1 is always better than of S_2 because the variances of both options need to be considered too.

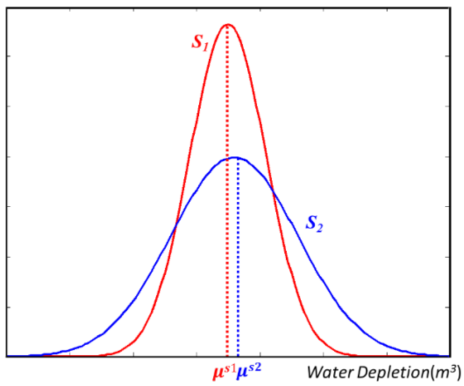

Figure 2: Distribution Curves of Two Different Designs

In this paper, a ranking based decision making framework is proposed to tackle the above mentioned challenges. In the proposed decision making framework, the Probabilistic Pareto Selection method is used to select the Pareto Front with uncertainty first and the Ranking based Rate of Substitution is implemented to select the best design options among the Pareto designs based on the trade-off. The details of the framework will be discussed in the next section.

2 Decision Making Framework

In the previous section, two major challenges of the LCA based decision making process were discussed. To overcome these challenges, a Ranking Based Decision Making Framework as illustrated in Figure 3 is proposed. Two building blocks, Probabilistic Pareto Section (PPS) and Ranking based Rate of Substitution (RRS) are discussed in this section.

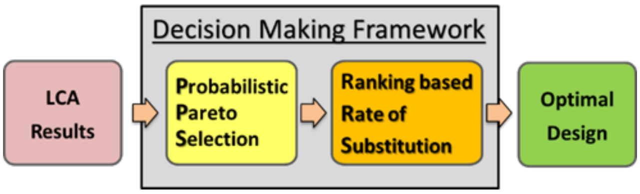

Figure 1: Diagram for Decision Making Process

2.1 Probabilistic Pareto Selection (PPS)

To identify the Pareto Front with uncertainty from the design candidate set, a Probabilistic Pareto Selection (PPS) method is presented. The PPS is composed with two main parts. The first one is an algorithm to generate the Pareto Front based on the mean values of all design options and the second one is to further consider uncertainty to refine the Pareto set generated earlier. A design option can be considered as a Pareto solution if any one of the environmental impact indicator values of this design option is not dominated by any other design. A conceptual illustration is shown in Figure 4. In the left figure, the blue point is dominated by black point in the lower left so it cannot be considered as a Pareto solution. On the other hand, the red point in the right figure is not dominated by any other points so it is a Pareto solution.

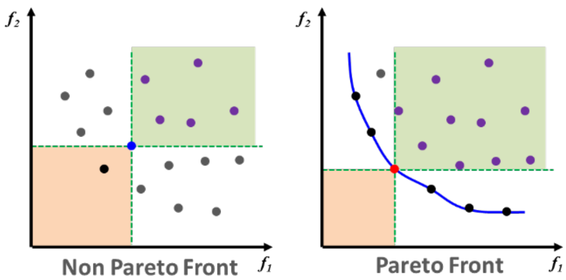

Figure 2: Defining Non Pareto Front and Pareto Front

A conventional method to generate the Pareto Front is to use an exhausting searching method. This method is very simple but is not efficient because every design option must be compared against the entire set of design options until all Pareto solutions are founded. To improve the efficiency of generating the Pareto Front, a designer can first rank one of the environmental impact indicator results from the minimum to the maximum based on the preference of the designer or the importance of environmental considerations. After ranking is done, the best design (the lowest value of the selected impact indicator) is automatically a Pareto solution because no other design option is better under this environmental impact category. To continue the process, all design options are checked in the ranking order and are compared based on the second environmental impact indicator. For example, if f_1 is the most important indicator and the f_2 is the second one, then all data are ranked based on f_1 values first. The best design in f_1, which is plotted as red point in Figure 5, will be selected as a Pareto solution. Then, all other options are checked against the Pareto designs under the second environmental impact factor, f_2. In case of the blue point, it only needs to compare with the higher ranked Pareto designs to check the dominancy but not the lower ranked solutions since blue point is always better than lower ranked point for f_1. Then, the comparison process continues to all environment impact indicators one by one. This selection process has been found to be much more efficient than the exhausted search method.

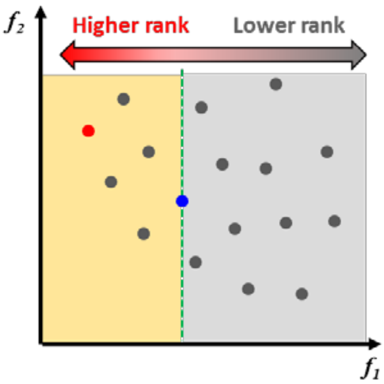

Figure 3: Pareto Front Selection: Ranked by f_1

To extend the Pareto selection process under uncertainty, the following equation is implemented for the probabilistic dominancy comparison:

$$P\left(f_n(S_i) < f_n(S_j)\right) < P_c, \quad \forall\, n = 1 \cdots m \tag{1}$$

where $P(\cdot)$ is a probability operator, f_n is an environmental impact indicator, m is the number of indicators used, P_c is the probabilistic criteria. If the probabilistic dominancy of S_i over S_j is less than the criteria, then the design option, S_i, is not considered to be a dominating design option over S_j on this indicator. If one design option has at least one dominating environmental impact indicators over any existing Pareto design, then the design can be considered as a Pareto solution and will be included in the Pareto front. By incorporating the probabilistic dominancy comparison, we will be able to consider the uncertainty of LCA results during the Pareto Front selection process. As a result, some of the designs which has larger mean values but still can be selected into the Pareto set if it satisfies the probabilistic criteria. Furthermore, the Pareto Front selection will be more flexible depending on the designers' preference by adjusting the probabilistic criteria, P_c. A comparison between the deterministic Pareto Front selection and the probabilistic Pareto Front is illustrated in Figure 6.

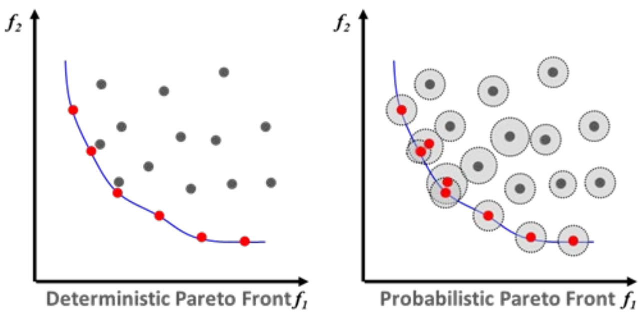

Figure 4: Deterministic Pareto Front (Left), and Probabilistic Pareto Front (Right)

2.2 Ranking based Rate of Substitution (RRS)

Once the Probabilistic Pareto Front is identified, the designers may still have too many "good" design solutions that cannot be implemented in practice. To resolve this challenge, we have developed a Ranking based Rate of Substitution (RRS) to reduce the number of possible solutions.

The operation of RRS is based on the trade-off between two Pareto designs. This trade-off, R_{np}^{ij}, can be calculated in the form of equation (2):

$$R_{np}^{ij} = \frac{f_n^i - f_n^j}{f_p^i - f_p^j}. \quad \forall\, n = 1 \cdots m \;\wedge\; n \neq p \tag{2}$$

where f represent the values of environmental impact indicators; the subscripts n and p represent the n^{th} and p^{th} environmental indicators; the superscripts i and j denote two design options. R_{np}^{ij} is the trade-off of substituting design option i for design option j in terms of the gain of f_n over the loss of f_p. If the trade-off is greater than a pre-defined minimum trade-off value, then the substitution of design option i for j is acceptable. Designers can first select an acceptable Pareto design, f^j, as the baseline. If the trade-off of substituting another Pareto design, f^i, is acceptable, then f^i will be included in the set of possible solutions otherwise it will be rejected. The comparison process continues until the entire Pareto front set is evaluated and a final reduced Pareto set is obtained. To control the number of possible Pareto solutions in the final set, the designer can choose a different baseline design and/or define different minimum trade-off value for each environmental impact indicator

The designer can also define the priority of environmental impact indicators along with the implementation of trade-off to further reduce the size of final possible solution set. For example, six Pareto designs are identified after the PPS and the priority of environmental impacts are ranked from high to low as f_1 to f_6. Let us use the design option S_1 as the baseline and the designs S_1 to S_6 are in the ranked order of f_1 as shown in Table 1. The red cells represent the designs that are considered as acceptable for trade-off from the gain of f_n (corresponding column) over the loss of f_1. When the designer considers only the top two environmental impact indicators, f_1 and f_2, then only S_1, S_2 and S_3 can be added in the final possible solution set. If the designer considers two more environmental impact indicators, f_3 and f_4, then both S_2 and S_3 will be included in the final set. The Pareto design S4 will not be included because its low trade-off value found in f_1 to f_4.

Table 1: Environmental Impact Priority Selection

	f_1	f_2	f_3	f_4	f_5	f_6	
S_1	×						f_1
S_2		×	×				f_2
S_3		×	×		×		f_2
S_4					×	×	f_5
S_5				×		×	f_4
S_6				×	×		f_4

3 Case Study

In this section, one case study is presented to demonstrate the functions of the proposed decision making framework. PackageSmart from EarthShift Inc. is used for LCA and six indicators are defined for LCA as: (1) Climate Change (*kg CO_2eq*), (2) Energy Demand (*MJ*), (3) Ecosystems (*species/yr.*) (4) Human Health (*DALY*), (5) Resources (*\$/kg*) (6) Water depletion (*m^3*).

3.1 Milk Package Design

Milk is one of the largest consumed food products in the world, and many different packaging designs are developed to protect the milk product from recontamination. In this case study, milk packaging design is studied to demonstrate the process of the proposed decision making framework. Three packaging stages for milk packaging levels are defined as shown in Figure 11. The primary packaging is composed of two components, jug and cap. The secondary and tertiary packaging is defined as container and pallet respectively. For the jug, three different types of plastic materials (HDPE, Recycled HDPE, PET), glass, and carton are considered. For plastic and carton jugs, the materials of closures can be chosen from HDPE, and PP; for glass jugs, aluminum closure is used. For the secondary packaging, two types of plastic material (HDPE, PP), and two types of carton packaging are considered (carton box and carton container with wrap). Wood Pallet will be always used regardless selection in other packaging stages. Packaging options of each package stage are shown in Figure 7. In this case study, a total of 44 possible packaging combinations are considered.

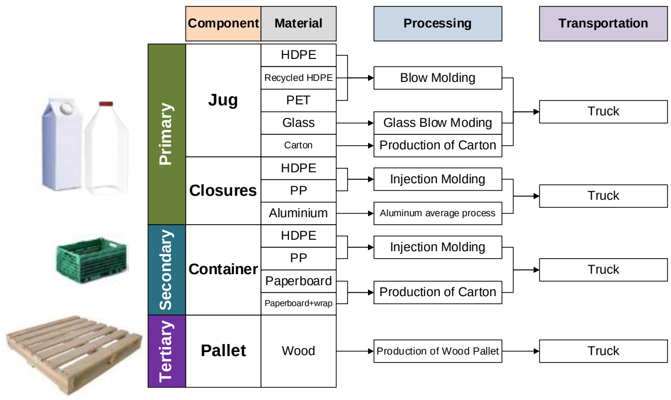

Figure 7: Milk Packaging Stages and Options

Using LCA, each design option is evaluated its environmental impact on six different categories and the results are plotted in Figure 8. A simple deterministic Pareto Selection method will identify 8 out of 44 packaging options as the Pareto Front. If the probabilistic criteria, P_c, in Equation (1) is chosen as 0.5, the PPS will give 15 packaging design options are the Pareto solutions under uncertainty and they are plotted in red color in Figure 8. After the Pareto Front solutions are founded, designer can examine the trade-off and arrives at the final eight solutions as shown in Figure 9. We can then define the priority of environmental indicators to further reduce the size of the possible solutions. In this case study, the priority is defined from high to low as: $f_1 \rightarrow f_3 \rightarrow f_5 \rightarrow f_4 \rightarrow f_2 \rightarrow f_6$ and the final designs are listed in Table 2. Finally, if the designer only focuses on three environmental impact indicators, f_1, f_3 and f_5, then the designs 1 to 4 will be selected as marked in yellow in Table 2.

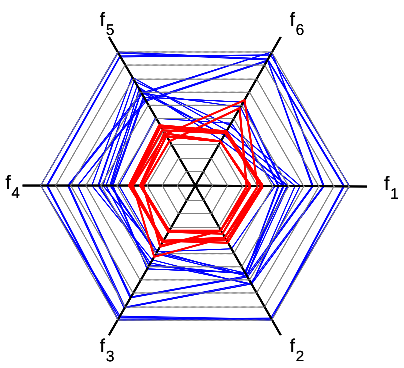

Figure 5: Radar Chart of LCA results for Milk Packaging

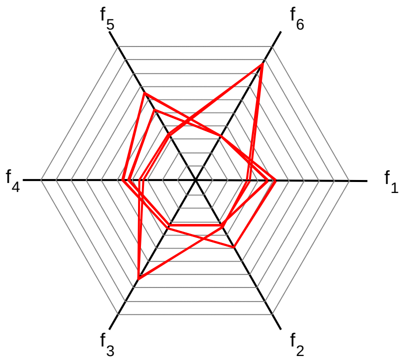

Figure 6: Radar Chart of Final Packaging Design Set for Milk Packaging

Table 2: Final Packaging Design List for Milk Packaging

Design	Jug	Closure	Container	Function
Design 1	Carton	PP	Paperboard	f_1
Design 2	rHDPE	PP	Carton	f_3
Design 3	rHDPE	PP	PP	f_3
Design 4	Carton	PP	Paper+Wrap	f_5
Design 5	rHDPE	HDPE	Carton	f_4
Design 6	rHDPE	HDEP	PP	f_4
Design 7	rHDPE	PP	Carton	f_4
Design 8	rHDPE	HDPE	Carton	f_4

CONCLUSIONS

In this paper, a decision making framework in Life Cycle Assessment (LCA) for sustainable packaging design is presented. Under this framework, the Probabilistic Pareto Selection (PPS) method is introduced to select the Pareto Front with uncertainty first. Then, the Ranking based Rate of Substitution (RRS) is implemented in the decision making process in order to select the best design options based on the trade-off of each Pareto design. This framework solved two major challenges of the LCA, multiple and conflicting environmental impact indicators results, and uncertainty associated with the LCA.

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Determination of wind turbine far wake using actuator disk

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Abstract

The growth in size of wind turbines over the last years is significant. The rotor diameter becomes somehow comparable to atmospheric boundary layer at the land surface. In this case the assumption of uniform velocity of upcoming wind cannot be valid. The aim of this paper is to create a simplified model of wind turbine rotor which can represent the aerodynamic interaction of atmospheric boundary layer with a horizontal axis wind turbine. Such model will be also useful for the study of optimal placement of wind turbines in a wind farm when a large number of calculations is needed and when the time required for full CFD calculations becomes prohibitive. In this study we adopt actuator disk model which takes in account with sufficient precision the influence of blade geometry on wind turbine aerodynamic performance. The proposed actuator disk model is tested in the case of horizontal axis wind turbine using wall-modelled large eddy simulation. The obtained results of aerodynamic performance and wake show the rapidity of calculation and the reliability of proposed approach.

1 Introduction

The aerodynamic interaction between atmospheric boundary layer (ABL) and wind turbines becomes important problem in both the wind turbine design and also the optimizing of wind turbines placement in a wind park. The wind turbine rotor converts airflow kinetic energy into mechanical energy and as results the flow velocity behind the rotor will be lower than the upstream velocity. The Froude-Rankine momentum theory shows that the amount of power which can be extracted by a wind turbine rotor is 16/27 of the total power in the wind. At this point of operation, so-called Betz limit, the velocity decreasing at the rotor plane represents 1/3 of upstream velocity and becomes 2/3 in the far wake, Hansen [1]. The accurate prediction of the wake is of great importance for the study of optimal placement of wind turbines in the wind farm. The flow in the rotor wake is highly turbulent with large scale turbulent structures. If another wind turbine operates in this wake, its blades will be subjected to unsteady aerodynamic forces and that will lead to the decreasing of blade fatigue life. It should be noted that it is not practical to avoid completely aerodynamic interference between the wind turbines because in this case, the increasing of distance between the wind turbines will decrease significantly the park efficiency. As rule of thumb the distance between the wind turbines is nearly seven diameters, if the wind farms have multiple rows of turbines, Wizelius [2]. However, depending on local land use requirements, ground surface relief or atmospheric boundary layer, this rule cannot be always applied.

Generally the optimal wind turbine placement is carried out by means of special software. For many years this software was based on simplified engineering tools, but in recent years the use computational fluids dynamics (CFD) becomes more and more common. Depending on optimizing algorithm, during the design process, multiple cases of wind turbine placements must be considered. However, the full geometric modelling of all of the wind turbines is not practical, because of the high computational requirement. In order to reduce computing time, several researchers adopt the so-called hybrid models which couple the CFD solver to blade element model, Vermeer [3]. In this kind of modelling, the aerodynamics forces applied on the blade do not result directly from CFD, but are calculated separately using inflow data and blade geometry. This calculation is carried out jointly with the numerical simulation. The blade forces are calculated at each iteration and are implemented as source terms in the flow. Depending on the distribution of the source terms, there exist three hybrid models: actuator disk, actuator line and actuator surface.

The simplest hybrid model is the actuator disk which replaces the wind turbine rotor by a thin disk volume. Generally, the disk has a diameter equal to the rotor diameter and in its interior the blade forces exerted on the fluid are replaced by equivalent source terms. This model was introduced in the case of wind turbine by Sørensen&Myken in [4] by means of an axisymmetric Euler solver. In this study, the rotor is replaced by equivalent source terms with constant intensity. This intensity is calculated from the thrust of the wind turbine. Lately Sørensen&Kock [5], propose improved model in which the source terms vary depending on rotor radius. In this study, the authors calculate source terms from the rotor inflow and the blade aerodynamic data. Three-dimensional calculations with actuator disk are presented by Amara et al [6] in the cases of isolated and clustered wind turbines. The obtained results for isolated wind turbine are similar of those calculated in axisymmetrical case, but in 3D permit to show a positive effect of interference for two row periodic find farm. The actuator disk is extensively tested by Mikkelsen [7] for several operation conditions. Here, the author proves model reliability for wind turbine analysis and wake calculation. Kasmi&Masson [8] also develop actuator disk model and apply an extended k–ε turbulence model. This turbulence model permits to improve the flow simulation around the rotor and also in the near and in the far wake. Calculations carried out for three different wind turbines, show better results especially for near wake in comparison with standard k–ε methods. The Reynolds Averaged Navier-Stokes (RANS) based turbulence modelling is often used for modelling of flow over complex terrain. The RANS provides reasonable accuracy but have some difficulties to represent the instantaneous flow. For this kind of flow it is well known that the method of Large Eddy Simulation (LES) reproduces well detailed flow characteristics, Jimenez [9]. The simplified rotor model with constant source term intensity, gives satisfying information not only for the mean flow, but also for eddies larger than the mesh size. The authors suggest that LES will be especially useful to reproduce the wake meandering. The advantages of using of LES are confirmed by Wu et al [10] who compare the results of simulation with those obtained by means of hot wire anemometry in the wind tunnel. Additionally, the authors show that the actuator disk with source terms distributed according to blade load gives better results in comparison with uniform distribution. Lately, the same model presented by Porté-Agel et al [11] is applied in case of large offshore wind park. In this study, the researchers calculate the power output of the wind turbine for multiple wind direction and show a strong power fluctuation for small wind direction shift.

The actuator disk gives a good result for the far wake, where the individual presence of the blades becomes small and therefore can be neglected. However, if a detailed representation of near wake or blade tip vortices is needed, a three-dimensional model for each blade must be used. Sørensen in [12] proposes so called actuator line model. In this model, the real blades geometry is replaced in CFD by source terms distributed radially along lines coincident with blade axis. Compared to actuator disk, this model represents each blade individually with its tip and root vortices which improves the near wake representation. The comparison of the actuator line with experimental data reveals the effectiveness of this proposed model for power characteristic calculation. The reliability of the model to represent near and far wake are proved by Ivanell [13], Troldborg [14] and recently by Lynch et al [15].

More complete hybrid model is the model of actuator surface applied by Dobrev&Massouh, [16], [17], Shen [18] et al and Sibuet Waters&Masson [19]. The main advantage of this model is more realistic force distribution along the blade. Instead of generic radial distribution around the blade axis, in this model the sources terms (or pressure discontinuity) are distributed similarly to pressure discontinuity created by the real blade. Thus velocity gradients created by the actuator surface becomes very close to real case which improve the initial conditions for the wake.

Regardless of good results presented by the actuator line and actuator surface, the model of the actuator disk is useful where the rapid calculation is needed. In fact, more realistic and fine source terms distribution needs more cells. Thus, the study presented by Churchfield et al [20] needs 315 million cells in order to simulate a wind park with 48 wind turbines.

The aim of this work is the creation of a numerical model of actuator disk which is capable to take into account the atmospheric boundary layer and also the development of wake behind the wind turbine.

2 Numerical model

The development of the actuator disk model presented in this paper is based on the works of Amara et al [6]. The model is implemented in commercial CFD code Ansys Fluent using special user defined functions (UDFs). The blade forces are represented by source terms which are calculated using blade geometry, blade airfoil data and the velocity field. Blade airfoil data can be obtained from experimental tests or extracted from 2D/3D simulations. CFD simulations are viscous and unsteady and use RANS or WMLES approach. The numerical model is developed for the case of single wind turbine installed on flat terrain and takes in account the inlet atmospheric boundary layer.

2.1 Actuator disk

The classical actuator model is developed for the case of steady flow and constant upstream velocity. However the atmospheric boundary layer should be taken into account and thus, some assumptions are required. Here we follow the approach present by Macridis and Chick [21], which distributes source terms depending on velocity in plane of actuator disk.

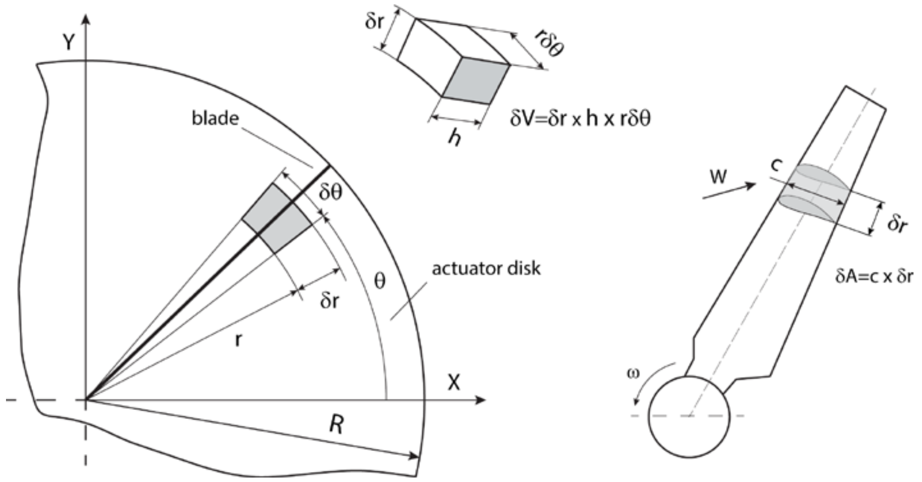

Fig. 1. Actuator disk concept

In the simulation model the rotor blades forces are distributed in a thin disk and each cell of this disk takes a fraction of the total blade forces. Usually, when the inflow velocity is constant, the blade forces depend only on radius and do not vary azimuthally so they can be averaged spatially. Here contrarily the blade forces are averaged temporarily over one blade passing period *T*:

$$T = \frac{2\pi}{N.\omega} \quad (1).$$

Here ω is the angular velocity and *N* is the number of blades. The actuator disk, with a radius *R* equal to the rotor radius, is presented in Fig. 1. Let's calculate the averaged source terms intensity for an infinitesimal element situated at the radius *r* and the azimuth angle θ. This element corresponds to the sector $\delta\theta$, and if the blade is assumed as a thin line, the staying time of the blade in this element will be $\delta t = \delta\theta/\omega$, Fig.2. During the time δt this element will be submitted to the blade element force $\delta F_{L,D}$. Therefore, during a blade passing period, the time averaged force can be calculated as:

$$\delta F_{m\,L,D} = \delta F_{L,D}\,\frac{\delta t}{T} = \delta F_{L,D}\,\frac{N\delta\theta}{2\pi} \qquad (2).$$

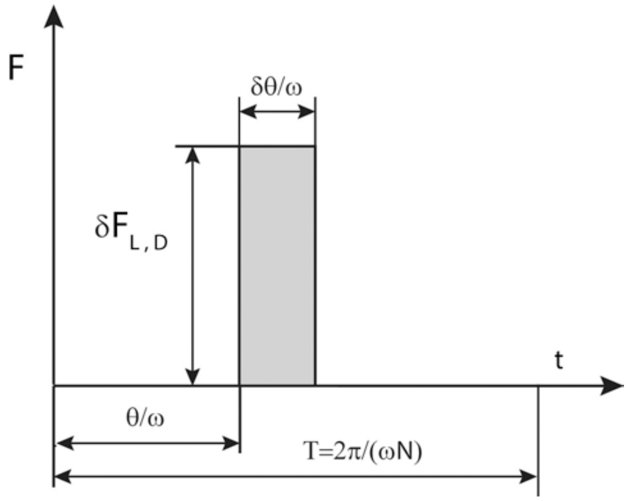

Fig. 2. Time diagram

Here, the force $\delta F_{L,D}$ which is applied on infinitesimal blade element with radial length of δr and chord of *c*, can be obtained by means of the blade element theory:

$$\delta F_{L,D} = \rho\frac{W^2}{2}C_{L,D}(\alpha)c(r)\delta r \qquad (3).$$

In this formula, ρ is the air density, *W* is relative velocity and $C_{L,D}$ is the lift/drag coefficient of the blade section, Fig 3. The angle α is angle of attack, β is pitch angle and ϕ is the flow angle.

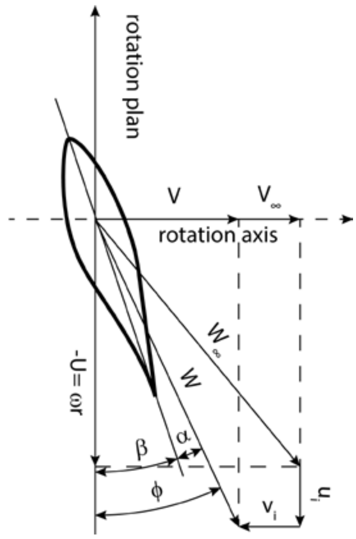

Fig. 3. Velocity

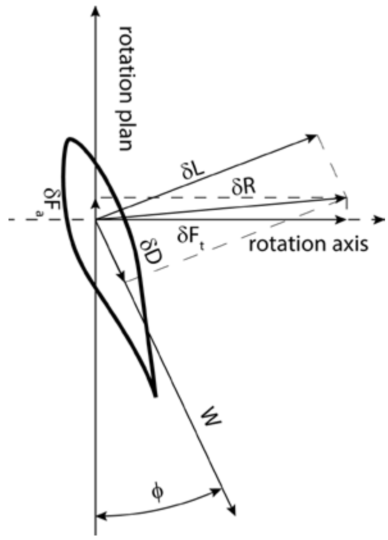

Fig. 4. Aerodynamic forces

Replacement of the blade force in Eq. (2) by means of the force, represented by Eq. (3), permit to obtain the averaged blade force applied on the infinitesimal actuator surface element:

$$\delta F_{m\,L,D} = \rho \frac{W^2}{2} C_{L,D}(\alpha) c(r) \delta r \frac{N\delta\theta}{2\pi} \quad (4).$$

If the actuator disk has a thickness *h*, the volume of the considered infinitesimal element is dV = $\delta r \times r\delta\theta \times h$. Therefore intensity of source terms is this element is:

$$f_{L,D} = \frac{\delta F_{m\,L,D}}{\delta V} = \rho \frac{W^2}{2} C_{L,D}(\alpha) c(r) \delta r \frac{N\delta\theta}{2\pi} \frac{1}{\delta r r \delta\theta h} \quad (5).$$

The simplification of Eq. (5) gives:

$$f_{L,D} = \rho \frac{W^2}{2} C_{L,D}(\alpha) c(r) \frac{N}{2\pi r h} \quad (6).$$

Thus, the eq. (6) permits to calculate the source terms intensity for each cell of the actuator disk, depending on cell centre radius r_c. In Eq. (6) the relative velocity is calculated from the following relation:

$$W = \sqrt{(\omega r + u_i)^2 + V^2} \quad (7).$$

Here ω is the angular velocity of the rotor disk, *V* is the axial velocity and u_i is the tangential velocity. The axial and tangential velocities should be obtained from CFD model during calculation, in the plane of actuator disk.

2.2 Tip loss correction, power and thrust

The tip loss correction for the wind turbines and propellers take into account finite aspect ratio of the blades. This correction takes into account the decreasing of pressure discontinuity near the blade tip and should be applied when blade element method is used. The correction factor F_1 is introduced in order to correct the blade section aerodynamic coefficients. Here the method proposed by Shen et al [21] is adopted:

$$C_{L,D} = F_1 C_{L,D}^{2d} \quad (8).$$

In this formula $C_{L,D}^{2d}$ is the lift or drag coefficient issues from 2d airfoil data and

$$F_1 = \frac{2}{\pi} \cos^{-1}\left[\exp\left(-g \frac{B(R-r)}{2r\sin\phi}\right)\right] \quad (9).$$

Here the function *g* is equal to:

$$g = \exp[-0.125(N\omega / V_\infty - 21)] + 0.1 \quad (10).$$

To obtain the power and the thrust (axial force) of the rotor, it is needed to calculate the tangential f_t and axial f_a source terms intensity. These intensities can be expressed by projections of the total aerodynamic force δR, Fig. 3, on the axial and tangential directions as follows:

$$f_t = f_L \sin\phi - f_D \cos\phi \quad (11),$$

and

$$f_a = f_L \cos\phi + f_D \sin\phi \quad (12).$$

Integration of f_a in the volume of actuator disk gives the thrust of the rotor:

$$F_a = \int_V f_a dv \quad (13).$$

Integration of f_t gives the power of the rotor:

$$F_a = \omega \int_V r f_t dv \qquad (14).$$

Generally for CFD calculation the source terms should be expressed for Cartesian coordinate system. In the model presented in this paper, the axial direction coincides with z-axis, but tangential source terms should be expressed as source terms which act in *x*- and *y*- directions:

$$f_x = -f_t \sin\theta; \qquad f_y = f_t \cos\theta; \qquad f_z = f_a \qquad (15).$$

2.3 Inflow boundary layer

The parameters of boundary layer which is used in this paper are proposed by Richards&Norris [23] and Tominaga et al [24]. Thus inlet velocity varies with height H as:

$$V(H) = \frac{u^*_{ref}}{K} \ln\left(\frac{H + H_0}{H}\right) \qquad (16),$$

where K=0.433 is von Karman constant and u^*_{ref} is the friction velocity at the reference height:

$$u^*_{ref} = \frac{KU_{ref}}{\ln\left(\frac{H_{ref} + H_0}{H_{ref}}\right)} \qquad (17).$$

The turbulence kinetic energy k and turbulent dissipation rate ε can be calculated as follows:

$$k = \frac{u^2_{ref}}{\sqrt{C_\mu}} \qquad (18),$$

$$\varepsilon(H) = \frac{u^3_{ref}}{K(H + H_0)} \qquad (19).$$

The atmospheric boundary layer parameters Eq. 16-19 are implemented in CFD code as user defined functions.

3 Numerical result and discussion:

3.1 Numerical model

The studied horizontal axis wind turbine has 3-blade rotor with diameter of 60m and hub height of 60m. The computational domain has length of 27.5D, width of 10D and height of 7.5D, where D is the rotor diameter, Fig. 5. The block structured grid of the domain has approximately 3 million hexahedral cells. Initially, the mesh has 200x100x100 cell, but in order to ameliorate the boundary layer modelling, the boundary cells of the ground surface are refined two times. The number of cell is limited, because such grid should represent only a part of large wind park model. The nacelle and mast are not modelled, distinct volume for the actuator disk is not defined and source terms are imposed only in cells in virtual volume which represent the rotor. Such approach permits to change wind turbine placement without change of initial grid.

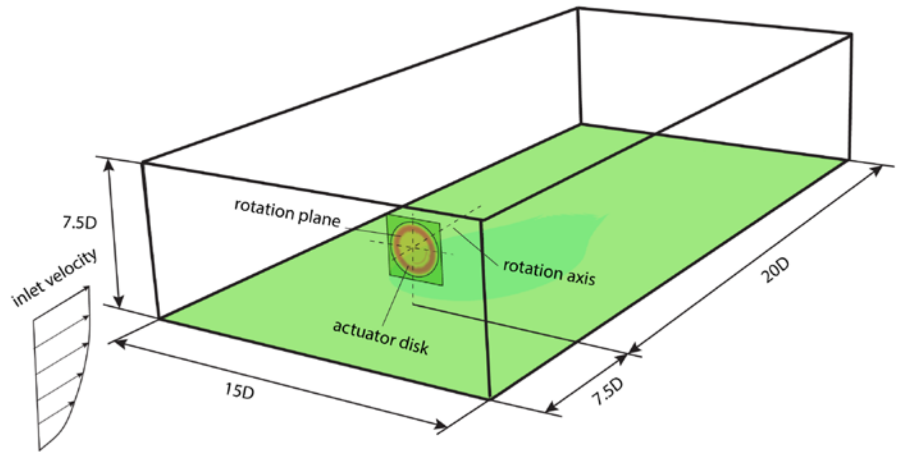

Fig. 5. Computational domain

The simulation is carried out by means CFD Ansys Fluent 14.5.7. For the turbulence, the model of wall modelled large eddy simulation (WMLES) is applied, Shur et al [25]. This kind of modelling permit to use LES, without needs of fine boundary wall cells. The WMLES model is unsteady and can capture the vortex structures behind the rotor, better than any RANS method. Somme inconvenience is the low time step; CFL should be less than 0.3. In this study the time step is equal to 0.01s. In order to obtain sufficient information about the flow structures behind the rotor and wake stability, more than 15000 time step are carried out during the simulation.

The presented simulation is carried out in the case of upstream velocity of 12.5 m/s at hub height, and angular velocity of 2.83 rad/s. The inlet velocities are calculated by means of Eq.16-17 and perturbed using method proposed by Mann [26]. The Fig. 6 and Fig. 7 shows the results obtained for unsteady velocity in horizontal and vertical plane. The Fig. 8 and Fig. 9 represent the vorticity and show that after a distance of 150m (nearly 2.5D) the wake becomes instable and after 10D vorticity tends to disappear.

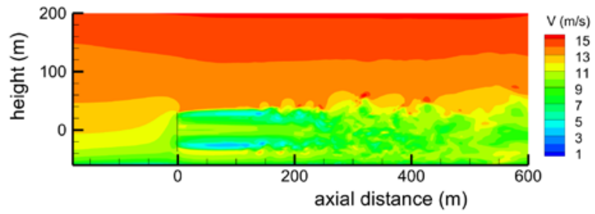

Fig. 6. Snapshot of velocity in vertical plane

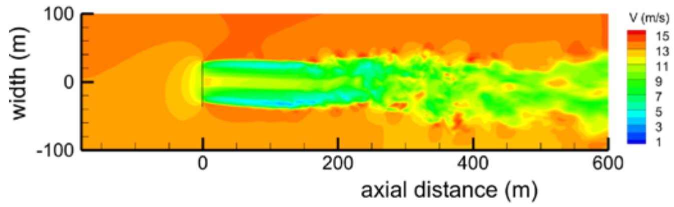

Fig. 7. Snapshot velocity in horizontal plane

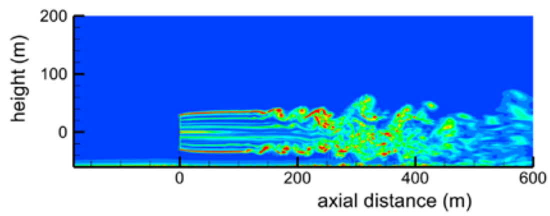

Fig. 8. Snapshot of vorticity in vertical plane

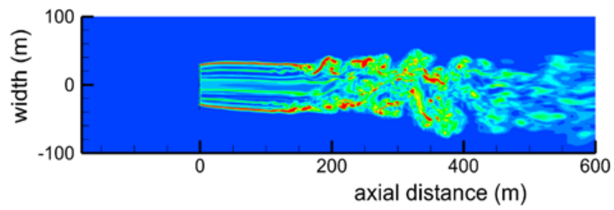

Fig. 9. Snapshot of vorticity in horizontal plane

The unsteady information about flow field is interesting, but it is important to show mean flow parameters. For this proper orthogonal decomposition (POD) is carried out using approach proposed by Chen et all [27]. The result for first mode POD of flow velocity in the vertical plane and corresponding vorticity are shown in Fig. 10 and Fig. 11. The second and third modes POD of velocity are shown in Fig. 12 and Fig. 13. These velocity fields are quite similar, but slightly shifted in axial direction.

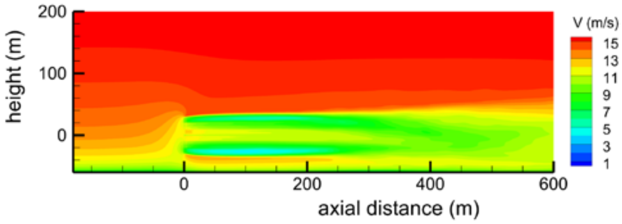

Fig. 10. POD, first mode: velocity in vertical plane

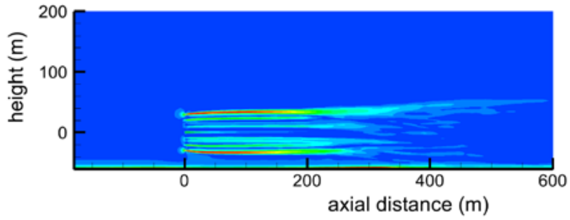

Fig. 11. POD, first mode: vorticity in horizontal plane

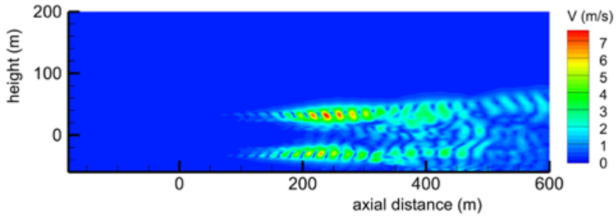

Fig. 11. POD, second mode: velocity in vertical plane

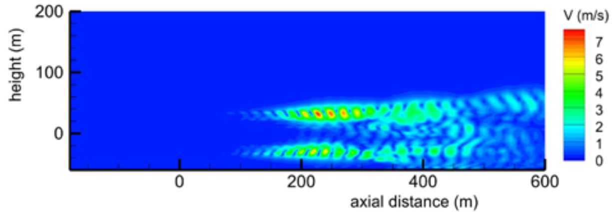

Fig. 12. POD, third mode: velocity in vertical plane

4 Conclusion

The proposed model of actuator disk takes into account the irregularity of the flow through the rotor and permits to represents the interaction of the wind turbine with atmospheric boundary layer. Despite of limited cell number it is possible to explore the wake development, its instability and mixing with the external flow. The obtained results are promising and the next step of model validation should be PIV measurement.

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FUNDACIÓN SERVIPOLI

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Conference Key Areas: Employability across borders. Conocimientos transversales, habilidades, competencias, empleo

Abstract

The Servipoli Foundation was established in May 2008, as they say their statutes " with the character of foundation of services and with its own legal personality". The basic purpose of the performance of the Foundation Servipoli is complementing the formation of the Polytechnic University of Valencia (UPV) students, through the acquisition of work experience in order to increase their ability to future integration in the labor area, through the provision of services in the field of the UPV and in the territory of the Valencian Community.

In this way the Social Council of the University agreed to the Constitution of the Servipoli Foundation, which began in May 2008. Once established and approved its statutes, the Servipoli Foundation, begins to develop its activities. Due to its specific characteristics, is a pioneer in in the Spanish universities.

Since the first moment, the Servipoli Foundation with its activity of providing services has benefited around two thousand UPV students who have had the opportunity to have their first professional experience providing an initial contact both with the particularities of industrial relations: employment contract, contributions to Social Security, prevention of occupational hazards and basic labour legislation, as well as a work environment. The knowledge acquired in this field will be useful throughout their professional careers.

All this occurs in the framework of the collaboration agreement signed between the UPV an the Foundation in July 2008, given that through it the UPV becomes the main customer of the Servipoli Foundation. But in addition, the Foundation, throughout this time, in his ambition to bring its services to the greatest number of students has achieved that pupils from UPV can take their first steps in business and develop their skills and competencies.

1 Introduction

The Foundation Servipoli in the provision of services to their customers develops different activities that bring students cross-cutting skills, general knowledge common to the majority of jobs and, sometimes, also allows them to put into practice the knowledge acquired in their university studies. The greater learning in the Foundation is the experience, it means that they have to live it to learn it. The workers become familiar with working hours, working procedures, regulations, team work, adaptation to changes, etc.

The Foundation provides services in different areas of the UPV. Since the reception of visitors in guided visits to the Sculptural Campus of UPV and in *open days*, to organise seminars and conferences, through placement of books on the shelves of the libraries of the UPV, promotion of international programs, survey pass, graphic design, promotion of social networks, web design, informative contents to update web pages, etc. Tasks that provide students the opportunity to put into practice the knowledge acquired in their studies, as well as cross-cutting skills, include graphic design, website programming, development of databases, work in libraries, related degrees such as Fine Arts, Design Engineering, Computer Engineering, etc.

In recent months there has been an increase in demand from our clients for services related to social networks and multimedia services. Among them the following:

Dynamization of social networks, Facebook, Twitter, LinkedIn, and update web pages content and news are perfectly suitable for a college student because uses them for their daily life. As well as the retransmission of conferences through Twitter, a service that we have recently added to our offer.

The design and development of web pages to which we can count with titulations such as Design, Fine Arts or Computer Science students, is also an example of the tasks which the UPV students are perfectly prepared, and that achieve high levels of customer satisfaction.

Other of our contributions to the University community is through graphic design. Posters that advertise important events that are held in the University are carried out by employees of the Foundation.

About multimedia services, comprehensive management of documentation: scans, archiving and cataloging, allows the University services scanning (the) documentation.

One of our services more important takes place in sessions, conferences and seminars that are held in the University. We deal with the reception of the participants, audiovisual support, attention and information, etc. In some cases, previously we are requested the revitalization in networks social, fliers to publicize the event, and even the design of the image of the Conference.

Table 1. Activity Indicators 2008-2013.

For the correct implementation of the activity of the Foundation, we follow a very carefully selection of students procedure for the development of the activities. Consistency with the environment it’s necessary to be a student of the UPV in studies concurrent to an official character of first and second cycle, degree and master's degree. The students need to have approved at least 60 credits from their degree. And finally, have approved at least 30 credits registered in the previous year or the current course. From this moment the best average academic record note will take preference when the specific requirements for the provision of the service are met.

Procurement in the Foundation is carried out within the framework of the existing labour legislation. And paying special attention to the work carried out by the student is compatible with progress in their studies. The dedication of the students to work in term can’t exceed 60 hours per month. For a greater distribution of labour and to benefit the greatest number of students of the University, every pupil in the UPV can work in the Foundation a maximum of 22 months.

2 Internal organization

The internal organization of the Foundation is very simple, and concentrates almost all workers in the human resources area, where the students/workers of the University are the engine of the Foundation, since they provide the services that we offer and are, at the same time, the beneficiaries of the Foundation.

The organigramme of the Foundation is divided into three areas: economic financial, human resources and labour administration, directed by management. The three perfectly reflect the workflow of the provision of services, our core activity.

Fig.2 Organigramme.

Our customer service requests are received in the economic area, where the service is quoted. Once accepted the budget, the area of human resources begins the selection process, which is determined by the order of middle note and the requirements for the proper provision of services.

Once selected the candidate, starts the work with the paperwork that the law determines for its hiring. This work is carried out in the area of labour administration.

From the start of the service, monitoring will take place in three areas. Billing to the client, payment of salary and other obligations to social security, troubleshooting, monitoring of the proper provision of the service.

Fig.3 Providing Services Process.

The jobs of University students in the Foundation are:

Development, editing and design of audiovisual material:

- Evidence of sound and lighting for the recordings.
- Recording events.
- Editing and framing the made recordings.
- Cataloguing in the database of the recordings once published.

Fig.4 Providing Services Servipoli Foundation.

Elaboration and editing of web pages:

- Design of the documents that will be part of the web.
- Design of the structure of the website.
- Graphic design of web
- Programming of image galleries.
- Development of the website.

Elaboration of informative contents:

- News.
- Translation of news writing.
- Upload the news to the server.
- Editing and graphic design of the news.

Dynamization of social networks:

- Search of information content of interest.
- Drafting of the informative content found.
- Publication of the informational content in the emicrowebs.
- Editing of images, documents and videos for publication.
- Publication and dissemination of content on the social network Facebook.
- Monitoring of the different channels and social networking profiles to facilitate a rapid response.

Computer activities:

- install hardware and software.
- Control of network cards.
- start projectors, microphones and cameras.

Elaboration and editing of web pages and databases:

- Redesign or expand functionalities of web.
- Analysis applications, interface design, and requirements.
- Design and management of data bases.

Design, production and editing of brochures and publications:

- Design of posters, logos, t-shirts, brochures and publications.
- Print and layout designs.

Broadcasting of international program:

- Welcome to exchange students.
- Advice and monitoring of the process of incorporation into the UPV.
- Search for general information about the foreign universities of destination for UPV students.
- Update the information channels, social networks, to report the news related to the broadcasting of international programs.
- Attention to the public and information about exchange programs.

Broadcasting of practices in companies:

- Attention to the public and information about the internship programs.
- Attention to the companies interested in participating in practices of the UPV programs.

Distribution of documentation:

- Distribution of documents to different services of the campus.
- Collection of documentation.
- Classification of the collected documentation.
- Registration of the collected documentation.

Survey pass:

- Planning of the survey pass, setting the date and time of each survey pass.
- Pass the surveys according to planning.
- Classification of the completed surveys.

Library:

- Pick up the books of tables.
- Place and order the books collected from the tables on the shelves.
- Review the management of the books on the shelves by the bar code reading.

Fig.5 Providing Services Servipoli Foundation.

Wait reading:

- Visit to the five points of reading of the campus.
- Review of the State of the books.
- Replacement of the books in poor condition.
- Control and record survey points wait reading users.

Cataloguing and management of the library:

- Carry books, journals and audiovisual materials to catalogue to the central library of the UPV.
- Ordering and registering the books on the shelves.

Scanning and file:

- Digitalization of documentation.
- Archive of scanned documents.

Organization of concerts of the music band of the UPV:

- Assembly and disassembly of the stage: chairs, music stands, stage director and cast of folders.
- Transfer from instruments on stage.
- Distribution of scores.
- Transfer from instruments on concert days.
- During rehearsals reinforcement to the musicians of the band playing with her.

Guided visits to the sculptural campus of the UPV:

- Preparation of the presentation of the visit for the group.
- Reception of the visitors at the Student House.
- Projection of the presentation.
- Guided tour through the campus sculpture, explaining the works.
- Revision of the inventory of the works of Fund of Art
- Take pictures to the works for inventory.
- Packing works.

Organization of student tutors:

- Management of the lists of students targeted to the PATU and classification in groups.
- Coordination with the teachers and students tutors for their attendance at tutorials groups host-tracking sessions and meetings.
- Warning to users of the program of Student Tutors.
- Organization of groups to show the school during the days of reception.
- Planning itineraries for school.

Coordination of European convergence:

- Preparation of lists of participants in the program.
- Collection and treatment of information collected in the software SAGAD.
- Preparation of reports with the data collected.

Statistical analyses and technical reports:

- Data collection and entering the information in the database.
- Analysis of the data.
- Preparation of reports with the data obtained.

Control room:

- Implementation of computers and plotters.
- Assistance to the users of the printing system.

Organization of conferences, seminars and meetings:

- Preparation and distribution of promotional material.
- Preparation of the documentation to deliver to the attendees.
- Preparation of the romos.
- Documentation-care assistance.
- Delivery Control to attendees.

Fig.6 Providing Services Servipoli Foundation.

Sporting activities:

- Organization of sport activities.

Attention and information:

- Attention face-to-face and telephone to visitors and users of the UPV
- Delivery of brochures and promotional material.

Fig.7 Providing Services Servipoli Foundation.

Elaboration and edition of multimedia material:

- Development of the interactive map of the UPV to match UPV3D.
- Improvement of the functionalities of a machine tickets.
- Update of the interface of the machine vending.

Virtual Labs:

- Receipt of Virtual Labs Flash sent by teachers.
- Insert flash laboratories in a template to upload them to the web.
- Reception of virtual laboratories in matlab.
- Review to adapt them to the own application
- Check application for the proper functioning of the files on the testing server
- After tested, upload to the public server.

Development and testing for the Opencast platform:

- Loading drivers card Epiphan.
- Perform the installation of the operating system Linux.
- Install software Galicaster Class.
- Set audio devices video software.
- Manage the intake of Matterhorn.
- Add video functionality to the operating system Linux.
- Manage access to videos with the authorization of the Matterhorn program service.

Elaboration and edition of e-learning materials:

- Installation of software.
- Writing manuals for the use of the platform
- Configure Apache servers.
- Search for errors in the PoliformaT program.

3 Figures, tables and equations

3.1 Tables

Table 1. Activity Indicators 2008-2013.

INDICADORES	2008-2013
Trabajadores-alumnos beneficiarios	1.949
Número de contratos	3.085
Horas de servicio prestadas	587.087

3.2 Figures, diagrams, illustrations

Fig.1 Servipoli Foundation Logo.

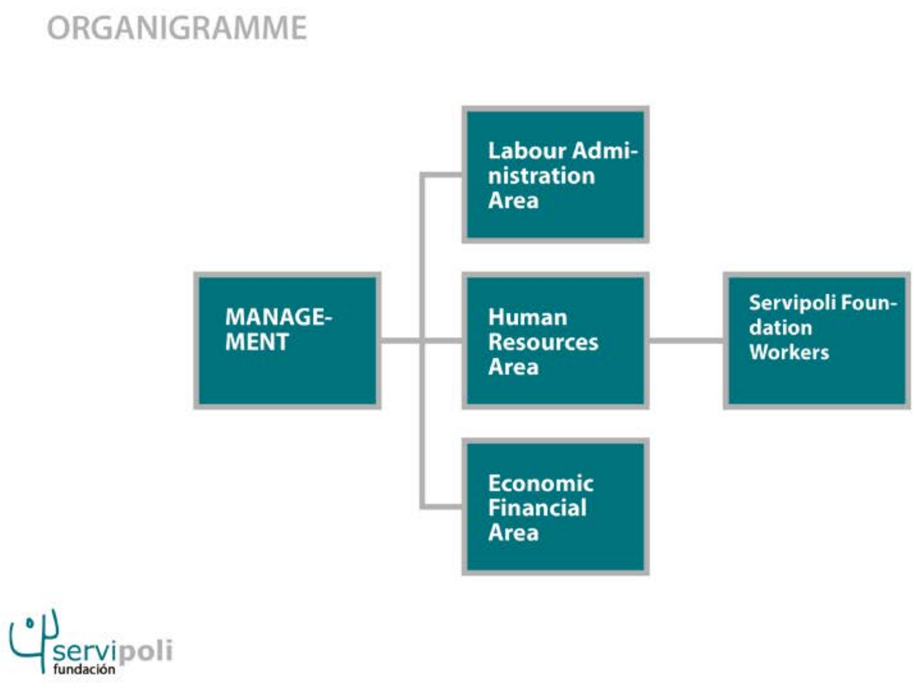

Fig.2 Organigramme.

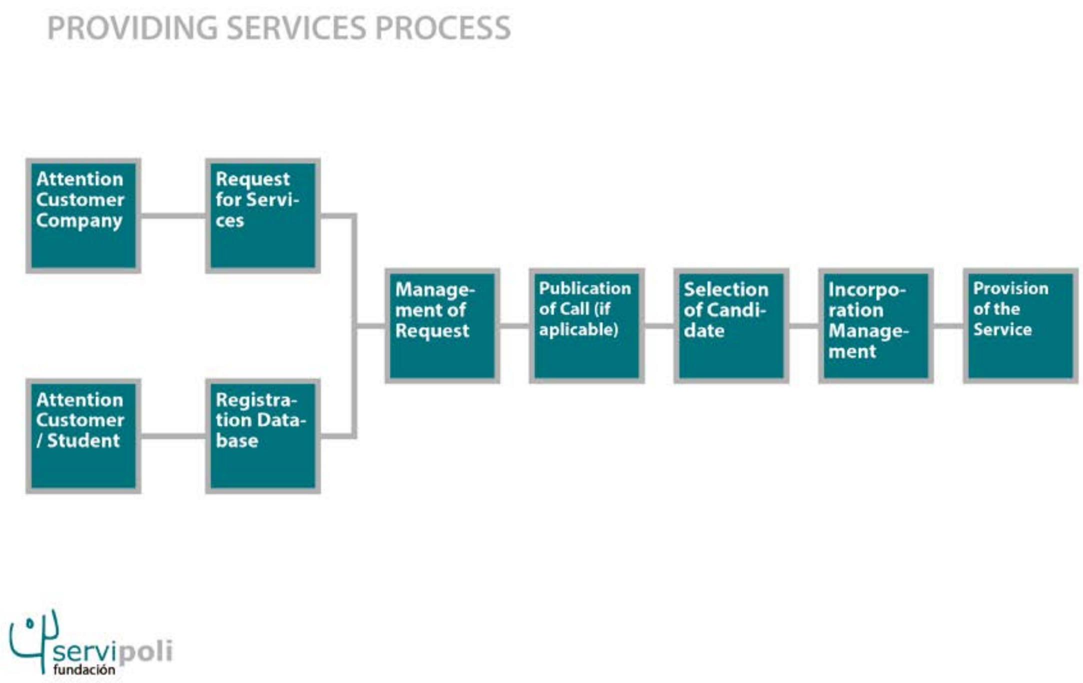

Fig.3 Providing Services Process.

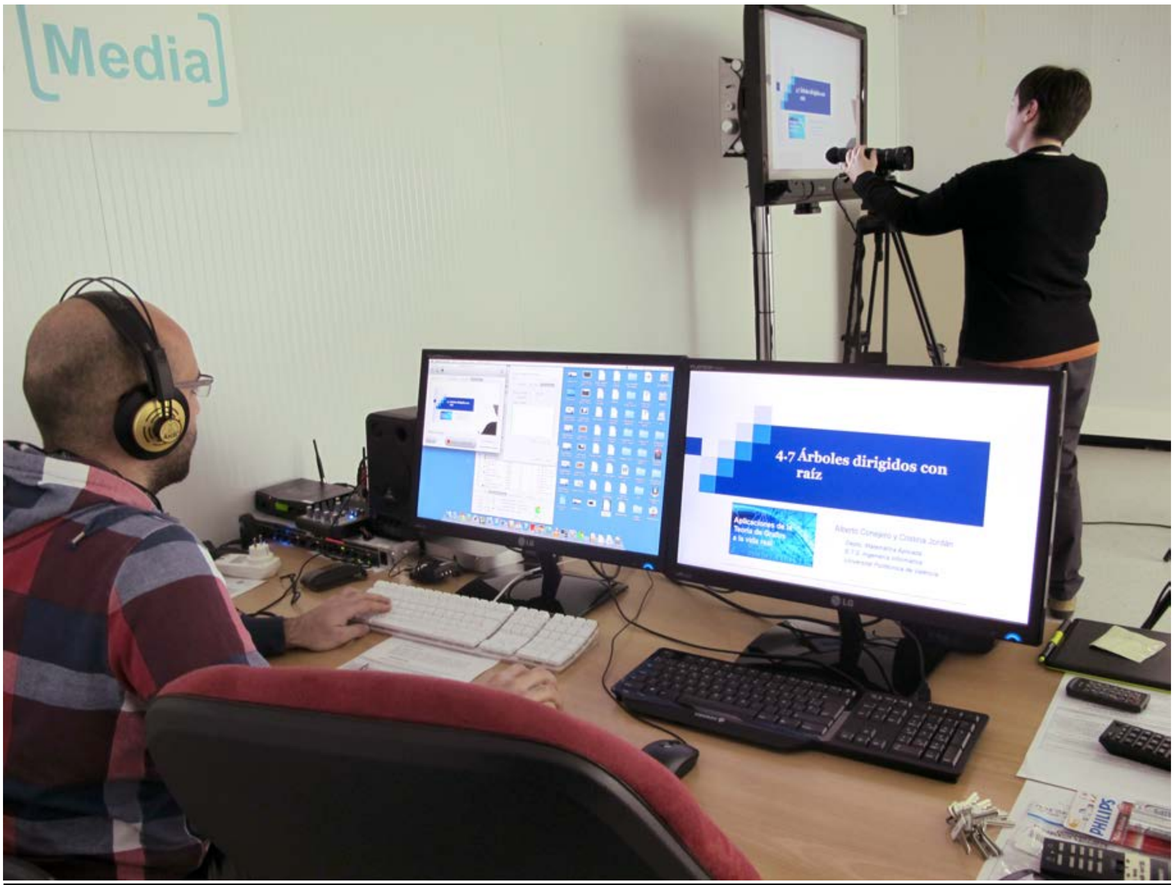

Fig.4 Providing Services Servipoli Foundation.

Fig.5 Providing Services Servipoli Foundation.

Fig.6 Providing Services Servipoli Foundation.

Fig.7 Providing Services Servipoli Foundation.

4. References

[1] Servipoli Foundation documents.

Self-directed learning of Physics in Engineering Degrees by means of Moodle quizzes

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Conference Key Areas: Innovation in EE, Bologna Process & New European Curricula
Keywords: Self-directed learning, Continuous assessment, Physics Education

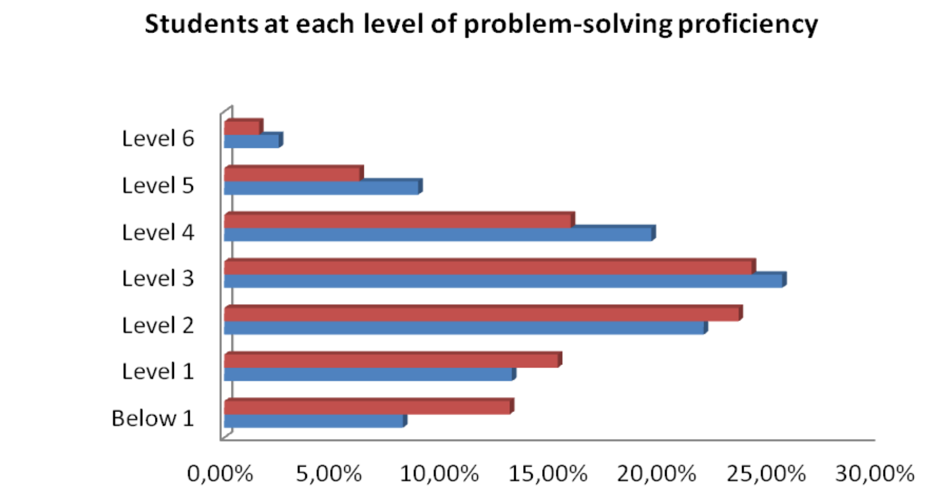
Abstract

We have applied Moodle quizzes in an introductory Physics course in the first year of an Engineering Degree to motivate the self-directed learning of our students. Independent learning is a key point for reinforcing the concepts and procedures presented in the lectures. Our Moodle quizzes are basically a set of questions for students classified by topic. These questions are automatically marked by Moodle. Besides, after sending the results, the student gets a feedback with the correct answers. In order to encourage students to participate in the Moodle quizzes, a small part of the final mark of the course corresponds to the average score obtained in the quizzes. We have observed that this methodology provides a more precise evaluation of the effort that the students devote to the course, as copying from other students is prevented by the randomness introduced in the questionnaires. Moreover, once the quizzes are implemented, the time the teachers correct the questionnaires is reduced considerably, limited to the task of detecting mistakes or misconceptions by analyzing the results. Further improvements of this educational research project will include the improvement of the questions banks and of the feedback provided to the students for the most common issues.

1 Introduction

It is alarming that, according to the *Programme for International Students Assessment* (PISA) report, Spanish students are not well prepared to confront – and solve – the kinds of problems that are encountered almost daily in 21st century life [1]. PISA is a triennial international survey which aims to evaluate educational systems worldwide by testing the skills and knowledge of 15-year-old students. In Spain, 2709 students in 368 schools completed the problem-solving assessment. The results obtained in comparison with an average of the rest of the countries of the *Organisation for Economic Co-operation and Development* (OECD) are shown in Fig. 1. The levels indicate the difficulty of the task. So up to Level 2, tests are simple challenges that do not require deep thinking from the student, while Level 6 indicates complex problem situations. In general, even simple tasks that range from buying a ticket for the subway to make a search in internet are done with less proficiency by Spanish students than by students from other countries. Specifically, the Spanish students are 23 points below the average for developed countries in solving everyday problems. These data reflect that our educational system does not provide an opportunity for students to be creative. As Andreas Schleicher, head of Education of the OECD, stated, "the twenty-first century requires a different approach to teaching" [2].

Reinforced by these PISA results, various forums claim that higher education students should be given more materials suitable for self-directed study [3]. As discussed by Armstrong, "*Students should be encouraged to do independent work. Faculty members should develop learning materials for students that would be suitable for self-study. Students could use discussions, videos, and* *books. However, for more effective learning, students should engage in active tasks such as writing papers, problem-based projects, and experiential exercises.*"



	Below 1	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Spain	13,10%	15,30%	23,60%	24,20%	15,90%	6,20%	1,60%
OECD average	8,20%	13,20%	22%	25,60%	19,60%	8,90%	2,50%

Fig. 1. Comparison of the students at each level of problem-solving proficiency. Data from Ref. [1].

Along with the Bologna system implementation [4], the Spanish academic staff was encouraged to move towards a new paradigm, a methodology more focused on the student's autonomous learning rather than in the role of the teacher, as previously. And now, one of the European strategic goals is to open up Education through new technologies [5], having in mind the increase in the effectiveness of education, a more personalized learning, a better learning experience, and an improved use of resources. As a consequence of the increased availability of knowledge, a higher degree of equity is expected.

On the other hand, a recent study points out that multimedia learning modules provide a better introduction to the basic Physics content [6]. One of the reasons for this improvement is the relevance of receiving striking visual information. Motivation for using multimedia comes from the conviction that expository lectures have been somehow unsuccessful in helping students acquire conceptual and procedural knowledge. This is the thesis of Heuvelen [7], who asserts that the conventional form of instruction does not consider the characteristics of students' minds. From this point of view, students need to use concepts and skills repeatedly in a variety of contexts over an extended time interval to make these ideas and abilities become a real part of their knowledge. Thus, students should become active participants during lectures and the others parts of the course, and autonomous multimedia activities can facilitate this goal.

2 Moodle quizzes as an integrated system for self-studying

The key of our project is to face the above described demands of the new methodologies by developing an interactive tool to help the students' self-directed learning. To this end, we have developed Moodle [8] quizzes. Moodle is a popular system for online learning that is used worldwide. We decided to use this platform mainly for five reasons:

1) Moodle is an Open Source program (free!)

2) The students submit the information electronically (safe for the environment)

3) It is automatically marked (it saves teacher's time)

4) The questionnaires can be shared (good for interchanging information with other institutions)

5) The questions may be in sentence or number form or contain various media such as video or sound (very versatile).

Our Moodle quizzes are basically a set of questions presented to the student classified by topics. Each quiz corresponds to a lesson of the course (electric field, electric potential, electrostatic energy and capacitance, electric current and DC circuits, the magnetic field, sources of magnetic field, induction and magnetic energy, and so on). In the quizzes we incorporate different type of questions: multiple choice, numerical, matching, and calculated. Some examples of our quizzes are shown in Fig. 2.

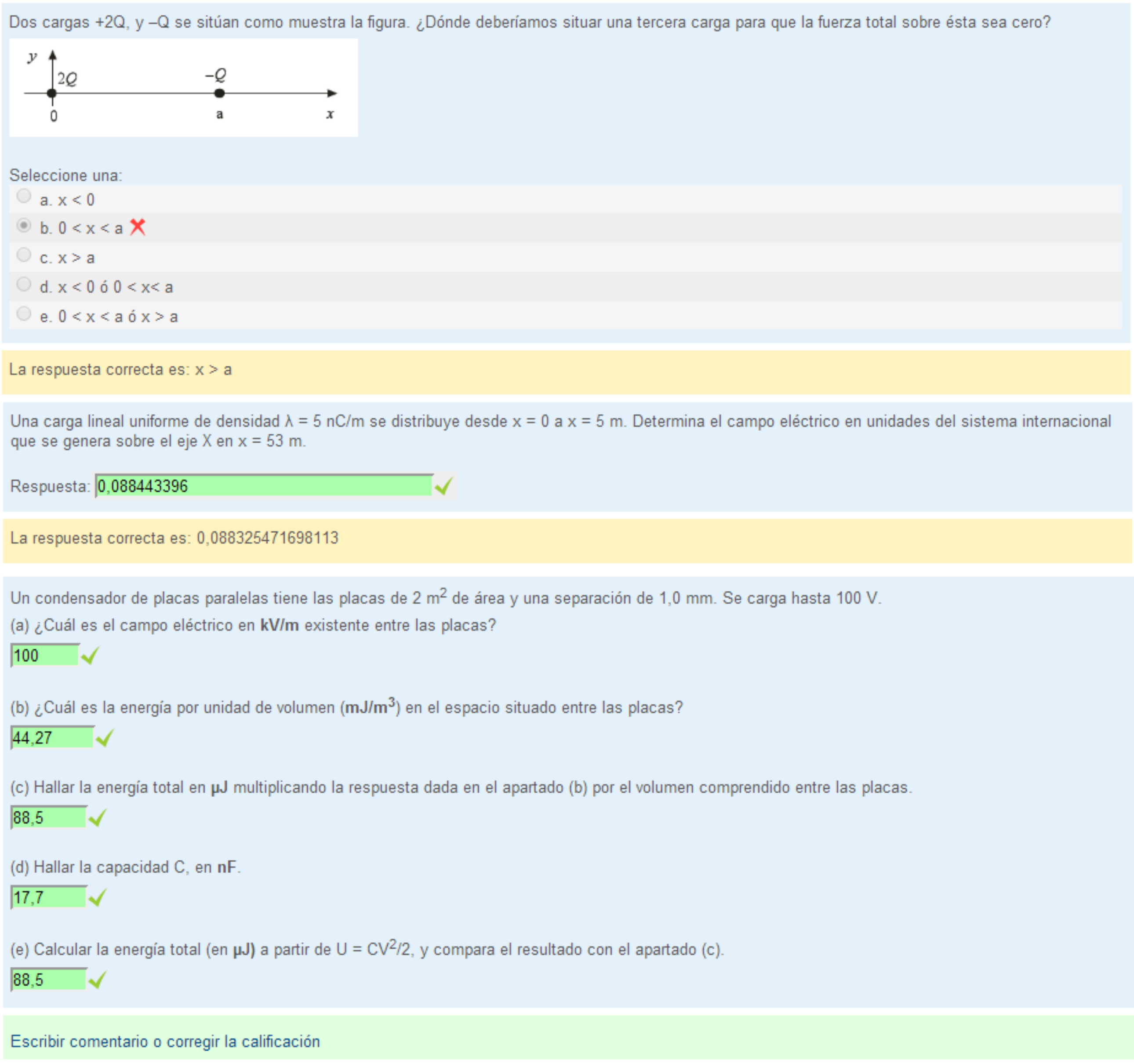


Fig. 2. Example of questions of the quizzes.

Another advantage of Moodle is the quiz statistics report. This report gives an analysis of the quiz, and the questions within it. See Fig. 3 as an example. Using the statistics report the instructor obtains general information about the quiz such as the average grade for the first or all attempts, the median grade, the standard deviation of grades, the skewness and kurtosis of the grade distribution, and so on. Moreover, the teacher is able to know when the student starts the quiz, how many times he opens a specific question, how is the mark distribution... In summary, a huge amount of information is available to verify whether the quiz is well proposed and whether it is effective to encourage self-directed studying.

Descargar informe completo como

Nombre del cuestionario	Evaluación continua tema 1
Nombre del curso	Física II (Grupo D) (2013/2014)
Cerrar cuestionario	domingo, 9 de febrero de 2014, 17:23
Número de primeros intentos	73
Número total de intentos	73
Promedio de los primeros intentos	53,44%
Promedio de todos los intentos	53,44%
Calificación media (de primeros intentos)	52,00%
Desviación estándar (para primeros intentos)	28,90%
Asimetría de la distribución de puntuaciones (para primeros intentos)	-0,0615
Curtosis de la distribución de puntuaciones (para primeros intentos)	-1,0661
Coeficiente de consistencia interna (para primeros intentos)	66,43%
Ratio de error (para primeros intentos)	57,94%
Error estándar (para primeros intentos)	16,74%

Fig. 3. Example of the quiz results statistics information.

3 Results

In order to encourage the students to participate in the Moodle quizzes, a certain part of the final grade of the course corresponds to the average mark obtained in the quizzes. We have noticed that this methodology provides a more effective evaluation of the effort made by students. In fact, now copying the solutions from other students is more difficult because of the randomness introduced in the questionnaires. Our feeling, after the implementation of five quizzes, is that this tool has been very useful to the student. Thanks to the automatic grading and the feedback provided by Moodle, the students know which part of the lessons they need to reinforce. Lesson by lesson they obtain a mark that let them know if they have achieved a good understanding of the most important concepts related to each topic. Moreover, as the quizzes are open during about 10 days, the students learn to administrate their time in order to finish everything on time.

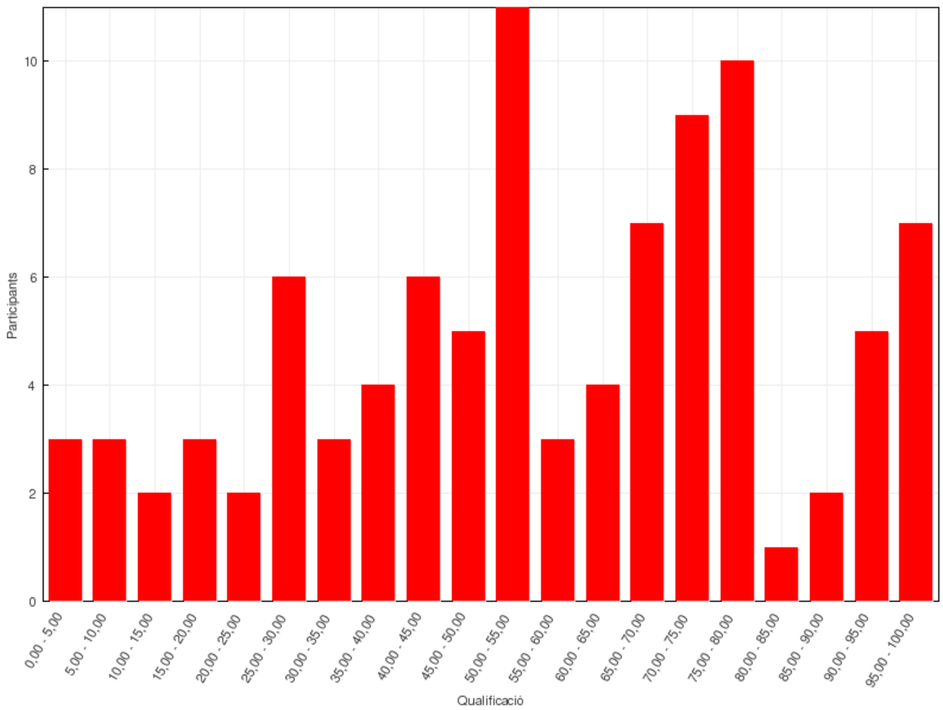


Fig. 4. Example of grade distribution.

4 Summary

Self-directed learning should be motivated in the higher education. One way to promote independent learning is by means of quizzes implemented in an open platform as Moodle. Our experience with this project has been very positive. The students find a novel tool for studying and for knowing their maturity in the course, lesson by lesson. The teachers find an easy way to save time grading and with the statistics offered by the program they can detect the main difficulties of the students' learning process, and the points to be reinforced in subsequent classes. In summary, we strongly recommend the use of these tools.

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Students perceptions of the methodological change in language teaching of a higher education institution in Spain

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Abstract

With the advent of the Bologna process, although not entirely due to it, a series of shifts have been significantly implemented in the teaching methodology of higher education programmes in Spain. This change of paradigm includes the integration of the so-called active methodologies. In the case of modern language teaching it involves the pedagogical use of ICTs (Information and Communication Technologies), and several tools and platforms to promote computer mediated communication (CMC). The aim of this paper is, firstly, to describe how this paradigm shift has taken place in the School of Design Engineering (ETSID) at the *Universitat Politècnica de València* during the last five years, and, secondly, to assess how this change in language teaching methodology has been perceived by the students, in a descriptive and qualitative way. The main reason for this research of specific student perceptions lies in the assumption that learning takes place in a more efficient way when the learners show a high degree of awareness of the learning and teaching process and have positive perceptions about that process and about the strategies, resources and tools associated with it.

1 Introduction

At present, the social and educational context makes it necessary to reconsider most of the traditional language teaching and learning approaches. This involves a paradigm shift in language teaching that has been carefully taken into consideration in the process of devising and adapting to the European higher education system the English subjects (Technical English and English B2 Level) offered by the Higher Technical School of Design Engineering (ETSID) at *Universitat Politècnica de València* (UPV), in Spain. Part of this process is discussed here. The paradigm shift that informs and guide the teaching of these subjects, which are fully adapted to thee new higher education degrees of the institution (within the common European framework), is based on three main foundations: (1) a communicative language learning approach; (2) the pedagogical implementation of Information and Communication Technologies (ICTs); and (3) the adaptation of teaching to the new social and educational environment brought about by the European Higher Education Area processes.

In this study, first, an overview of the fundamental features of this pedagogical paradigm shift is presented with a focus on language teaching. Second, the theoretical base underlying the implementation of this paradigm shift is discussed, through the analysis of a series of key pedagogical aspects regarding the application of ICTs to language teaching and learning. Next, the characteristics, resources and ICTs tools that enable the adaptation of the technical English subjects offered by the institution (ETSID) to the new degrees and the new paradigm are analysed. Finally, the study deals with the perception of such a paradigm shift from the point of view of the Engineering students at the institution.

2 Paradigm shift in the language teaching process

The first main foundation of this paradigm shift started to be built many decades ago, with the advent and establishment of the communicative approach in language learning [16]. In fact there is no approach or methodology within this field nowadays that does not regard itself as communicative. According to it, language teaching is fully effective only when the main role in the process is played by communication, i.e. the most important purpose of human language, rather than by the mere acquisition of formal knowledge about the linguistic code. The concrete implementation of communicative language teaching has varied very widely since its first enunciation in the 1970s, and it continues to evolve, thanks, among other reasons, to a series of technological advances.

On the other hand, we are currently witnessing the establishment of a second major foundation in the educational paradigm shift, through a technological revolution whose historical dimensions are comparable to those of the invention of the alphabet many centuries ago in Greece: the generalization of the ICTs, especially Internet and the World Wide Web. The creation of the alphabet allowed for rational conceptual discourse, which had a strong influence on the qualitative evolution of human communication. The alphabet provided the mental infrastructure for cumulative communicative, based on knowledge. But that new alphabetical order separated written communication from the audiovisual system of symbols and perceptions, which is of prime expression for the full expression of human mind [3] [4]. The current technological revolution is due to "the creation of a hypertext and a metalanguage which, for the first time in history, integrate within the same system, the written, oral and audiovisual modalities of human communication" [3]. The society resulting from this revolution is characterized by a growing tendency towards globalization, a consequence of ICTs and of constant information exchange, and by the creation of a space of social relationships and communication closely related to what we do in our daily life, thanks to the global network known as Internet [5]. In addition, ICTs enjoy significant success among students, since they are "useful, entertaining and fun" [6] and because they make our work easier, for, regardless of the type of work, it is always necessary to have some kind of information to carry it out, as well as data processing or communication between people [10], with the added value that "now everything is faster than before" [12]. The social Web, which represents one of the most important uses of ICTs at present and at all levels, is built around the central core of the application of two fundamental actions in human behaviour: communicating and sharing. And it is through these two activities that the Web today can efficiently serve communicative language teaching.

The third foundation of the paradigm shift is related to the new social and educational context resulting from the adaptation of higher education to the European Higher Education Area framework. This process of adaptation in teaching has a series of determining factors related both to common higher education directives from Europe, and to factors concerning the educational institution where teaching occurs, i.e. UPV and ETSID in our case. In the former group, generally speaking, the European convergence emerging from Bologna promotes certain approaches such as a more active type of learning on the students' part, lifelong learning, skill-based teaching, and autonomous learning, among others. In the second group of determining factors, specifically at UPV and ETSID there has been for a long time institutional support to student mobility, which is only possible through effective knowledge of foreign languages. Along this line, recent regulations have been approved at UPV according to which all students must show a B2 level of competence in any foreign language as a requirement for graduation. These determining factors exert a direct influence on the design process of the new university degrees, and, particularly in our case, of the English language subjects, since it is necessary to develop and deal with a series of skills and competences both at a general and specific level.

3 Pedagogical base of the English language subjects at ETSID

Every design and adaptation of subjects to a new educational context must take into account such context and establish a series of theoretical and pedagogical principles which give support, in a coherent way, to the practical implementation of the subjects within the institution. In this section these theoretical principles will be briefly discussed. In the case of the English for Specific Purposes subjects offered by ETSID, those are based on certain pedagogical principles underlying our approach, which can be summarized in the following:

1. Communicative approach in language teaching
2. Collaborative language learning

3. Learner's autonomy

Each one of these three principles, which must not be considered as isolated concepts, since they somehow overlap and share certain characteristics, can be implemented in practical instances of teaching through the use of ICTs, more specifically through the Web 2.0 and the online learning management system available at UPV, called *Poliforma-T*, which is an institutional customization of the *Sakai* environment.

First, the language learning methodology that is based on a communicative approach is based on a concept of language and its learning that considers as fundamental an essential trait in human communication: interaction for the construction of meaning. According to Richards and Rodgers [14], the major facets of the communicative approach are the following: (1) importance of contextualized meaning as opposed to decontextualized structures and linguistic forms; (2) reasonable use of the L1 (mother tongue) and translation as useful tools under certain circumstances, rather than their radical prohibition; (3) communicative competence vs. linguistic competence; (4) fluency rather than correction, and (5) structural exercises as complementary support, not as tha only way of learning. Communicative methodology in language learning is based, in turn, on collaborative work among language users resulting in an improvement in the acquisition of communicative skills, given the appropriate conditions. As mentioned above, here is where one can see the first coincidence between the different theoretical foundations of our approach.

Second, the aim here is to promote a collaborative type of language learning. But in order to bridge the gap between collaborative learning and communicative language learning, it is important to know the characteristics of collaborative methodology well. Collaborative learning is a process based on argumentation and shared knowledge whereby students learn while they propose and share ideas in order to solve a task, through dialogue and reflection on one's own ideas and those of the others [11]. The interaction between the members of a group offers each participant the possibility of learning more than when working on their own [2]. This working methodology builds on the idea that learning and knowledge are the result of a social process. That is why it proves to be an ideal method for language acquisition. The Web, in turn, enables pedagogical initiatives to develop collaborative projects resulting in good outcomes as far as language learning is concerned.

A widespread assumption nowadays is the idea that the use of ICTs in language learning promotes a collaborative type of learning, since the underlying philosophy in most Web-based resources has to do with sharing and co-operating, apart from communicating.

But, apart from these principles, if we wish to be in line with the methodologies suggested by the common European framework which are related to the importance of life-long learning, it is very convenient to incorporate within our pedagogical approach the third principle mentioned above, namely, learner's autonomy. Autonomous learners are able to organize, monitor and evaluate their own learning; this self-regulation allows them to deal with the barriers often imposed by pedagogy between learning and life. These features of autonomous learners in general are reflected, in the case of an autonomous language learner, in the capability of applying critical thinking not only to the learning process, but also to the target language.

It has been suggested that the new ICTs, especially those based on computer networks, may very positively assist the development of learner autonomy, as long as they are used adequately and accompanied by careful reflection [13] [15]. These researchers suggest that the mechanisms of Computer-Mediated Communication (CMC) themselves provide the learners with a significant possibility to take control and work on their own initiative in language learning.

Internet- and Web-based technologies facilitate exchanges between people, companies and institutions, thanks to different systems that manage the transfer of texts and files of all types, apart from enabling communication through voice and image in real time, regardless of the actual physical place where learning is taking place. Moreover, communication is a central component in any type of training process or modality. If there is not communication, there will be not transfer, exchange or interaction at all [2]. An advantage of using the Internet for language learning is the nature of the environment, ideal for immersion of the learner within the target language.

4 ICT tools for communication and language learning

Technological advance, on the one hand, and social uses of the Web, on the other, resulted in the advent of the Web 2.0, a concept coined by Tim O'Reily in 2003, which implied a significant revolution in the world of Internet and its functionalities. Some experts define the Web 2.0 as the Web of people, as opposed to the Web of data or Web 1.0 [2]. At first sight, one could believe that this is a new version or upgrade of the World Wide Web, but this idea is not true, since the Web 2.0 represents an unprecedented technological and social landmark.

The Web 2.0 allows for maximum interaction and interactivity between users, as well as the development of social networks, through which those users can express themselves and give their opinion, search for and retrieve information of their interest, collaborate and build up knowledge (social knowledge, and share content too. Sites on the Web 2.0 are dynamic, in contrast with the static ones of the Web 1.0. Additionally, websites themselves become working platforms, for they may integrate a wealth of tools for different purposes which are available online and do not need to be downloaded to the local computer's drive [11]. Such a structure opens up a wealth of educational possibilities regarding the creation of content in an environment full of potential and rich in terms of knowledge collaboration, construction and sharing options. The group of applications created around the Web 2.0 is referred to as *social software* (blogs, wikis, podcasts, etc.).

The characterization of the communication forms which are possible through the Internet and the Web may be carried out from from different perspectives, such as considering temporal coincidence, the quantity of individuals that take part in communicative exchanges, the code type and the resources used during communication. Thus, a distinction can be made between synchronous and synchronous systems, between those allowing for unidirectional, bidirectional or multidirectional communication, or between systems using written or oral (with or without images) language. The combination of these features results in a wide range of modalities. The group of communication forms and formats is commonly referred to as Computer mediated Communication (CMC). Examples of asynchronous communication through which many people can participate are electronic conferences, distribution lists, discussion forums, etc. [9]. In contrast with these, synchronous systems require the temporal coincidence between sender and receiver(s), for instance in chats, Internet-based telephone calls, video- or audio-conferencing, etc. [18] adds an exchange modality that he calls virtual conversation, to refer to a wide range of possibilities to enable interactions by means of avatars or 3D virtual personae.

At the ETSID within UPV there is availability of computer classrooms and laboratories fully equipped with Internet connection, and an online platform or Learning Management Environment called Poliforma-T is widely used in the teaching of all kinds of subject. This tool incorporates a lot of CMC resources and, therefore, facilitates the implementation of a collaborative and communicative approach to the teaching of the English language through the pedagogical use of ICTs.

5 A model for the use of ICTs in the technical English subjects at ETSID

At the ETSID, there is an offer of several elective subjects related to the teaching of specific technical English for each one of the new Engineering degrees resulting from the adaptation to the European framework within the School: Mechanical Engineering, Industrial Design and Product Development Engineering, Industrial Electronic Engineering and Automation, Electrical Engineering and Aerospace Engineering. These subjects are of two types: Technical English (B1 to B2 level) and English Level B2. The teaching of these subjects makes extensive use of the communicative tools mentioned above. We believe that the linguistic training of students nowadays should incorporate the efficient use of ICT tools and take full advantage of their possibilities, since these resources promote a type of teaching which is communicative, meaningful, pragmatic, authentic, collaborative, constructivist and motivating.

An example of such a kind of teaching can be shown through the use of the Virtual Learning Environment (VLE) implemented at UPV and called Poliforma-T. One of its many functionalities is the use of chat (Figure 1).

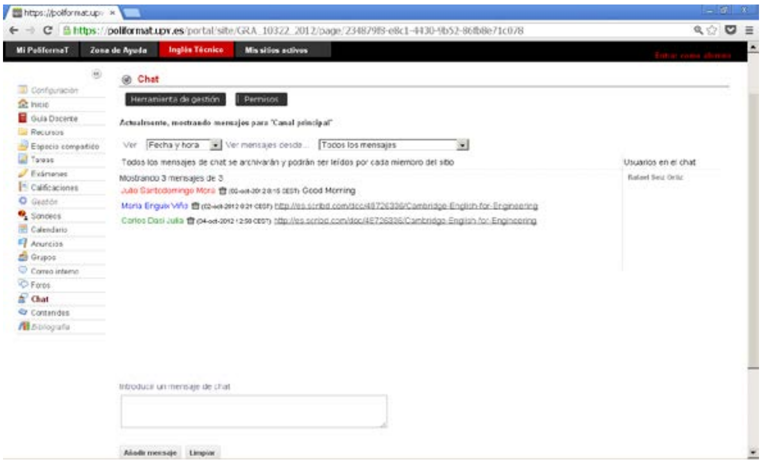

Fig. 1. VLE: Poliforma-T, use of chat

This online platform or VLE comprises a series of communication tools with three main purposes: (synchronous and asynchronous) communication between learners and teachers, document publishing, and dissemination of notices and key information on the subject. For such purposes, the platform incorporates a menú including the following tools and functionalities, widely used in the Technical English and English Level B2 (capital letters indicate the original name of the section in Spanish):

- RECURSOS (resources): working documents can be easily and dynamicaly made available to students, for instance, subject notes, schemes, presentations, graphics, vídeos or any other type of learning object (LO).
- ESPACIO COMPARTIDO (shared space): in this section, which is really a personal folder for learners, students may upload their work in an individualized way, as well as those documents they want to share with the teacher, allowing the latter to know the exact date and time of the upload. Each individual student can with total freedom edit the contents of his or her personal folder.
- TAREAS (tasks): this tool enables a high degree of student-teacher interaction, since the teacher can propose tasks and assignments that are open and available for a selected period of time (at the teacher's choice), so that the students complete the assignments during this time and upload the results of their work. The date and exact time of completion gets automatically registered, and, moreover, the teacher can correct, mark and assess the completed tasks through the platform itself. The student may then access the documents modified by the teacher, where modifications are clearly noticeable. In this way, language awareness is promoted, since students may be conscious of weak and strong points of their performance.
- CALIFICACIONES (marks) / CALENDARIO (calendar) / ANUNCIOS (announcements): these three different and separate sections share the common feature of the possibility of disseminating important information on the subject in a centralized, concise and therefore efficient manner. Students are then able to access key information about the subject on demand, and in so doing, students may take an active responsibility on their own learning process.
- WIKI: collaborative space which is used, for instance, as a co-operative class diary. After each session each student may summarize the key aspects discussed during the class, as well as the work done and note down assignments for the next sessions.
- CORREO INTERNO (internal e-mail): it allows to send internal e-mail messages to individual students or groups (asynchronous student-teacher communication).

- FORO (forum): discussion work can be implemented through this tool, which allows users to engage in written debates about different topics in an interactive and dynamic way (asynchronous student-teacher communication).
- CHAT: written conversations in real time are enabled through this section (synchronous student-teacher or student-student communication).

Therefore, this interactive platform makes it possible and easy to carry out a wide range of functions that promote different ways of communication between the main agents of the teaching and learning process. The type of communication facilitated by the tool is not only formal, or institutional, but it can also be more open and interactive, between teachers and students and among students themselves too. As we have noticed for over five years now, these communicative tools in a very efficient way promote tutor-student interaction throughout the whole teaching and learning process, which is especially relevant and significant in the case of language subjects.

6 The students perception of the paradigm shift

The paradigm shift that has been discussed so far is implemented at ETSID as a way of improving teaching and learning processes in language courses, among other subjects. The level of institutional and teacher support to carry out these new and more active methodologies, as opposed to former traditional-approach subjects, where communication and learner autonomy were not priorities, is very high indeed. Nevertheless, the present study also focuses on students perception regarding the methodological paradigm shift towards active and communicative methodologies. If such a paradigm is to be pedagogically effective, it is essential that it is perceived by students as positive.

In order to assess perceptions by students, then, this study has used two basic tools, apart from informal communication by the students themselves. The first one is a very brief questionnaire administered to 150 Engineering students of the new degrees. The aim of this questionnaire is to ascertain in a qualitative way whether the students are aware of the tools available and use them, as well as their personal opinions and feelings about the new methodologies. The second analytical tool consists of results from the survey that the university administers institutionally to get to know the degree of students' satisfaction on different aspects of a given teacher and subject. Some items of that survey are related to methodology. In this case, comparisons could be made between satisfaction in former courses and the new degrees resulting from the Bologna process.

Regarding the first tool, the qualitative questionnaire included the following questions:

1. What *Poliforma-T* tools and sections do you use? Please order them all from most-used to least-used.
2. Which one did you like the most? Which one did you like the least? Give reasons for your answers.
3. Would you add any functionality to the existing *Poliforma-T* configuration? Explain.
4. In general, do you believe that the use of the communicative tools in *Poliforma-T* have contributed to improve your English? Which tool was the most useful one in this respect?
5. Rate from 0 (minimum) to 5 (maximum) your degree of satisfaction regarding the *Poliforma-T* tools from the point of view of your own learning experience?

Overall results from this questionnaire show, on the one hand, that the preferred communicative tools according to students are the wiki, the chat and the forum functionalities, suggesting a general preference towards collaborative work and communication between students and also with the tutor, both at the asynchronous and the synchronous level. The tasks section came next on the list, since a significant amount of university students would allegedly go for more formal types of formal communication exchanges between learners and teachers. As regards question 4, a high percentage of students (83%) believed that there is a direct causal connection between the use of online communicative tools and gains in their effective learning of the English language. With respect to question 5, also a high amount of students (90%) marked the answer with a "5" in the scale, i.e. maximum learning satisfaction. Only 3% of the participants marked a “1”, showing the lowest degree of satisfaction, since no student marked the lowest option (“0”).

This study also analyzed and compared results from the institutional surveys that have been administered for over a decade by the UPV to all the students of all the subjects to assess the degree of student satisfaction on the teaching process. Since the questions have varied over the years, such a comparison can only be carried out through the analysis of the general mark obtained in these surveys by the teacher (which can range from 0, minimum grade, to 10, maximum mark). Thus, the analysis applied to 138 surveys administered to students doing the new Bologna-based degrees (during the academic year 2012-13) and to 146 surveys from former ETSID’s degrees which did not make use of the new ICTs and active methodologies (academic year 2003-04). The mean marks in both cases (former and new Engineering degrees) were used as the base of the comparison. These overall results show that in the year 2003-04 (former degrees with the old traditional methodology) the average mark or mean was 6.4, whereas the mean for the new degrees (year 2012-13) was 8.3, i.e. significantly higher, suggesting an increase in the overall satisfaction of students when new ICTs tools and active methodologies are implemented. These results advertently ignore specific questions of the survey, since they mostly refer to teacher performance. This is true except in the case of the survey in year 2012-13, where questions 5 (“*Does the methodology used and the tasks proposed in the subject help students to learn?*) and 6 (“*Are materials and didactic resources useful from the point of view of the learning of the subject?*”). Specific results from these two questions (focused on methodology and resources) show that 79% of students gave the maximum mark to question 5 (methodology), whereas 87% of students also gave the maximum mark to question 6 (materials and resources). These results generally speaking suggest again a high degree of positive feedback from students regarding the use of ICTs and active methodologies in the English language subjects taught at ETSID.

7 Conclusions

The results from the questionnaires and the student satisfaction surveys in this study are very general, descriptive and qualitative in nature. As a result, no statistical evidence can certainly be drawn from it. Further experimental research is suggested, therefore, to shed light on the general feeling that the use of ICTs and active methodologies in the teaching of technical English subjects at ETSID are perceived positively and with a high degree of satisfaction by students of the institution. Aware of the limitations of this study, no claims are made on the superiority of the pedagogical changes brought about by the paradigm shift depicted here and implemented in the lecture rooms of the university. Nevertheless, informal feedback from students and teachers alike point at the positive learning consequences of the paradigm shift from a pedagogical point of view, and also in the students’ opinion in general.

The continuous use of ICTs and CMC tools that has been described here as part of the language subjects taught within the new Engineering degrees at ETSID, has proved to have many advantages. One of them is flexibility in terms of learning paces, learning styles and the timing of the learning and teaching process. Those new methodologies and tools also promote the implementation of several didactic approaches, especially the communicative approach together with a collaborative teaching methodology. They make it easier for students to access course materials, a wide range of resources and tasks, which are readily available. A further advantage is that they allow students and teachers to use materials more efficiently, partly because they may be easily upgraded. Moreover, there is the added value of a feasible supervision of the students’ performance, the possibility of keeping an updated record of activities and student participation and involvement in several collaborative endeavours (chats, forums, wikis, etc.). To sum up, the use of ICTs in language learning subjects bring about a series of benefits when implementing a communicative approach, as long as pedagogical principles and criteria are predominant and the ICTs are driven by their didactic potential, rather than used merely because they are new or trendy. It seems that the perception of students regarding these new tools and methodologies is highly positive, although future qualitative and quantitative research is required to support such an assumption.

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An innovative approach for education in aircraft design engineering

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Abstract

The great importance of the combination of theoretical contents and experimental tests is well known in engineering. This work presents an educational methodology developed and implemented for teaching Aerospace Engineering students aircraft design, taking into account the requirements in performance, applications, green design, sustainability and viable economy. The methodology consists of two parts; the first step focuses on the knowledge of the students of aircraft design, establishing smaller design groups destined to collaborate and compete between them. Each student of the group focuses in one field, i.e. structural load, and has to collaborate closely with the rest of the group. This is the simplest way to calculate the aircraft. The second part is encouraging each group to perform experimental tests by themselves using the wind tunnel. The evaluation of the students' performance shows that the approach is proper for them, it helps to understand the complexity of the aircraft design process. In fact, several designs resulted in ideas that have been transferred as contributions to conferences, contests or actual applications where the students have been able to build prototypes of small unmanned aerial vehicles rather than staying at the conceptual design stage.

1 Introduction

The Engineering education in Europe has had a great modification to transmit the theory in various topics to the students [1]. The Aeronautical Engineering education is not an exception, because it is affected by the Bologna plan [2]. This plan has an educational frame which consists in establishing a new base about how to communicate the information theory to the students where priority is given to approach the theory through the practice. Another important aspect to be considered is the competitiveness fund in the worldwide aerospace industry. Therefore, taking both situations into account it is convenient to develop a new educational sense where motivation is very important.

UNESCO, through the International Commission on Education for the XXI century, points out that the main theme of any educational project should be “teach to know how to carry out” the job. The important subject of this sentence is educating using the theory knowledge to be applied in a practical form. Students should learn how to apply the knowledge, but it is not feasible to apply it in everything. Therefore, education must take a compromise between where, when and how to teach the theory and its application in order to obtain a faster maturation of the knowledge. Thus, introducing these arguments it is possible for the students to reach the motivation necessary to learn the more important concepts in every lecture.

One of the most dynamic and competitive of the technical fields is the aeronautical and aerospace industry [3], and aerospace devices and systems are required to be highly optimized [3]. In addition, the problem of educating aerospace engineers is worldwide, given the strong competition in different countries [1] in this industry. Furthermore, the Bologna declaration and the European Higher Education Area make it necessary to improve the teaching-learning process. Assessment becomes more dynamic and short-term based. Therefore the students have to mature the knowledge in a faster way. New initiatives, projects and methodologies are needed in order to provide the future engineers with a comprehensive view of the practical aspects of engineering [1], training not just scientists and designers, but professionals that could deal with multidisciplinary problems, including design, manufacturing, finances and business plans, among others. At this point, teaching activities and facilities that bring the students closer to real life situations in aerospace systems are essential in order to progress in the teaching-learning procedure and contribute to stimulate the student to acquire knowledge.

The methodology here described is designed to involve the theory with its application, focused on determining the most important parameters to take into account to design an airplane by using the equations and theory seen in class. The students are divided in work groups. Each group has the obligation to design a proper airplane configuration. All of these designs have the same requirement. To maintain the motivation there is a competition measured in time employed to the calculation process. At the end of this action, a model of each airplane designed is built in order to take measurements in the wind tunnel or to be evaluated in flight. Furthermore, each group simulates to be an enterprise, so that students have the responsibility to determine direct and indirect costs invested in the design.

The results of this experience show the close relation between the students and their responsibilities in the future. Furthermore, there is a direct application of the knowledge as engineers. The motivation is kept high and constant throughout all the work.

2 Methodology

The work outlined in the present paper has been performed in the frame of the *Aircraft Design* course corresponding to the 4th year of the *Aerospace Engineering Bachelor Degree* in the *Universitat Politècnica de València*. At this point, the students already have the basic foundations in Mathematics, Physics, Structures, Solid Mechanics, Fluid Mechanics, Aerodynamics, Control Systems and Aerospace Technology. The *Aircraft Design* course has been structured as a project-based course, in which the students are required to apply their knowledge of those different topics in order to perform the conceptual and preliminary design of an aircraft that fulfills the requirements in all different areas, also taking into account general requirements such as performance, applications, green design, sustainability and economy.

The methodology applied in the course consists of two parts. Firstly, the students are required to learn the basics of aircraft design and perform the theoretical conceptual design of an aircraft that meets certain specifications given to them at the beginning of the course. It is important to note here that, in the early stages of aircraft design, several important parameters are estimated either from aircraft with similar design specifications, or from classical empirical correlations that only apply for designs with a conventional architecture. This is a handicap for innovative designs, for which the aforementioned estimations are not valid. Since the students are encouraged to come up with innovative design ideas, other tools must be provided to them in order to estimate the values of the parameters needed for their design, especially with regard to aerodynamics. Thus, the second step of the educational methodology applied for the course is to let the students perform experimental tests in singular facilities such as the wind tunnel. The students are required to build a scale model of their design and introduce it in the tunnel in order to validate their initial estimations. As it was mentioned in the Introduction, the objective of this task is to apply the knowledge in a practical way, getting one step closer to the reality of an engineer's daily work in the industry. As it will be discussed later, it has been found that this approach strongly motivates the students to bet for innovative approaches, since they are given the possibility to test their design rather than remaining at a theoretical level.

The following subsections show how this two-step approach is translated to the course structure and evaluation. A deeper insight on the project work demanded from the students is given, with a discussion of the outcomes expected from the authors based on the proposed evaluation.

2.1 Course structure

Once the *Aerospace Engineering Bachelor Degree* was adapted to the European Higher Education Area (EHEA) after the Bologna Process, the *Aircraft Design* course consists of 6 ECTS, divided into 3 ECTS for theory lectures and 3 ECTS for practice and lab sessions. In accordance to the ECTS Users' Guide [4], this is translated into a workload of about 150 to 180 hours for the student. According to the ECTS division, the presential learning has been implemented in two different ways, each of them being given half of the time:

- Traditional formal lectures: in these lectures, the students receive the basics of aircraft design theory. Notions of aircraft architecture, systems integration, preliminary sizing, aerodynamics calculations, range, weight balance and stability are given, with special emphasis on the calculation procedures compiled in the bibliography (which may differ from one another). The aim of these lectures is to give the necessary tools to face the aircraft design project along the course.

- Practical classroom sessions and labs: during the first practical session, the students are divided into the working groups for the design project. In these sessions, they are able to work together for the project, applying the calculation methodologies that have been introduced in the formal lectures. Students are encouraged to propose their doubts and questions to the professors, which will discuss them with the whole classroom. Later on, these sessions can be used to prepare the experimental work, which is performed when the labs or the wind tunnel are available. When a certain design milestone is achieved, the groups can produce a short report as a deliverable that is given to the professors in order to get their feedback.

Figure 1 shows an example of scale model built by students and introduced in the wind tunnel in order to validate some of their theoretical calculations. Specifically, the friction coefficient and the interference drag, which contribute to the total drag of the aircraft, were evaluated. With this kind of activity, the motivation of the students is enhanced by giving them the opportunity to use singular experimental facilities and incorporate research results to their work, in a similar way of how research transfers knowledge to the industry in real life.

Fig.1. Picture of the scale model built by the students and introduced in the wind tunnel. The mechanism to modify the angle of attack is depicted

2.2 Course objectives and evaluation

In this course, the students are expected to apply the knowledge they acquired in previous years in order to meet the design requirements for an aircraft to accomplish a certain mission. The evaluation is broken down as follows:

- Design project (50%)

The students are divided into groups of 3 or 4 people in order to perform the conceptual and preliminary design of an aircraft. Every year, all the students are given the specifications at the beginning of the course in a document called Request for Proposal (RFP). Table 1 depicts the specifications for the project of the last three years. These specifications result in conflicting objectives when it comes to aerodynamics, structures, stability and control, etc. Thus, a compromise must be taken between them. Since each of the students of the group is in charge of one or more of these areas (simulating the real work in a design office), teamwork and communication become essential in order to achieve this compromise. It is important to remark here that, in addition, aircraft design is an iterative procedure, which means that the aforementioned transversal skills are developed in a strong basis since each of the group members will need to update the calculations of his area of responsibility on a regular basis when incorporating the results from another area.

During the first stages of the conceptual design of an aircraft, the estimation of some parameters comes from available data from aircraft with similar missions or specifications. This fact forces the student to meet the objective of getting to know the aircraft market situation and promote the aeronautical culture.

In order to evaluate the project, two reports are asked for the students as deliverables: one of them at the middle of the semester and another one at the end, when the design is finished. Each of these reports is worth 25% of the global qualification of the course. It is important to note here that innovation is strongly taken into account during the evaluation, being one of the items that needs to be qualified by the professor (together with the report presentation and the calculations).

Table 1. Request for Proposal (RFP) of the project.

Year	**Passengers**	**Range**	**Max. speed (Mach number)**
2010-11	8-12	7000 km	0.9
2011-12	150	4500 km	0.9
2012-13	6-10	Not specified	0.6

- Project oral presentation (25%)

Once the design project is finished and the final report has been submitted, each group has to defend their work against a tribunal (constituted by the professors of the course and other professors of different related disciplines) in a public oral presentation. In this presentation, the students are asked to try to sell their design. For this, they need to perform a market study and find their piece of market share, highlighting their strengths in order to attract potential buyers. The objective of this task is to develop other transversal skills that the degree is supposed to consolidate, such as public speaking, paralinguistic abilities, etc. rather than focusing on the technical issues. At the end of each presentation, there is a time for questions from the professors and also the audience, where the ability of the students to justify their projects' technical weaknesses is tested.

- Exam (25%)

An exam is programmed at the end of the semester in order to evaluate the individual learning of each student. The exam includes theoretical questions (either multiple choice or questions to develop) about possible architectures, systems or regulations, as well as short problems related to some calculation procedure involved in the design project. The objective of this task is to ensure that, even when a student has focused on a particular area for his project work, he or she assimilated the concepts involved in the other ones.

As it can be seen, one of the key features that are implemented in the course, following the Bologna plan, is the methodology known as continuous evaluation [5][6]. This methodology has already proved its high efficiency in several knowledge areas [7][8]. The concept of continuous is referred to assessing not only at the end of the formative process, as it was tradition not many years ago, but along the course, with a certain periodicity, through several activities that enhance the acquisition of the contents of the course.

It is also important to note that some activities are assessed but not computed in the global qualification of the student. This is the case of the short reports that the students may deliver to the professors during the practical sessions in order to obtain feedback. This was planned so that, in order for the formative function of the continuous evaluation to work, the students must feel free to raise their questions without hiding their weaknesses, which is more difficult to accomplish if the results of the activities are used to compute their final qualifications [5].

With all, the evaluation has been designed to promote the motivation of the students and their implication in the learning process, while keeping the coherence among the evaluation activities and the methodology followed to teach the course so as to ensure a profitable experience for the student [9][10].

3 Results

3.1 Innovative projects

Three projects, listed below, have been selected as examples of innovation in engineering. The motivation of each idea, also stated in the list, is the one given by the students:

- Joined wing (Figure 2): this configuration grants larger number of degrees of freedom in the design than the conventional wing configuration. According to the literature [11], its main advantages are: low induced and transonic drag, stiffness, lighter structure and good maneuverability. As drawbacks, uncertainty in its stability and possible aerodynamic interactions between lifting surfaces.
- Open Rotor Conceptual Aircraft (Figure 3): according to the literature and research projects led by ESA [12] and NASA [13][14], the open rotor architecture plays a major role in the future development of aircraft to accomplish fuel consumption reduction objectives. The main problem of this type of propulsion is the noise level generated. One of the possible solutions to this problem (in addition to active vibration reduction systems) is the noise box: the noise footprint generated by the propeller is contained by the tail in such a way that is reflected only upwards.
- Electric propulsion system (Figure 4): one of the advantages of this propulsion system is its high global efficiency, about 75%, whilst conventional systems have a maximum efficiency of 40%. Benefits in medium/long term are also extraordinary: savings in maintenance cost, no fuel consumption/cost and, therefore, zero emissions.

Fig. 2. Joined wing design.

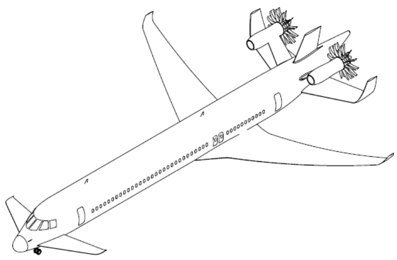

Fig. 3. Open Rotor design.

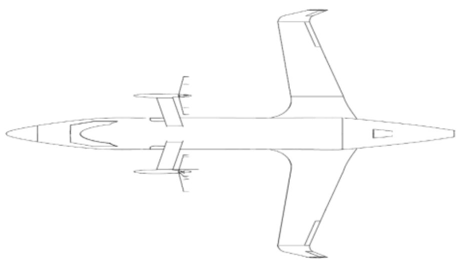

Fig. 4. Electric design.

The first project in the list approaches the problem from the aerodynamic point of view, reduction in drag means reduction in thrust and then in fuel consumption. The second and third project approaches are related to the propulsion/power group, they use a more efficient propulsion group and try to overcome their flaws. For both approaches, and as the students point out in their reports, a bibliographic research is needed, first to identify the most suitable innovative solution and second to investigate about that solution. This research task is fundamental in an engineer daily life.

Students have presented some other resourceful aircraft designs for the past 5 years such as canard configurations, three lifting surfaces aircraft, lifting fuselages, screens to replace windows (idea and development which in 2009 reached the final phase of the contest “Fly Your Ideas” organized by Airbus), etc. It is interesting to see how this type of course projects move the student to the state of art in aircraft design, making them able and willing to research about possible solutions to the actual problems of aviation, mainly fuel consumption (emissions), noise, and economic viability.

In order to motivate the students to do this extra work, innovation is one of the seven topics to be evaluated in the public oral defense of the course project. Not only the idea is important, but also how they develop that idea, how much they learn about it and, over all, their critic analysis (a transversal skill of the Degree in Aerospace Engineering). At the end, students commonly employ ideas from large research and technology projects, such DREAM [12] or Clean Sky [15], led by the two most famous space agencies, ESA and NASA. This is an additional benefit of this type of assignment: students get to know what main players in the industry are doing and how to access to their information.

3.2 Knowledge transfer

A direct result of the project, and also the high motivation achieved with it, is the knowledge transfer. Students can directly apply the knowledge acquired during the realization of the work to real world projects. Also to other courses of the degree, for example, the group that decided to build an electric aircraft is now able to design a safe and efficient electric installation.

A very good example of knowledge transfer to real projects is the following. Some students that worked in the design of the open rotor conceptual aircraft are currently building a quad-rotor flying wing, shown in Figure 5. First model of it was presented in the 10th edition of the Pegasus-AIAA International Student Conference, held in Prague (Czec Republic) on April 23-25, 2014.

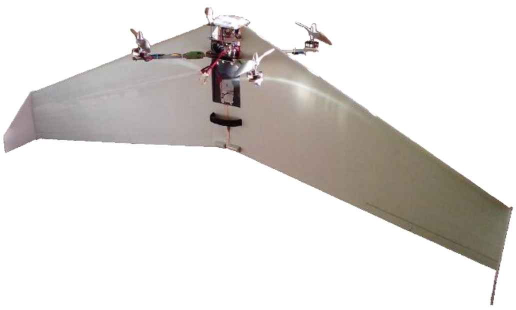

Fig.5. Picture of the quad-rotor built by the students and continuation of the open rotor aircraft design.

As seen in Figure 5, the quad-rotor is a convertible aircraft designed for vertical take-off and landing and a horizontal cruise flight. Structural loads, flight dynamics and longitudinal and lateral stability were studied based on the knowledge acquired in the *Aircraft Design* course, and checked experimentally during the flight tests.

Not only was the theoretical knowledge applied on this project, also the experimental one. The propeller of the propulsion system was introduced inside the wind tunnel to acquire its behavior. An example of the results obtained by the students is shown in Figure 6. This plot was used to control the power requirements of the propulsion system in every flight phase.

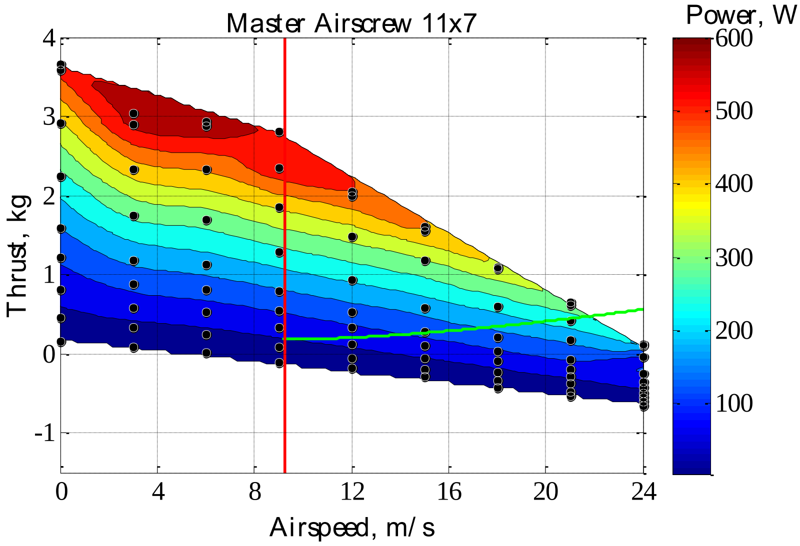

Fig.6. Measured thrust data of the propulsion system of the convertible quad-rotor.

This is just one example of knowledge transfer, but some others were obtained. For example, some students continued the work started in this course and made their final degree thesis from it. Some other built their own models and flew them in model aero-plane fields. Even the professors took advantage of the course and they are currently building a small-scale flying wing for teaching purposes.

3.3 Personal opinion of the students

It has been proved that the organization of the course described in Section 2 motivates the students, at least some of them, and promotes the aeronautical culture. But it is important to know their personal opinion about if that is true or not. The *Universitat Politècnica de València* accounts for some control mechanisms to evaluate the quality of the teaching activity, the most important among them is the "Teaching Evaluation Inquiry Form", where students punctuate some aspects of the course and professors from 1 to 5, where 1 is the worst value and 5 is the best.

Table 2 shows the averaged answer of all students to some topics treated by the inquiry form. The overall opinion of the students about the course is evaluated with a 3.5 over 5, proving that they are happy with the course, though some aspects could be improved, for example, the precision and clarity of the professor answer to the doubts arisen by the students. As observed in the table, all topics are more or less evaluated with the same value, meaning that the course in general is well planned and carried out.

Table 2. Averaged punctuation given by the students to some aspects of the course.

Organization and planning	4.0
Methodology	4.3
Motivation	4.5
Satisfaction	4.7

Although there is not tangential prove because it was not on the evaluation plan of the course, transversal skills are trained too. By means of interviews with graduated students after 1 or 2 years of obtaining their diploma, they remarked that, not only the course project helped them to learn how to work in a group, also improved their critic spirit and oral skills. Professors also noted that they were well aware of the economic and environmental aspects of engineering projects

4 Summary

The *Aircraft Design* course corresponding to the 4th year of the *Aerospace Engineering Bachelor Degree* in the *Universitat Politècnica de València* has been deeply analyzed. Their objectives, mainly to introduce the undergraduate student to real engineering projects and promote the aeronautical culture, are accomplished.

Innovation and critic spirit are emphasized during the course not only in the practical classroom and lessons but also in the conventional lectures. The benefits of that are obvious, not only in the final evaluation of the course, but also in terms of knowledge transfer, motivation and screening the future.

In general, undergraduate students are happy with the course and recognize the direct applicability of the knowledge they acquire. This fact has been reflected in the surveys anonymously filled by the students at the end of the course.

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Cooperation with Industry and Work Placements at the University of Ruse

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Abstract

According to the Education and Training 2020 (ET 2020) framework, education strategy is very much linked with the knowledge triangle; education, research and innovation. The Bologna Process was created to ensure comparable standards and quality of higher education qualifications. Each Member-State has its own education system which allows people to move and learn different languages and cultures and become 'EU experts' and that such knowledge will ensure human resource development and will empower citizens. Higher education has a crucial role to create and disseminate knowledge and ensure innovation and social research. The paper aims to presents the good practice of the University of Ruse, Bulgaria concerning the partnership with the industry enterprises. Based upon this experience the University is able to offer an international internship for incoming Erasmus students. Obstacles to mobility should be overcome with mobility being seen also as an opportunity for cultural enrichment.

1 Introduction

The Erasmus+ programme replaces several programmes and responds to a need for increased resources. In terms of supporting individual mobility, goals include having 1,800 movements of academic staff by 2030 and encouraging joint master degrees for 2,650,000 students (scope for EU-Japan movements) and 500,000 examples of youth mobility.

The author team considers also that according to the Education and Training 2020 (ET 2020) framework, education strategy is very much linked with the knowledge triangle; education, research and innovation. The Bologna Process was created to ensure comparable standards and quality of higher education qualifications.

Each Member-State has its own education system which allows people to move and learn different languages and cultures and become 'EU experts' and that such knowledge will ensure human resource development and will empower citizens.

Higher education has a crucial role to create and disseminate knowledge and ensure innovation and social research.

The objective of the paper is to present examples of good practice of the University of Ruse, Bulgaria concerning the partnership with the industry enterprises.

Based upon this experience the University is able to offer an international internship for incoming Erasmus students. Obstacles to mobility should be overcome with mobility being seen also as an opportunity for cultural enrichment.

2 Examples of Good Practice at the University of Ruse, Bulgaria

The following examples for partnership development with business enterprises aiming at high quality of education can be indicated as especially successful good practice at the University of Ruse, [1, 2]:

1. Research, expectations and dialogue between industry and university

Consulting councils and boards of trustees with the participation of business organizations at the Transport faculty and the Faculty of business and management have been created. Periodic analysis of the employers' opinions is carried out, *Fig. 1* and *Fig. 2.*

Fig. 1. Board of Trustees Meetings

Fig. 2. Discussion with employers

2. Examination of study curricula and syllabi aiming at adaptability for employment of future graduates

Business representatives from the relevant professional areas take part in creating the syllabi of industrial and other forms of internships and in commissions for defending of Degree Theses. Those representatives also review the subjects' syllabi.

The topics of Bachelor and Master degree Theses and PhD dissertations are defined in accordance with the needs of industry organizations. Some practical tutorials are delivered in business environment in order to use contemporary equipment, for example Training in "Steiner Electronic Ltd", etc., *Fig. 3.*

Fig. 3. Practical tutorials delivered in business environment

3. Mobility from University to business organizations and vice versa

Internship programs for students from the University of Ruse are implemented in Bulgarian enterprises since 2008. The University management is responsible for the scientific and financial support for publications of students, elaborated in business and industry environment, *Fig. 4.*

Fig. 4. Presentation of students' paper during international event

4. Expanding the range of the projects with business organizations

Networks of the University of Ruse graduates (alumni netwoks) have been created. Thematic scientific schools with the participation of students, researchers and business representatives are organized annually. A "stock market" for scientific ideas of students is also inspired and carried out, *Fig. 5.*

Fig. 5. Thematic scientific schools

Expositions and Fairs at the University campus are organized annually since 1999, *Fig. 6*. The academic equipment and infrastructureis improved in several ways: by sponsorship, which supplies financial means or laboratory equipment, by placing market exhibition units at the University laboratories, etc.

5. Extending the opportunities of the University based upon Life Long Learning

This activity is characterized through the following measures: ensuring of continuous education of the University graduates; transforming the Directorate of Continuing education in main centre for qualification and re-qualification in the relevant country regions; implementation of goal education based upon requests of business organizations aiming to improve the competences of employees; relevant contacts between University and business organizations in order to establish the demands for new skills at regional level; organization of topical, current and of the present day distance education courses for employees of SME; improving the collaboration between the University and the National Employment Agency in order to ensure high quality education for unemployed people; introducing ECTS for continuing education; organization of conferences between the University and the Regional Employment Agency.

6. International mobility aiming at adaptability for employment of future graduates

This activity is characterized mainly by extending the international mobility of students from the University of Ruse to other European partner universities.

There are several structural units at the University of Ruse which are responsible for strengthening the partnership with business organizations: Faculties and Branches; Career Development Centre; Continuing Education Directorate; Scientific Research Sector.

Their intensive management and organizational work contribute to a great extent to strengthen the contacts between the University of Ruse and the industry enterprises.

3 Extracurricular internship for incoming Erasmus students at the University of Ruse

Based upon the experience with successful partnership with industry enterprises the academic staff at the University of Ruse is prepared to offer internship and work placements opportunities for international incoming students in the framework of Erasmus plus program.

The period of the work placement could be envisaged during the summer holidays. Therefore, the EU students can carry out their internship at the University of Ruse in summer and after that they can continue their study process at the Home University.

The following extracurricular internship program can be offered to the incoming students at University of Ruse:

1. Research and Laboratory work

The laboratory equipment at the Engineering faculties at the University of Ruse is at a very high level. The international students can carry out experiments at the laboratory class rooms at the Transport, Mechanical engineering, Electrical and Agricultural Engineering.

The academic staff will supervise them. The experience achieved by this research and laboratory work is to be summarized in a scientific report written by the student.

2. Improving practical skills in working with software products

The computer laboratories at the Engineering faculties at the University of Ruse are very well equipped. The academic staff at the University of Ruse has experience in working with AutoCAD, Solidworks, Matlab, Abaqus, etc.

This experience can be shared with the incoming students. Therefore, their practical skills can be improved according to the interests of the students. This opportunity will increase the employability of the future graduates in the area of the Engineering specialties.

3. Writing of academic and scientific reports

The academic staff at the University of Ruse has been working in a great number of national and international scientific projects. This experience can be shred with the incoming students in non-formal and informal way. After this kind of teaching and learning activities, the incoming student will improve their skills in writing scientific reports and papers.

4. Literature survey at the Library

The library at the University of Ruse is one of the largest scientific libraries in Bulgaria. It possesses 423 647 library units: 338 062 books, 45 052 periodicals issues, etc. The online access is ensured by 5 information systems giving information to a full text data base with over 15 000 titles in scientific and periodical editions and issues.

The incoming students can take advantage of this facility and make a fundamental literature survey in a subject area according to the individual interests of the student.

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Campus of Alcoy First European Double Degree in Mechanical Engineering

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Keywords: EPSA, Double, Ostfalia, UPV, Mechanical, Engineering

Abstract

After 3 years of work, the Campus of Alcoy of the Universitat Politècncia de Valencia signed in 2012 his first double degree. The partner institution is Ostfalia University of Applied Sciences (Wolfenbüttel, Germany), which has a good reputation in the whole country. Students from both universities can then get the official diploma for the mechanical engineering degree in each university if they spend two consecutive academic semesters in the partner institution. This has many benefits for the students and professors, which will be discussed in this paper, as well as the main process followed to arrive to the final agreement.

1 Introduction

Double degrees are becoming more popular in Europe since the last 10 years. It's a good way for higher education internationalization. While many institutions find them challenging to organize, these collaborative degree programs continue to gain traction around the world, in part because they offer an opportunity to build strong academic and institutional partnerships.

The purpose of the present paper is to show how the double degree in mechanical engineering started and some other statistics. The Bologna Process, which has been running for almost thirteen years, is designed not only to standardize programme structures and implement common quality standards for teaching and studying in the 46 member states but also to promote Europe worldwide as an attractive place to study. To achieve this, the participating higher education systems need to transcend national boundaries and converge. A good indicator of success in meeting this challenge is the ability of universities to plan and implement double degrees. Cultural barriers are always a challenge to succeed for this kind of agreements.

2 The partner universities

2.1 Campus of Alcoy

The Campus of Alcoy of the Universitat Politècnica de València (EPSA) is located in Alcoy, Spain. Alcoy (Alcoi) is a small city of roughly 60,000 people in the Valencian state of Spain. It is nicely situated in an inland valley approximately 50 km away from the Costa Blanca. Alcoy is best known for the annual Festivity of Moors and Christians, held in April, where Alcoy celebrates its founding. Alcoy is also known as the City of Bridges, because of the multiple bridges that span the local gorges.

Alcoy has been part of the Universitat Politècnica de València since 1971, and originally started as an Engineering College in 1853. The Campus of Alcoy is one of the three campuses of the Universitat Politècnica de València.
The climate in Alcoy is typical of southern Spain: dry, sunny, and hot. Alcoy is surrounded by natural parks with excellent hiking opportunities.

Alcoy is near the Mediterranean Sea, so daily excursions to the beaches of Benidorm, Gandia or Alicante are possible. The local cuisine will reflect proximity to the sea, as well as southern Spanish delicacies such as paella (a rice dish flavored with saffron) and jamón (a very special form of cured ham). Alicante province is not as famous as Rioja for wines, and certainly not as prolific in the number of wineries, but Alicante wines are very good, and wine will often be served in restaurants. Tapas are common, often jamón based.

Alcoy enjoys an ideal climate, protected from rain by surrounding mountains and ideally located in the south of Spain. It's a city surrounded by gorges which are passable only with great difficulty on foot, and certainly not by car, truck, or wagon. Thus, until the construction of Maria Christina's Bridge from 1828-1837, Alcoy was restricted to a small area between the Riu Riquer and the Riu Molinar. Thus "Old Alcoy" is the part of the city that predominantly dates to the time before 1837 or so. People still talk about going to "Alcoy" or "Old Alcoy" even though they live within the city limits.

Spanish is widely spoken, but in Alcoy and the regions around Valencia, a Valencian language is spoken, and it's possible to see street signs in both Castellano and Valenciano. Valenciano is considered to be similar to Catalan, and has been described as Catalan with a lisp.

Fig.1. Location of Campus of Alcoy in Spain

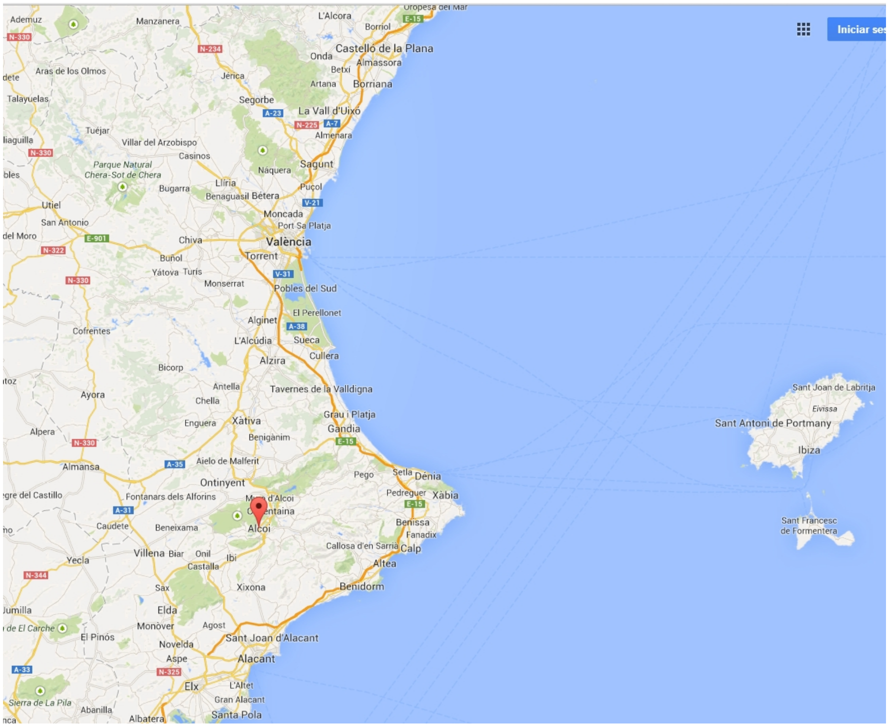

Fig. 2. Location of Campus of Alcoy in Valencian Region

The Campus has got 2.250 students and 315 academic staff. It is an international Campus with students from all over the world with an average of 100 incoming and 100 outgoing students every year. It is located in two traditional and elegant buildings with all the facilities: Free wifi, computer rooms, library, affordable gym for students, restaurant, cafeteria, employment office,…

2.1 Ostfalia University of Applied Sciences

Ostfalia University focuses on practical and forward-looking academic studies, applied research and development as well as continuing education. It has campuses in the following cities: Salzgitter, Suderburg, Wolfenbüttel and Wolfsburg.

Currently there are about 9.000 students enrolled. Research and development is aimed at practical applications. Bundled, scientific know-how, high-tech laboratories and highly qualified and motivated staff ensure successful collaboration with business companies.

They emphasizes on international relation- and partnerships. They have partner universities in all continents; and encourage their students studying abroad to gain international experience and to broaden their scientific education.

Science@Work is the slogan under which Ostfalia has developed its activities in applied research and development. Companies benefit from state-of-the-art results of research as well as cost effectiveness.

The Faculty of Mechanical Engineering was founded in 1928. The curriculum included a practical semester as early as 1974 and as this practice has proven its worth from the start it has been included in the new Bachelor‘s degree courses. The Mechanical Engineering Faculty played a major role in the founding of a new Institute of Automotive Engineering in 1988 – the first institute ever at a German university of applied sciences. The new European Engineering Technology course introduced in 1995 demonstrates how long the faculty has prioritised an international study orientation; the faculty ranks in the top ten of Germany's universities.

Fig. 3. Location of Ostfalia University in Germany

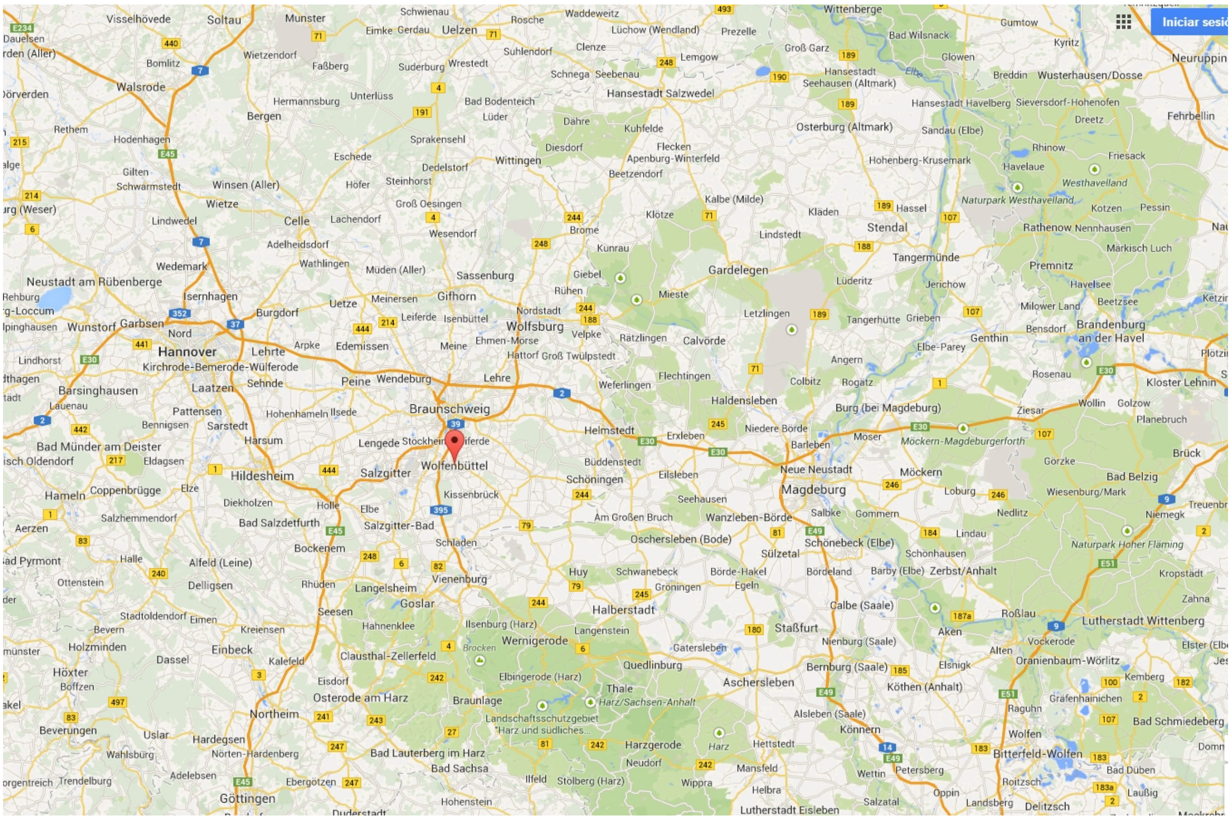

Fig. 4. Location of Ostfalia University in Brunswick Region

As ever, the faculty‘s strength lies in its practical orientation – in research and training, the faculty‘s close proximity to companies such as Volkswagen, MAN, Siemens and Salzgitter Stahl but also many small and medium-sized businesses is a benefit that the faculty uses to its best advantage. The faculty also offers highly intensive support for students in small groups from capable lecturers with experience in their field.

The main campus is located in Wolfenbüttel, and with its 56.000 inhabitants and over 600 timber-framed buildings, is the first Renaissance city emerged from the drawing board. Over three centuries (from 1432 to 1754) Wolfenbüttel was residence of the Dukes of Braunschweig and Lüneburg, who engaged the best master-builders and urban planners of their times. Thusly they made Wolfenbüttel highly attractive for celebrated public characters such as Lessing, Leibniz, Busch and Casanova. Until today the cosmopolitan city has not lost its charm. Not just the special charisma of the picturesque Old Town with its numerous cafes and shops makes Wolfenbüttel a place to stay and rest. Open-Air events in the castle like “KulturSommer” and the near-by natural swimming lake “Fümmelsee” with more than 13.000 square meter expanse of water contribute to the quality of life and leisure activities in Wolfenbüttel.

3 Industrial zones

3.1 Alcoy zone

The growth of its textile industry has converted Alcoy into the most important town in the area. Fabric is still produced in Alcoy today; as well as food, plastic parts and metallurgical components. The growth of rural tourism is also important to the town and it remains an important agricultural area as well.

Alcoy is the financial, commercial and cultural center in the surrounding area. Important companies in Alcoy or very close to are: Erum, Korott, La Española, El Serpis, Actiu, Playmobil, Famosa,…

3.2 Wolfenbüttel zone

That industrial zone is one of the centers of the industrialization in Northern Germany. During the 19th and early 20th century the canning and railroad industries and the sugar production were of great importance for the economy, but eventually other branches such as the automotive industry became more important.

Current factories in the region include Volkswagen, Siemens, Bombardier Transportation, Alstom, MAN and Bosch.

The fashion label NewYorker, the publishing house Westermann Verlag, Volkswagen Financial Services and Volkswagen Bank have their headquarters in the region as well. Also two major optical companies were headquartered in Brunswick, Voigtländer and Rollei.

4 The double degree in Mechanical Engineering

4.1 Difference between Joint Degree and Double Degree

The agreement in between both institutions is a double degree. This is different that a joint degree. The differences are:

- *Joint degree:* a single diploma issued by two or more institutions offering an integrated study programme. The single diploma (Bachelor, Master, and Doctor) is signed by the rectors of all participating universities and recognized as substitute of the national diplomas.
- *Double degree:* two nationally-recognized diplomas issued separately by the universities involved in the integrated study programme.

4.2 Double degrees in Europe

EU authorities actively pursued academic internationalization for more than two decades, as part of the move to economic and political integration.

The prime goal of the first double degree schemes was, therefore, to increase the employability of internationally mobile students. Graduates of international programmes who had spent a year abroad and were willing to look for a job abroad, should be enabled to apply with university diplomas known to the potential employers in the host country.

With the increased Erasmus mobility of students, a second motivation was added. As Erasmus changed its face from an elite-type exchange in its beginnings to a “mass” movement which included also average students, participants in integrated programmes needed to present evidence that they had not spent their Erasmus stay as “educational vacation” but had acquired a deep knowledge of the host country’s culture and business practices. For these graduates, earning a double degree made a great difference.

4.3 How our double degree started

In the fall of 2008, professor Dragos Balan and 10 students, from Ostfalia University, visited the Campus of Alcoy. This was the first time they were in Spain, and came with the financial support of their university, because of the interesting program “Look and See trip”.

The Look and See trip has the intention to show another country and university to a selected group of students. This is important since some of these students have selected the Campus of Alcoy as an Erasmus destination in the following years.

The partnership developed between both institutions has not stopped with the implementation of the double degree agreement. The Look-and-See trips are taking place every year as a part of an extended partnership.

During the first Look-and-See trip, the former vice dean for International Relations at the Campus of Alcoy, Elena Pérez, and the former Mechanical Engineering Degree Coordinator, Miguel Angel Sellés, started conversations with the visiting professor Balan to establish a double degree between both institutions.
Elena and Miguel Angel visited Ostfalia in April of 2011 in order to prepare all the issues regarding the double degree conditions and have an interview with both the dean and president. Everything was clear by the Ostfalia side at that moment.

After some exhausting paperwork, the agreement in both institutions was finally signed in September, 20th, 2012.

4.4 Clauses of the agreement

The clauses are:

1. The students must have completed a minimum of 180 ECTS in the EPSA or 152 ECTS in OSTFALIA successfully before they start their participation in the exchange. They have to spend 2 complete academic semesters at the host university.
2. The students during their stay at the host university will be enrolled in their home university. For this purpose, the current regulations for grantees will be applied in the respective countries. The students participating in the double degree program are exempt from paying tuition fees at the destination university.
3. The EPSA students will enroll in the OSTFALIA as European Union citizens and are required to comply with the examination regulations of the destination university. Regarding the Bachelor Thesis, however, only the rules of the home university are applied.
4. The OSTFALIA students will enroll in the EPSA as European Union citizens and are required to comply with the examination regulations of the destination university. Regarding the Bachelor Thesis, however, only the rules of the home university apply.
5. After successful completion of studies and according to the respective regulations, the UPV will award the degree of "Graduado en Ingeniería Mecánica" and the OSTFALIA the degree of "Bachelor of Engineering".
6. Both institutions will assist the students in finding accommodation and with social integration.
7. The exchange will be done through the Erasmus programme or its successor and starts at the beginning of each academic year.
8. Both institutions will provide exchange students with the adequate possibility to improve their knowledge of the language of the host country. The host university will provide continuous language training for the incoming students.

4.5 Conditions of the agreement

The conditions are:

a) Mobility from EPSA to the OSTFALIA.
Before mobility, EPSA students must demonstrate knowledge of English equivalent to level B1 as well as basic knowledge of German, equivalent to level B1.
The EPSA students must meet the following requirements in OSTFALIA to obtain a double degree:

- The students must have completed at least 180 ECTS in the EPSA, as indicated in Annex 1.
- They will have to complete in the OSTFALIA 60 ECTS in combination with the following activities (48 ECTS + 12 ECTS of the Bachelor Thesis):
  - Subjects of the “Bachelorstudiengang Maschinenbau” degree that students did not complete previously at the EPSA.
  - Mandatory: 24 ECTS in one of the subjects of the “Maschinenbau Bachelorstudiengang” degree of semesters 6 and/or 7.
  - The students could also do internships in companies, obtaining then a maximum reduction of 16 ECTS credits (12 ECTS of a student project, 2 ECTS for the presentation, and 2 ECTS for a “social skills seminar”).

  The Bachelor Thesis (12 ECTS) will be supervised by two professors or lecturers from the OSTFALIA and one from the EPSA. The Bachelor Thesis will be done in the OSTFALIA and shall be written in English and will have full recognition in the EPSA.

EPSA students, in addition, must complete 30 additional ECTS in the EPSA or in the OSTFALIA in order to get the degree of “Graduado en Ingeniería Mecánica”. Then, the total amount of ECTS required to get this double degree is 270.

b) Mobility from OSTFALIA to the EPSA
Before mobility, OSTFALIA students must prove knowledge of English equivalent to level B1 as well as basic knowledge of Spanish, equivalent to level B1.

The OSTFALIA students must meet the following requirements in EPSA to obtain a double degree:

- The students must have completed at least 152 ECTS in the OSTFALIA before participating in the exchange with the EPSA, as indicated in Annex 1.
- They will have to complete in the EPSA 60 ECTS in combination with the following activities (48 ECTS + 12 ECTS of the Bachelor Thesis):
  - Subjects of the degree “Grado en Ingeniería Mecánica” that the students did not complete previously at the OSTFALIA.
  - 36 ECTS of the 48 ECTS will be obtained studying one of the optative subject blocks that will be available at the last year of the degree “Grado en Ingeniería Mecánica”.
  - The students could also do internships in companies, obtaining then a reduction of ECTS credits in the subjects.

  The Bachelor Thesis (12 ECTS) will be supervised by two professors or lecturers from the EPSA and one from the OSTFALIA. The Bachelor Thesis will be done in the EPSA and shall be written in English and will have full recognition in the OSTFALIA.

5 Summary

This double degree is the first one that has been offered in the Campus of Alcoy. At the moment, a student from Germany has completed his studies, and obtained the Mechanical Engineering Degree in both institutions.

A student from Alcoy will finish his studies in Germany by joining the double degree the next academic year 2014/2015.

These participating numbers are low due to the recent agreement and the strict conditions in the language level. Students that are in the first or second year of their studies, and want to join this double degree, have two or three years to acquire the adequate required language level prior to the participation acceptance.

The FSU program in Valencia

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Conference Key Areas: Education and Research; The Global Engineer; Internationalizing the engineering curriculum
Keywords: International Programs; USA-EU cooperation.

Abstract

The Study Abroad (International Programs) of the Florida State University has over 50 years of experience in providing students with extraordinary study abroad opportunities. Through challenging academic programs, students can study in more than 20 global locations.

In the case of Valencia, the Broad Curriculum program gives students the opportunity to earn credits in both general requirements and elective courses while experiencing Valencia, surrounding areas of Spain, and neighboring European countries. The curriculum encompasses basic Liberal Studies, Hispanic Culture, intensive Spanish Study, and Business. Students can also take business, math, and science courses at the Universidad Politécnica de Valencia due to our affiliation with this facility, while in Spain studying with Florida State.

The FSU program in Valencia has undergone a continued and growing evolution which evolved from their first location at Galileo Galilei, to a collaboration agreement in 2012 where UPV professors collaborate with FSU International Programs in for delivering US curriculum courses for their students. Further developments are expected and the experience of over 10 years will be presented.

1 Introduction

Nowadays there is a clear on the governments and universities in the globalization of the higher education. For instance, the main interchange programme in Europe is the Erasmus programme [1]. Erasmus stands for European Community Action Scheme for the Mobility of University Students, honouring Desiderius Erasmus of Rotterdam. Its purpose is to provide foreign exchange options for students from within the European Union and it involves many of the best universities and seats of learning on the continent. Students can go abroad for 3 to 12 months (including a complementary traineeship period, if planned). The same student may receive grants for studying or being trained abroad totalling up to 12 months maximum per each cycle of study:

- During the first study cycle (Bachelor or equivalent) including the short-cycle (European Qualifications framework, EQF levels 5 and 6)
- During the second study cycle (Master or equivalent EQF level 7) and
- During the third cycle as doctoral candidate (Doctoral level or EQF level 8)

The duration of a traineeship by recent graduates counts towards the 12 months maximum of the cycle during which they apply for the traineeship.

This program has a strong impact in Europe, reinforcing the European spirit in more than three million students and forming the elites that have to stronghold Europe.

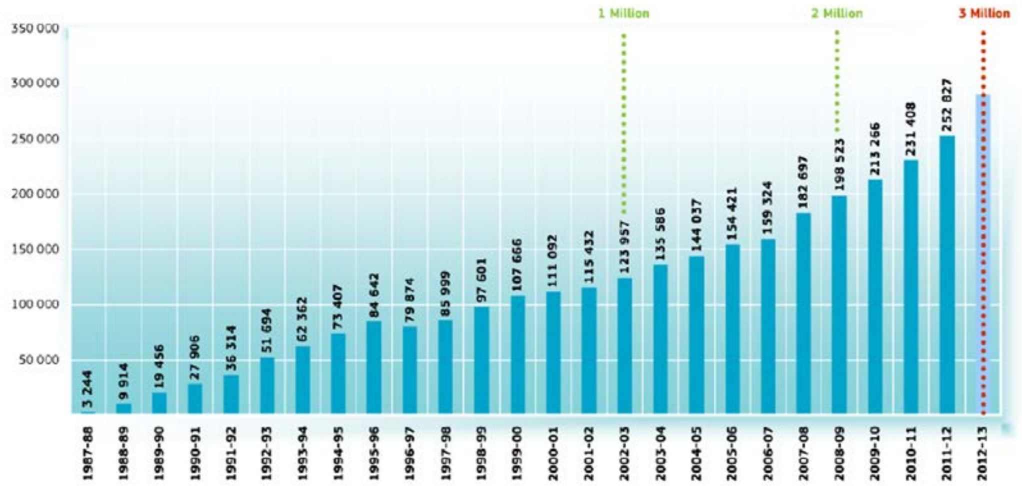

Fig. 1. Progress to achieving the three million student mobility target [2]

The counterpart on the US is The Fulbright Program [3], which is the flagship international educational exchange program sponsored by the U.S. government and is designed to increase mutual understanding between the people of the United States and the people of other countries.

The Fulbright Program operates in more than 155 countries worldwide and has provided approximately 310,000 participants with the opportunity to study, teach, or conduct research in each others' countries and exchange ideas.

Approximately 8,000 competitive, merit-based grants are awarded annually in most academic disciplines and fields of study.

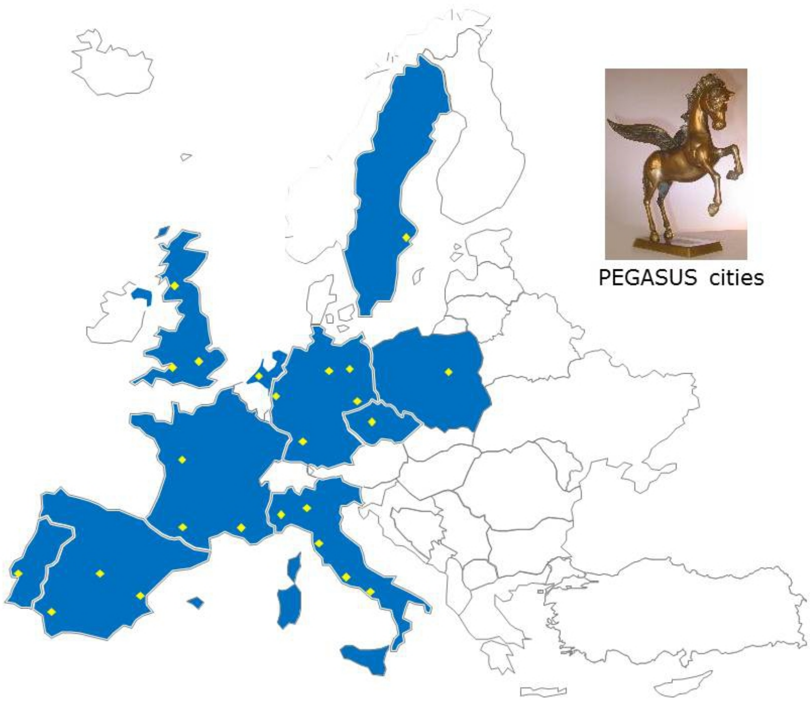

Fig 2. Universities participating in Pegasus Network [4]

Yet another internationalization initiative is the university networks. As an example, we can mention the Pegasus (Partnership of a European Group of Aeronautics and Space UniversitieS)[4.]

The general objective of Pegasus is to optimise the services we offer in the best interests of Europe both in terms of continuing to attract the best students and also to offer highly relevant educational and research programmes. The founding Partners of Pegasus have collaborated for some years in an ad-hoc manner (largely supported by EU funding) but now wish to work more closely together in a manner that better satisfies the needs of our students and their employers across Europe. Today more than 2000 aeronautical engineers graduate from the member institutions of Pegasus each year. Pegasus has been formed from an initiative taken by the four main French Grandes Ecoles involved in aerospace. Co-ordinated change and innovation will be required to achieve objectives to be defined through close links and interaction with the aerospace Industry and relevant Government agencies.

2. The FSU and the FSU International Programs

The Florida State University (commonly referred to as Florida State or FSU) is a space-grant and sea-grant public research university located in the state capital city of Tallahassee, Florida, United States. It is a research university with very high research activity The university comprises 16 separate colleges and more than 110 centers, facilities, labs and institutes that offer more than 300 programs of study, including professional programs. The university was established in 1851 and is located on the oldest continuous site of higher education in the state of Florida. It is one of two Florida public universities to immediately qualify as a "preeminent university" by law under Florida Senate Bill 1076, signed by Governor Rick Scott in 2013.

The university is also known for its undergraduate study abroad options: according to Uni in the USA, "the large numbers of students that study abroad nicely compliment the students that study here from abroad" [5]. There exist several options for the students, which will be described later.

Locations, Faculty, Classes

Each location's resources—historical sites, art, libraries, museums, government, and professionals—are fully integrated into courses. Faculty members have a passion not only for their subjects but for the cities, for the cultures, and for undergraduate teaching. International Programs faculty are by nature intellectually curious, globally conscious, energetic, inspired and inspiring.

Also small classes and personal attention create an intimate, liberal arts college atmosphere: no huge lecture classes, much more one-on-one instruction… It is a chance to grow and mature. Confidence, independence, and self-knowledge are chief rewards of this program.

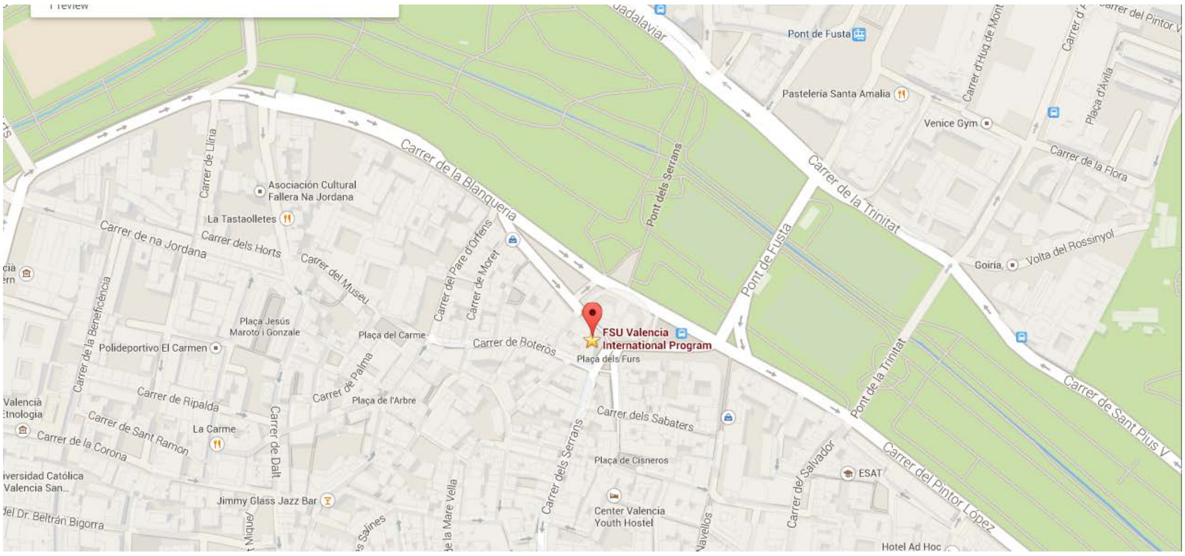

Fig 3, *FSU localization at Valencia*

FYA programs run concurrently with broad curriculum programs at each study center, so students share excursions, classes and other program components with upper division students.

FSU Valencia Program

FSU in Valencia Program is the perfect combination of academics and socio-cultural activities. With four sessions throughout the year FSU offers a large amount of different classes, ranging from business and Spanish to mathematics, humanities or multinational affairs.

FSU Valencia works hand in hand with the city's most distinguished universities, collaborating with faculty exchange and sharing facilities. Student will be able to experience the real European student life and use top-notch laboratories. Helping students immerse and understand Spanish education is a priority for FSU Valencia.

Most professors will actively use the city of Valencia and the programmed visits as interactive activities; a visit to an orange factory or the Valencia Government seat can give a different perspective to each class.

Complementing the academic hours, FSU in Valencia offers each session a calendar filled with activities, most of which are oriented towards meeting Spanish people and becoming part day to day Valencia. Two mandatory week long trips are also offered during the fall and spring semesters, and one on each summer session where the students are taken to places like Andalucía, Madrid, the Pyrenees or Barcelona to understand the complexity of Spanish history and its distinctive art and way of life. FSU wants the students to feel they really are a part of Spain!

Programs in Valencia

1. **The Broad Curriculum program.** This program gives students the opportunity to earn credits in both general requirements and elective courses while experiencing Valencia, surrounding areas of Spain, and neighboring European countries. The curriculum encompasses basic Liberal Studies, Hispanic Culture, intensive Spanish Study, and Business. Students can also take business, math, and science courses at the Universidad Politécnica de Valencia and the Universidad Católica de Valencia, due to our affiliation with these facilities, while in Spain studying with Florida State.

   Participants in this program experience both local and more distant travel opportunities which are tied to critical means of academic study. Each term includes weekly group activities, as well as a very complete cultural program featuring two mandatory excursions. All group trips provide comfortable accomodations and visits to a wealth of important sites. Most courses in all terms allow a three-day weekend for additional exploration activities. Fall and spring semesters both have a 10-day term break for extended personal travel.

   The following table summarizes the several dates through the year where the student can perform his/her stay in Valencia

   The Areas of Study includes Archaeology, Art, Business Communications, Composition, Contemporary Literature, Environmental Science, Food & Society, Geography, Hispanic Cinema, Humanities, Literature, Management, Marketing, Mathematics (various levels), Multinational Business, Music History, Nutrition, Science, Spanish Composition, Spanish , Language (various levels), Spanish Literature, Women in Literature.

Session Code	Term	Start Date	End Date	Number of Nights
VA05	Spring 2014	Jan 9	Apr 24	105
VA03	Summer 2014	May 8	Jul 31	84
VA01	Summer 2014	May 8	Jun 19	42
VA02	Summer 2014	Jun 26	Jul 31	35
VA04	Fall 2014	Aug 28	Dec 11	105
VA05	Spring 2015	Jan 8	Apr 23	105

Table I. Different sessions of Broad Curriculum program.

PROGRAM SPECIFIC EXCURSIONS & GROUP ACTIVITIES*

Cultural immersion/social events planned for this program may include:

- Madrid excursion visiting surrounding locations of Toledo, Segovia, Salamanca or Alcalá de Hernares (3-4 days)
- Barcelona excursion visiting the Dali Museum and Sagrada Familia (3-4 days)
- Andalucía excursión, visting Granada's Alhambra, Sevilla, Córdoba and flamenco activities. (3-4 days)
- Pyrenees excursion with rafting activity, medieval castles, mountain activities (3-4 days)
- Optional day trips every Friday to locations around Valencia: Roman city of Sagun-to, Xátiva Castle, wineries of Requena, mountain walks, historical locations, special interactive museum visits
- Weekly activities including: sports events, exchange conversation meetings, tours, food tasting, group dinners, special events
- Club de Español weekly events for total immersion in the Spanish language
- Specific class field trips including: Valencia Court, local archaeology sites, historical landmarks, local markets, theatres, operas, distinctive biospheres
- Classes integrated in the local Polytechnic University and Universidad Católica with access to state of the art labs
- Lectures and demonstrations by Spanish professionals in various fields of work
- Optional trip to Morocco may be available for the fall semester. This trip to northern Africa is organized and accompanied by Florida State staff.

2. **The First Year Abroad (FYA)**. FYA program allows students to complete the first twelve months of their Florida State careers studying abroad with International Programs. Students can choose to spend their first year at any of our study centres: London, England; Florence, Italy; Panama City, Republic of Panama; Valencia, Spain. Of these centres, students interested in science or engineering majors must choose Panama or Valencia locations to meet their prerequisites.

   The program Benefits and Rewards, as stated by the FSU [6] are

   - Students take up to 49 credit hours over 12 months, beginning in the fall term.
   - Classes are taught in English, except for foreign language classes. Additionally, living among native speakers immeasurably aids Spanish or Italian skills.
   - Classes satisfy requirements of the Liberal Studies Program, many minors, and first-year prerequisites for most majors.
   - An academic advisor ensures students follow “mapping” for their majors.
   - First Year Abroad fulfills the summer residency required of Florida State students.
   - The rewards of being an FYA student continue upon return to the main campus. Upon completion of a minimum of 36 FSU credit hours at their European or Panama IP study center with an FSU GPA of 3.0 or better, FYA students who are in good judicial standing are assessed in-state tuition rates for the remainder of their first undergraduate degree atFlorida State in Tallahassee.

As an example, table II states the subjects of the different lectures to be given the next semester, Fall Valencia

Course	Title	Credits
ANT2100	Introduction to Archaeology	3
BSC2010	Biological Science I	3
BSC2010L	Biological Science I Laboratory	1
CHM1045	General Chemistry I	3
CHM1045L	General Chemistry I Lab	1
CPO2002	Introduction to Comparative Government & Politics	3
ECO2000	Introduction to Economics (online)	3
ECO2023	Principles of Microeconomics (online)	3
ENC1101	Freshman Composition and Rhetoric	3
ENC1144	Freshman Article and Essay Workshop*	3
ENC3310	Article and Essay Technique*	3
GEB3213	Business Communication	3
HUM2210	Humanities: Pre-History to Late Antiquity	3
HUM2235	From the Renaissance to the Enlightenment	3
HUM3930	Humanities: Special Topics: Culture & Civilization of Spain	3
HUN1201	The Science of Nutrition	3
LIT3383	Women in Literature	3

MAC1105	College Algebra	3
MAC1147	Precalculus Algebra/Trigonometry	5
MAN3240	Organizational Behavior	3
MAN3600	Multinational Business Operations	3
MAR3023	Basic Marketing Concepts	3
SLS1122	Academic Success (one credit only)	1
SPN1124	Comprehensive Elementary Spanish	4
SPN2220	Intermediate Spanish	4
SPN2240	Intermediate Spanish II	3
SPN3300	Spanish Grammar and Composition	3
SPN3400	Spanish Reading and Conversation	3
SPN3440	Language and Culture in Business	3
SPN4540	Regional Cultural Studies	3
SPT3391	Hispanic Cinema	3

3 UPV-FSU Agreement

UPV and FSU began their collaboration since the first program held in Valencia. The very first location for the FSU Valencia program was at the Galileo-Galilei. After running the program for a few years, and with growing requirements on science classes for the Study Abroad program, a first agreement was signed in 2008, and later expanded in 2009 for academic exchange. The most relevant results were the growing academic collaboration leading to good scientific results (25 students received from FSU and 5 UPV students hosted at FSU Tallahassee).

In 2012 the first specific agreement for the Study Abroad program was signed and has allowed since then the development of US science curriculum courses to be taught by UPV faculty to an always growing number of US students.

Fig 4, Nexus Building at UPV

CONCLUSIONS

We have presented in this paper one of the most successful international programs in USA. The main idea of the international program of the FSU is that the the student can share the life in several locations of the world while completing their studies. One important point is that the students follow exactly the same curricula that their fellows in Tallahassee. As an example, we have shown some of the peculiarities of the FSU courses in Valencia, and their agreement with the UPV.

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Distance Exams as a HEI Service for Promoting the Participation of Students in International Exchange Programmes

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Keywords: Remote Exams, International Exchanges Programs, Erasmus+

Abstract

Internationalizing the curriculum of engineers is no more an option, but a need to boost skills and employability in an increasingly competitive and global professional market. In this context, the provision of international exchange programmes of quality is becoming one of the major responsibilities of higher education institutions. The success of such programmes relies on the provision of services to eliminate as much impairments to the academic exchange as possible. As international exchange programmes offer higher levels of flexibility in terms of activities and scheduling to students, like the Erasmus+ program does, they increase the proneness of requiring the supervision of student's home exams at host institutions. Since exams are among the most important worries of students, the lack of a precise policy to manage them remotely emerges as a dissuasive argument against the application of students to exchange programs. On the other hand, the organization of on-site exams remotely requires the existence of a chain of trust whose deployment maybe relatively complex and not always possible. This paper proposes the distance exam policy that is currently under use at the School of Informatics (ETSINF) of the Technical University of Valencia (UPV).

1 Introduction

As stated in [1], students often do have a lot of anxiety about their upcoming study abroad experience. It is the mission of International Relations Offices (from now on IROs) of Higher Education Institutions (from now on HEIs) to spend the necessary time with students to listen them, answer their questions and allay their fears to prepare them to succeed.

Although simple in its formulation, coping with the aforementioned tasks is something that is becoming more and more complex as the variety of international programmes increases. This situation has lead the European Commission to rationalize in 2014 its offer of exchange programmes, including Life-long Learning Programmes (Grundtvig, Erasmus, Leonardo and Comenius), International Higher Education Programmes (Erasmus Mundus, Tempus, Alfa, Edulink and bilateral programmes) and Youth in Action Programme, and join all such programmes into a single one, named Erasmus+ [2]. Among the three key actions of the Erasmus+ program, key action one (KA1) focuses on learning mobility for individuals. This action is very ambitious and wants to contribute to the improvement of the competitiveness of the European economy by increasing the skills and employability of students [3]. Going to ciphers, 77.5% of all budget allocated to the Erasmus+ programme from 2014 to 2020 will be devoted to education and training, and 43% of this percentage will be invested in Higher Education. In other words, the strategy of the European Commission to "*support the creation of a true European area of skills and qualifications where citizens can move freely for job purposes or further learning*" [3] strongly relies on the success of existing and future exchange programmes between HEIs.
A typical method to assess the level of success of a programme consists of measuring the impact of such program on the population it targets [4]. Placing the spotlight on the Erasmus+ programme, its success will rely on the number of students finally participating in the different international exchange programmes promoted from, and offered by, European HEIs. In order to increase this

number, the strategy is to let students to tailor their academic exchange and adapted it to its profile (content) and availability (time). In fact, the Eramus+ guide [3] explicitly says that the means is to "support the creation of flexible learning pathways in line with learners' needs and objectives". More precisely, it states that "*the same student may receive grants for mobility periods totalling up to 12 months maximum per each cycle of study, independently from the number and type of mobility activities (studies or trainnerships)*".

On the other hand, the bologna plan [6] is on the process of creating an European Higher Education Area (EHEA) where traditional lectures and final tests to evaluate the students must be transformed into interactive lectures, combined with self-learning activities on the student's side and a continuous evaluation, where the final test is just a part of the global assessment [5]. For an in-site student, its success in a course would depend not only on the ability of the lecturer but also on the student capacity of work, dedication and interest. However, consider the case of a student that fails the course and has planned to go abroad next year. It will be unaffordable for the HEI of that student to organize a distance exam for each particular evaluation that the teacher will organize in class during the course. This exchange student will need to report one year this course if it is not able to find out at its host HEI a similar course for his/her learning agreement, which can be a real problem if this means to report one year the completion of his/her degree. Let us now consider the of an exchange student whose semester ends officially in January but returns home for Christmas with all the courses successfully passed except one whose exam is scheduled for January. This may happen if January is a month without classes only devoted to recover those courses' partial exams previously failed. If the student needs all courses to validate his/her semester, then he/she must return to its host HEI in order to retake the previously failed exam, which can be unaffordable from an economical viewpoint for him/her. One may consider that only brilliant students without any pending courses should access exchange programs and they must assume the consequences derived from failing any of the courses in their learning agreement, but this goes against the principle of flexibility promoted by the Erasmus+ programme. In addition, we should not forget that exams are among the most important worries of students, since their academic success is completely conditioned by the possibility of sitting the exam, even if it is performed remotely. The International Exchange Erasmus Student Network is very clear on this point when they write in [7] "*students are obliged to take their exams only during a special exam period – thus for some, this results in no mobility in order to avoid delays in their studies*". As a result, the lack of a precise policy to organize and perform distance exams emerges as a dissuasive aspect, rarely considered so far, against the application of students to exchange programs.

This is paper presents the organization of distance exams as a service of added value, non-mandatory but strongly recommended, for the implementation of the Erasmus+ programme. As the participation (or not) of a student in a particular exchange program maybe conditioned by the existence (or not) of this service, it becomes essential to i) establish an approach to make the community sensitive to the importance of this sevice for students, and ii) commit on which strategy is the best for the adequate deployment of the service in HEIs. The school of Informatics, officially named Escola Tènica Superior de'Enginyeria Informàtica (from nowon ETSINF), of the Universitat Politècnica de València (whose acronym is UPV) has a long tradition in offering distance exams to both in-coming and out-going students. Although coordinated from the ETSINF IRO, the service requires the participation of both the local teaching staff of the school (for providing the exam) and the teaching/administrative staff of each students' host HEI (for proctoring such exam). It must be noted that the experience reported in this contribution is not related to the technology required to provide remote exams through e-learning platforms. However, it is worth mentioning that it can inspire to, or serve as a starting point of discussion with, those defining the policy for distance exam that are behind the processes implemented by e-learning platform.

The paper structures as follows. Section 2 identifies and discusses various barriers of the existing barriers to mobility. The focus will be placed on distance exams that will be presented as a mean to alley students' anxiety before their study abroad experience and to support the success of their exchange. Then section 3 details the experience gained during last years from ETSINF-UPV in the organization of distance exams. Section 4 compares such experience with others carried out in other HEIs and formulates several questions that need further debate. Finally, Section 5 concludes this paper.

2 Distance exam as a mean to overcome certain barriers to students' mobility

Many have qualified uncertainty as the most important barrier to students' mobility [8]. Unhopefully, many different factors (institutional and personal) affect the level of uncertainty perceived by students. It is the responsibility of HEIs to deploy the necessary means to reduce such uncertainty to a reasonable level generally affordable for students. Next subsections detail the different barriers existing to students' mobility and discuss to what extend and how, distance exam reduces the level of uncertainty related to such barriers perceived by the student.

2.1 Institutional Barriers

At a European level, general guidelines are provided to member countries for the implementation of the Erasmus+ program [3]. However, students have perceived the change between the old Erasmus programme and the new Erasmus+ programme as a source of great uncertainty. First, there has been a lack of early information about the new programme and the funding supporting it. At the very beginning it was in fact impossible to know which was the budget allocated to the programme and which were the various key actions that will be funded and how. As a result, IROs were not able to translate to students the change of conditions within the Erasmus+ programme. It is worth noting that this is an aspect that will be naturally eliminated with time, as all HEIs and IROs become more familiar with Erasmus+.

Since member countries European recommendations are finally interpreted and implemented by each member country, there also some considerations to take into account at the state level. In fact, each country imposes its own curriculum constrains to his/her students. This is however an issue typically well managed by IROs when designing the learning agreements of the students. So, this aspect does not introduce a high level of uncertainty.

Economical issues pose however more problems that are nowadays exacerbated due the current context of crisis in Europe. Aspects like cuts of in the number and amount of scholarships imposed by countries, together with the lack of early information about financial opportunities within Erasmus+ has created the suitable breeding ground for a reduction of the number of students participating in exchange programmes. In addition, strong financial constraints have also imposed a reduction of the administrative staff in IROs' HEIs that is affecting, without doubt, the individual attention and follow-up provided to students. It must be said that IROs do they best to keep their service to students at the same level of quality that was provided before, but sometimes this is something unfeasible. In summary, students need to face a very complex economical situation when applying to exchange programs. The reality is that they do not really rely on scholarships, since even when they are granted their payment arrive in some countries, like it is happening in Spain now, at the end of the period of students' exchange. To mitigate that problem, HEIs are designing and deploying their own financial instruments for granting students and keep the quality level of the service provided by IROs.

In fact, it is at the level of IROs level where institutions can act more effectively to mitigate the aforementioned barriers and reduce the perception of uncertainty transmitted to students. On one hand, the personal attention and information provided to students is always a plus. On the other hand, specific actions maybe required for fighting against the strict scheduling of degrees' structure and assessment, and the lack of flexibility existing to arrange the academic recognition of students.

The problem of the strict scheduling of degrees' structure and assessment derives from the design of the degree itself, which most of the times is performed on the basis of local students. In other words, many degrees are designed assuming the needs of local students, which will be on-site along the whole semester or academic year, following all courses of the same academic year. This situation can be a problem for exchange students. Let us analyze the situation of both in-coming and out-going students.

In-coming exchange students use to adapt quite well to the semester or year structure of the degree since they are on-site. Most of the problems they use to have are a consequence of their need to select courses from different academic years (ex: 1st, 2nd, 3rd or 4th academic year for an Spanish Bachelor) whose scheduling can potentially overlap. When continuous evaluation is applied, like it is the case with most degrees following the bologna process, this overlapping maybe a problem from a grading point of view and it can negatively impact the results of the student. One needs to understand that exams are scheduled avoiding overlaps between exams belonging to the same academic year, but sometimes exams from different years are simultaneously scheduled. So, an in-coming student can potentially be in a situation when he needs to choose sitting one course' exam or another. It is obviously a potential source of failure for the student that is completely out from his control. In fact, when he/she applies for his/her exchange the scheduling of courses and exams in his/her host institution are rarely available.

Out-going students face another type of problems when preparing their exchange at their home HEI. First, not all students can apply for an exchange. In general, those that can potentially take a benefit from an international exchange are those in the last academic years of their degrees. At ETSINF-UPV, for instance, learning agreements are only negotiated on the basis of courses belonging to the 3rd and 4th year. In addition, students are filtered according to their results and the amount of credits approved. At ETSINF-UPV students must have 120 ECTS approved (the equivalent to 2 academic years) in order to be electable for an international exchange. However, and despite applying such filters, there are always students that having 120 ECTS approved, they have pending courses of the 2nd year or others that are not able to find out the equivalence for a 3rd or 4th year course at their host HEI. For these students the only option is to return to their home HEI to sit the exams when required. However, this option is always expensive and not always affordable from an academic viewpoint, since exam dates can overlap with important academic activities scheduled in their host HEI.

This enumeration of problems, which is far from being exhaustive, reflects the type of problems that our students can potentially encounter during their academic exchange. There are some that obviously cannot be addressed by HEIs, but others, like those relating to exams can be adequately managed in some cases by offering students the possibility of organizing a distance exam. From that viewpoint, the existence of a distance exam service at a ROI reduces the level of uncertainty that students need to assume when studying abroad.

2.2 Personal Circumstances

There are a bunch of personal aspects that students balance when thinking about an international exchange. They use to lack of confidence or prefer the easy option of staying at their home university and the programme obligations imposed by their HEI. Others realize at the moment of filling their exchange application that their level of knowledge is maybe not enough for following classes at a university level. But, without any doubt, financial costs are among the most important personal circumstances with an influence in the students' final decision.

Going abroad to study is not considered as an investment by many students, but rather as en expense. This come from the fact that, beyond the long-term benefits that one can obtain from an international academic exchange, the financial effort required is unhopefully too much for many families, specially under the current situation of crisis. However, many students are very persistent on their objectives and are able to combine part-time jobs or paid work placements with their studies. This extra effort results in some earning money that can be invested in an international exchange, but only if the risks assumed are affordable. The same applies if the student decides to get a credit from a bank.

This justifies the importance of the awareness work carried out at ROIs in order to ensure that all potential exchange students know, at least, the benefits derived from their participation in exchange programmes, the procedures that are in-place to define and recognize their learning agreements, and the set of scholarships they can apply to in order to get some financial support. But in addition to this, the major personal question that is systematically addressed by all students with a pending course is how to cope with the realization of the exam related to such course if they are abroad. It is important to underline the fact that if an exam is not carried out at the time it was scheduled the student must wait until the following year to resit the exam. In some cases, this means paying a second time the taxes of the course, with a penalization augmenting the taxes paid, and/or reporting the finalization of a degree one year imply a lost of time and professional opportunities.

Since the number of students with pending courses applying to international exchange programs is increasing, providing a good mean to address the problem of pending exams becomes mandatory. Obviously, one can simply say that the right of the student is to return to his/her home HEI and perform the exam. As already said, this is not always feasible for circumstances that are out of the control of the students. On the other hand, the financial cost for the student of this travel is not negligible and becomes more important if afterwards, the student is supposed to return to their host HEI until his/her exchange finishes.

2.3 To What Extend are Distance Exams Solving the Problem?

As commented above, distance exam is a service offered by certain ROI whose purpose is to support students during their academic exchange. The major benefits for the student are two-fold. First, all worries about the management of pending courses' exams are eliminated, so the student can focus on what really matters: the success of his/her exchange and the approval of the set of requested distance exams. Second, no extra financial cost is requested to the student since all the exam process is remotely managed by ROI staff of the students' home HEI and the exam is proctored by staff belonging to the students' host HEI.

3 The ETSINF-UPV Approach to Distance Exam

The ETSINF at UPV is organizing distance exams since more than 10 years. During that period, the ROI staff has refined the process attending not only to the service to provide but also o the set of available time and human and material resources. As a result, a certain number of restrictions have been imposed to the service, such as the number of maximum exams per semester that can be requested by a student, or the moment when the organization of this type of exams must be triggered. The following subsections presents the distance exam policy currently under use at ETSINF-UPV.

3.1 Some Initial Administrative Considerations

At ETSINF, all students must register themselves during June in the courses they want to follow during the next year and formalize their registration by paying the corresponding taxes. The registration in a course can be regular (for in-site students) or "with mobility" (for out-going exchange students). In the case of out-going students that want to sit the exam of a course remotely, they must be registered in such a course as regular students. Otherwise, they are considered as out-going students for such course and they will loose the right of doing the exam at their home HEI.

In addition to this, new degrees are implemented following the Bologna process, which means that continuous evaluation is applied to all of them. Consequently, all courses are evaluated by means of more than one exam. In most of the cases, the evaluation takes into account the note of control activities performed in classes, partial exams, labs and in some case, proposed projects. Since it is unfeasible to organize a different distance exam for each activity evaluated during a course, out-going students registered as regular students in some ETSINF courses must request the school an "exemption of class assistance". This special instrument has been designed for those regular students that cannot attend any of the classes of a course for a justified reason. The existence of this special type of regular students leads teachers to define two types of a regular evaluation: the normal one and the one adapted to students with an "exemption of class assistance". This second type of evaluation relies on the realization of a single exam plus the provision of several deliverables. In that case, if the exam is also organized as a distance exam, then the problem for the out-going students is solved. So, the consequence is that all out-going students registered as regular students in certain courses must request the "exemption of class assistance" for those courses. Then, it is only a matter of requesting the organization of the required distance exams in the correct way and at the correct time.

The case of in-coming students is much more simple. Since they are during a period of time ETSINF students, they also benefit from the distance exam policy. So, in case of need they can also request the organization of a distance exam. This case of figure is rare and only happens when the student has failed a course that is required in order to validate the credits of the semester at the student's home HEI. In that case, they only need to send an email to the ROI of the school requesting the exam following the public process available at the ETSINF exchange blog.

3.2 Public Availability of the Policy

The ETSINF-UPV policy regulating the realization of distance exams is public and available online at the ETSINF Exchange blog (http://intacadetsinf.blogs.upv.es) under the *Exámenes* section. The ETSINF Academic Commission has approved the last version of this policy in 2009.

The first paragraph of the policy is a disclaimer stating that: "The request of distance exams is not an adequate or advisable practice for academic exchange students. In fact, the organization of distance exams is not a right of the student, but rather a service provided to the school in order to easy his/her academic exchange." Beyond the service provided to the students, this disclaimer implicitly states something very important: the ROI will do its best to organize any requested distance exam, but sometimes it cannot be possible.

3.3 Simultaneity of the distance exam process

Every distance exam must be performed simultaneously (i.e. the same date and at the same time) to the regular one scheduled at ETSINF. This is typically a requirement quite reasonable if one restricts the purpose of the policy to Europe, but quite unreasonable if it also applies to the rest of the world. And even in Europe, this requirement may seem quite strict form the perspective of the different working journeys existing in the different EU member countries. For instance, it is quite use to schedule an exam from 17h to 20h in Spain, but those times may seem impossible in HEIs of North Europe, where even the institutions may close before the end of the exam in Spain.

In fact, the purpose of this requirement is double. First, it wants to warn students about the unfeasibility of ROIs to force teachers to prepare two different exams for a course: one for the regular students, and another for those having requested a distance exam. Second, it is a quality assurance requirement guaranteeing that all students are evaluated under the same conditions, which implies the use of the same exam and the provision of the same time to carry out the exam.

What it is typically done with European countries is to schedule the exam, either in advance or with a certain delay, depending on the needs, but ensuring that such exam in the host HEI will overlap the exam in the one in the home HEI. In such a way an agreement can be found between parts on when can students enter or leave the room where the distance exam is performed. The goal is to avoid any communication between the student requesting the distance exam and his/her colleagues at the home HEI, which may invalidate the result of the exam. This solution avoids the need of preparing anew exam, but its effectiveness is quite limited since it only solves the problem when the time difference between countries is not important.

A similar approach can be found if the scheduled time for the exam in Europe falls along the morning and it falls during the afternoon in the country of the student's host HEI, or vice-versa.

However, it will be always possible to find some cases where the time difference between the home and host HEI becomes unmanageable. In such cases, the teacher of the course must agree in preparing a second evaluation proof for students sitting the exam remotely. Then the ROI of the home HEI can schedule the exam at a time that becomes more reasonable for the students' host HEI. One can say that in that case the evaluation is unfair, but the level of fairness is the same resulting from the comparison of the exams prepared for the same course two different years. Going more in detail in this discussion falls out from the scope of this paper.

3.4 Requesting the organization of a distance exam

Students are responsible for triggering the distance exam process. They must respect the following 4 considerations:

A. The student will ask to the teacher coordinating the ETSINF course (referred as TEACHER from nowon) the permission to carry out the distance exam for his course. It is a responsibility of the student to indicate to the TEACHER all the information he/she requests to do his/her permission (such as the partial or lab to recover) and to obtain from him/her all the necessary information to carry out the exam (such as which material is allowed).

B. The student must find out at his/her host HEI a teacher or staff member that accepts to proctor his distance exam. It is the responsibility of the student to indicate to such person (referred from here as PROCTOR) the conditions required to carry out the exam.

C. Once the student has contacted with his TEACHER and has a PROCTOR, he/she must send and email to his IRO with the content and respecting the deadlines reflected by Tables 1 and 2 respectively.

Table 1. Email sent by the student to the IRO of his/her home HEI

- **Topic of the email:** Request of distance exam for SURNAME, NAME
- **Body of the email:**
    - Complete name of the course
    - Date, time and expected duration of the exam
    - Name and email of TEACHER
    - Name, email and position in the host HEI of PROCTOR

Table 2. Deadlines to respect (example) for requesting a distance exam
(only applicable to out-going students, not to incoming ones)

Period of exam	Deadline
January	23 December
Mars	24 February
June	25 May
July	29 June

D. It is the responsibility of the student to sequentially cope with steps A, B and C. After step C, if all the information is sent to the IRO of the students' home HEI, he/she will verify against the identity of PROCTOR. He/She will also verify with TEACHER that the student is allowed to carry out the distance exam. The exam procedure will be communicated to TEACHER and PROCTOR one week before the exam. In case the TEACHER or the PROCTOR do not agree with such procedure, the exam will not be organized. In case the IRO cannot coordinate for any reason the exam, it will not be organized. The only possibility in this latter case to perform the exam is that the TEACHER assumes directly the coordination of the exam.

3.5 Finding and Agreement Between Parts

Once the student triggers the process, the IRO send two emails to both the TEACHER and the PROCTOR with the purpose of obtaining their agreement on the distance exam process. Tables 3 and 4 shows the templates typically used for these emails.

The exam can be carried out if and only if both parts (the TEACHER and the PROCTOR) agrees in the proposed procedure. Otherwise, the distance exam cannot be organized.

Table 3. Template of email sent by IRO to TEACHER

Dear Colleague,

The International Relations Office (IRO) of the School of Computer Science (ETSINF) of the Universitat Politecnica de Valencia (UPV) in Spain. Our student XXXX has informed us that there is a possibility for him to be supervised during his exam of YYYY, but you ask for a formal confirmation for the exam.

The exam is scheduled for next DDDD and it must start at TTTT (spanish time) with a duration is of LLLL. According to our internal policy the exam must be performed the same day and at the same time of the one carried out in Valencia. If it is not possible for you to proctor the exam respecting this rule we will understand the situation, and the exam will not be performed.
Please remember to follow the next exam procedure:

1. Exam MUST start at the same time than the corresponding ones in Spain and must have the same duration
2. An email is requested to signal de START of the exam. This email must include the name of the student and its identity card /passport number in order to avoid any person replacement. So, an identification document must be requested to each student carrying out with the exam.
3. An email is requested to signal de STOP of the exam. This email must not be sent later than 30 minutes after the official finish time. This email may include a pdf with the answer sheets fulfilled by the student, although this pdf can be sent later.
4. The original answers sheet must be sent back to us using the postal mail address in the signature of this email (see bellow).

Please acknowledge this email and your availability to supervise the exam.

Thanks in advance for your support.

Regards,

IRO
+ Postal IRO address

Table 4. Template of email sent by IRO to PROCTOR

Dear Colleague,

The International Relations Office (IRO) of our school has received at least one request for the distance organization of the exam of EEEE. The students beyond such request should have already contacted you. This email wants to verify that you have provided your agreement to them for the realization of the exam.

I need you send me a pdf copy by email as soon as you can. The exam must be sent 24h before its realization in order to provide enough time to the HEI proctoring the exam for arranging everything.

On your side the process is the following one:

1. When the ROI receives the exam, it forwards it to the HEI (or HEIs) proctoring the realization of such exam. Despite sending it in advance, the exam will be performed the same day and the same time of the one carried out here in Valencia.
2. A pdf version of the answers sheet provided by students will be requested to the HEI proctoring the exam. Once such pdf will be received, it will be forwarded to you in order to grade the student.
3. The original copy of the answers sheet will be also addressed to you office as soon as it will be received.

Please acknowledge this email and your availability to supervise the exam. Detail us the date, time and duration of the exam and the material that the student can use for its realization.

Regards,

IRO

3.6 Proctoring the exam and Grading the Student

As previously stated, the policy that is under description is based on a trust chain involving the IRO of the students' home HEI, its teaching staff (represented by the teacher coordinating the course under exam – the TEACHER) and finally the person belonging to the staff of the students' host HEI that proctors the exam (represented by someone - either belonging to the administrative or teaching staff – whose identity can be verified: the PROCTOR). The guarantees that can be obtained from the correct realization of the exam rely on this trust chain.

Sometimes the TEACHER may ask for additional security measures, which is something not surprising if one considers that the ETSINF is an school of computer science. In such case, the exam sent by the TEACHER to the IRO can be encripted with a password. Obviously, the IRO does not include the password in the email where the exam is sent to the PROCTOR. It typically phones the PROCTOR in order to communicate such password.

On the other hand, the PROCTOR may ask for a written official request from the IRO in order to deploy the required process to supervise the exam. This is not a problem as far as the vice-dean of international relations or the dean of the school can sign such request. However, sometimes some entities (such as consulates or embassies) as for official request signed by the university rector, which is something more difficult to obtain if the service is not in the directory of services offered by the university. This type of special request arrives when proctoring a distance exam is not a service provided by the host HEI. In such cases, students use to explore other alternatives like the supervision of the exam by other official entities.

As Table 3 reflects, in order to assess the respect of the date, time and duration of the exam, and START and STOP emails are requested from the PROCTOR. The START exam must additionally include a verification of the identity of the student. Under such guarantees of fairness, the TEACHER can accept that the exam is carried out under acceptable conditions and can grade the copy of the answer sheets sent by the PROCTOR at most 30 minutes after the end of the exam. This latter requirement avoids the replacement of the answers by other carried out after the time. It must be noted that the recommendation to the TEACHER is to grade student exam using the pdf copy of the answers, but wait for the reception of the original copy to make the results official. So the student will not officially fail or pass the course until the original copy of his/her answers sheet is received.

3.7 Final considerations

Two final important considerations must be reported, since they directly affect the final grade obtained by the student performing the distance exam.

The first one relates to the loss of the original copy of the answers sheet sent the TEACHER to the IRO by postal email. In that case, the policy relies on the trust chain established between the IRO, the TEACHER and the PROCTOR and basically the pdf copy sent by email is considered are being the original one. It must be noted that the confidence on the originality of such copy can be increased if the pdf copy sent is encrypted using a password previously agreed by telephone between the IRO and the PROCTOR.

The second consideration points to the detection of copy in the exam. This situation may happen in case of organizing a multiple distance exam at the same HEI. Typically the proctor should ensure that this will not happen, but as in any exam, students can put a lot of effort and imagination to pass the exam using fraudulent means. In that case, the procedure to follow in order to demonstrate the copy and invalidate the exam depends on each HEI. It is typically the TEACHER the one responsible for demonstrating the copy. In the case of UPV, the written advice of the legal services is required in order to invalidate the exam. The PROCTOR integrity and honesty is never placed in question unless the situation repeats several times. It is very important to note here that the relation between HEIs can be compromised due to this type of situations. This is why it is important to understand that students can copy in exams and sometimes these cheat actions are difficult to detect, as shown in [9]. So the trust chain must remain unbroken in case of a singular event like this one. The trustworthiness of the chain should only be placed in question when multiple repetitions of this situation arise with the same PROCTOR.

4 Summary and Discussion

Previous sections has first motivated the interest and need of providing distance exam from IOs as a service of added value for promoting and supporting the participation of students in HEI's international Exchange programmes. However, it is difficult to find out in the bibliography articles describing distance exam policies and reporting the experience of HEIs in this domain.

In most of the cases, distance exams are managed as a technical level and discussion is mainly focused on the support provided by e-learning platforms to online exams [10] and remote exam proctoring [11]. Despite the importance of such technical aspects, the goal of this paper is to abstract from the technology supporting the policy and focus on the policy itself to distil its essence, discuss about it to finally refine and improve it. Although coping out of the purpose of the present publication, it is worth mentioning that the problem of how to automate or support the deployment of this policy using an e-learning platform is different and comes into scene later; once the policy has been well established and reaches agreement.

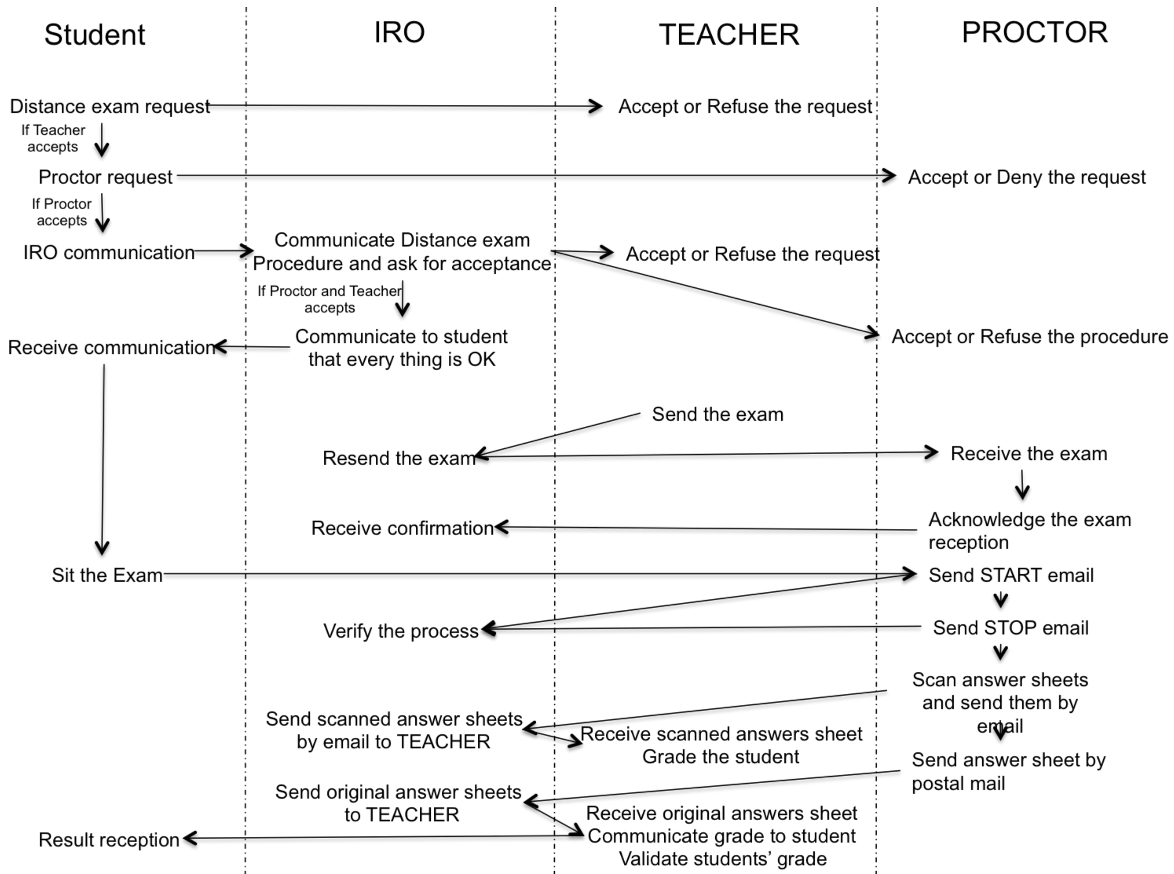

Fig.1. Proposed policy for the organization of distance exams

A global overview of the distance exam policy that is proposed is this paper is provided by Fig. 1. Although it is quite sure that other HEIs apply similar policies, it is very difficult to find out references to the processes that they deploy to cope with distance exam. The university of Kueleven in Belgium enable in some cases the re-taking of exams 'at distance' but only during its official exam period, which could not meet the one of the partner HEI [12]. This is explained by the fact that

Kueleven's distance exam policy is only designed to retake the exams failed by incoming students during their exchanged period. So, the support provided to students is partial, since the policy only applies to incoming students. The ETSINF policy applies to both incoming and out-going students and deadlines are only imposed to out-going ones, thus providing an increased degree of freedom to incoming students.

5 Conclusion

This paper has summarized in some pages the experience of the School of Informatics (ETSINF) of the Technical University of Valencia (UPV) in the organization of distance exams. The contribution has motivated the expected benefits for students of defining a public policy for managing this matter. Since the Bologna implementation of the ETSINF bachelor in computer is quite recent, there are not quantitative results available indicating precisely the impact that this service has in practice. However, what has been already assessed is that students are not anymore worried about their exams and they simply focus their efforts on what really matter succeed in their studies and take all the possible benefit from their exchange experience.

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Engineering Education in Third Countries through International EU Cooperation Programmes

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Conference Key Areas: International Cooperation Programmes, The Global Engineeer, Education and Research.
Keywords: International Cooperation, Third Countries, Global Engineering Education, Design of photovoltaic solar cells, Economy of photovoltaic solar energy plants.

Abstract

Engineering Education methods indeed depends on the location of Universities and the cultural heritage and characteristics of their respective sites. However, Engineering education methods tends to be uniform all over the world and in this sense International Cooperation Programmes are well suited to achieve homogenization of educational methods in Engineering. In particular IDEAS program, funded by EU, aims to establish a mobility network between Europe and Asia, to exchange excellence in research and education in several relevant disciplines; such is Innovation, Design Engineering and Environmental Science. It will expend the experience of European partners in student and staff exchange to the partner institution in Asia, and thus disseminate good practices with regard to organization and mobility. This paper describes the experience of two participants from Pakistan hosted in the Universitat Politècnica de València (Spain) in the frame of IDEAS programme. The Pakistan students are preparing their doctoral thesis in a subject related to renewable energies using an approach that involves both engineering and capital budgeting techniques.

1 Introduction

The aim of European Union cooperation programmes between Asian and European countries is to promote scientific and technological education as well as to share different sensibilities of researchers from both regions. An aspect to bear in mind is multidisciplinary training for engineers, in that way the academic training has to cover a broad range of items, from pure engineering to economics techniques.

2 International Cooperation Programmes

2.1 UE International Cooperation Programmes

The aim of European Union cooperation program between Asian and European countries that how to promote scientific, technological education and share different ideas of the researcher between both regions.

The most important motivation for scientist or researchers to cooperate the goal of doing state of art science on a topics of mutual interest and relevance, the feeling to contribute to the development of a country or the solving of global challenges, in the ideas cooperation project between Europe and Asia also giving financial support in the field of research, there is a bias towards Asians researcher like, Pakistan, India, Nepal, Button etc, coming to Europe.

Quality metrics for assessing the success of international European Union cooperation project have to be further developing, like regional training networks, joint research center and other joint research infrastructure can help to increase cooperation intensity.

For gathering information from the researcher is one of the main goals of European Union cooperation level between the two regions in the future. Due to international cooperation we are two research students from Pakistan doing research in the field of solar energy in UPV, and after research we don't want to break this international cooperation relation.

For further development in the field of research we want to sign MOU between our home university and UPV to promote and develop a new research center for the next generation.

2.2 IDEAS program

The overall objective of the ideas project is to create a partnership in research and education that will strengthen the ties between Europe and Asia, with a special focus on innovation and product realization in a global context. The project will provide student with an excellence in scientific and technological domains, based on both theoretical foundation and practical experience with an international perspective, and prepare them to participate in building and managing complex and large systems and infrastructures.

The project will establish a mobility network between Europe and Asia, to exchange excellence in research and education in several relevant disciplines; such is Innovation, Design Engineering and Environmental Science. It will expend the experience of European partners in student and staff exchange to the partner institution in Asia, and thus disseminate good practices with regard to organization and mobility.

IDEAS also facilitate the mobility of students and academic staff through a scholarship scheme, curriculum development of the individual, the transfer of know how, and the exchange of best practices. Although the funding of this specific lot is only for mobility from Asia to Europe, we will strive to implement the mobility in both directions. The emphasis will placed on capacity building aspects, in particular the ability of the partner institutions to handle international mobility and large international cooperation projects.

The project is also provides the long lasting value to the individual involved, who take benefit from a study/research period abroad. As the IDEAS consortium offers a wide range of thematic fields, many individual mobility demands will find the right educational or research environment at the Host Institutions. This will contribute to develop a pool from well qualified, open-minded and internationally experienced young women/men as future leaders.

The IDEAS project will primarily focus on collaboration in science and high technology domains with a special focus on the thematic fields Innovation, Computer engineering, Financial Engineering and Environmental science.

3 Engineering of Renewable Energies

3.1 Solar energy

Solar energy is energy derived from the Sun's radiation. The Sun is a powerful source of energy and provides the Earth with as much energy every hour as we collectively use in a year worldwide. It is important that we continue to harness and increase our use of solar energy (and other clean, renewable energies) as fossil fuels become depleted, expensive, and fall out of favor with their consumers (What is solar energy?, 2014). Solar energy technologies use the sun's energy and light to provide heat, light, hot water, electricity, and even cooling, for homes, businesses, and industry.

a) Thermal energy: Thermal energy is the part of the total potential energy and kinetic energy of an object or sample of matter that results in the system temperature. It is represented by the variable Q, and can be measured in Joules.

b) Thermo-electrical energy: The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice-versa. A thermoelectric device creates a voltage when there is a different temperature on each side. Conversely when a voltage is applied to it, it creates a temperature difference (known as the Peltier effect). At atomic scale (specifically, charge carriers), an applied temperature gradient causes charged carriers in the material, whether they are electrons or electron holes, to diffuse from the hot side to the cold side, similar to a classical gas that expands when heated; hence, the thermally induced current.

c) Photovoltaic energy: Semiconductor materials (like those used in computers) make up solar cells and are used to convert photons (e.g. light) to electricity. PV arrays consist of solar cells which can come in a variety of shapes and sizes. The PV array on a house generating electricity is likely made of traditional crystalline silicon. Alternatively, thin film solar utilizes stacked semiconductors only a few micrometers thick that can be applied as roof shingles or solar window tinting to generate electricity. What thin film gains in versatility and price reductions, it loses in terms of conversion efficiency. Typical solar cells have an efficiency of around 15%, although there are models that are up to 21% efficient.

3.2 Photovoltaic solar energy

Energy derives from the sun as solar radiation. Solar energy can be used in two different manner passive solar and active solar. To convert the sun radiation into current by using photovoltaics is the active form while passive solar techniques is to design spaces that naturally circulating air. There are several types of PV solar cells.

3.2.1 Silicon based Solar cells

Crystalline silicon (c-Si) solar cell first developed in the Bell Lab in 1953 with an efficiency of 6%, yet have dominated the Photovoltaic market from their first birth and due to the prominence of silicon in the integrated circuit market. Si solar cell used in the space program from that time. Silicon is abundantly available hence cheap and used abundantly in many electronic devices. The highest efficiency reported yet is 25 % for c-Si solar cell (Zhao, 1998). Basic schematic of crystalline silicon on glass (CSG) is shown in Figure 1. The top layer is the emitter and the bulk material is considered as base. Si has a low absorption coefficient and its indirect band gap is low from that of the ideal 1.5 eV. The market share for c-Si solar cell is above 80 %. The subdivision of Si solar cells are monocrystalline, multicrystalline and ribbon silicon solar cell (Glunz, 2012).

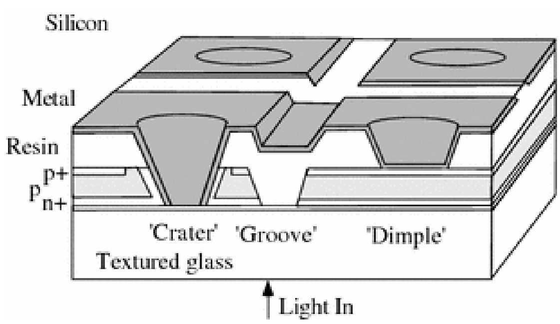

Fig.1. Crystalline silicon on glass (CSG) unit cell structure.

Crystalline silicon on glass (CGS) is the new era in silicon-based technology (Green M. A., 2004). To overcome the difficulties for silicon wafer-based technology at the lowest possible prices for large-scale photovoltaic application, the CGS might be the best alternative.

3.2.2 Thin-film chalcogenide solar cells

I-III-VI chalcopyrite materials have some very desirable properties for PV application. The bandgap for $CuInSe_2$ is 1.53 eV, an Ideal material for PV purposes. Further, the bandgap can be controlled by alloying with Ga, Al or S (Chopra, 2004). Moreover $Cu(In,Ga)Se_2$ has gained worthy reputation

with high efficiency. The experimental results reported give the efficiencies above 20%. A higher value of 20.1% and 20.3% efficient CIGS solar cell for 1 sun is reported (Jackson, 2011). The basic schematic of a thin-film CIGS solar cell is elaborated in Figure 2.
The efficiency for concentrated (multi sun) is 22.8% reported in the latest literature. The basic schematic for CIGS in Fiure 2, consist of a p-CIGS absorber layer with combination of n-CdS layer and ZnO window layer. The bandgap here is a function of Gallium and can be varied from 1.0 – 1.72 eV, its change causes the effect in the variation of other solar cell parameters (Ullah, 2014).

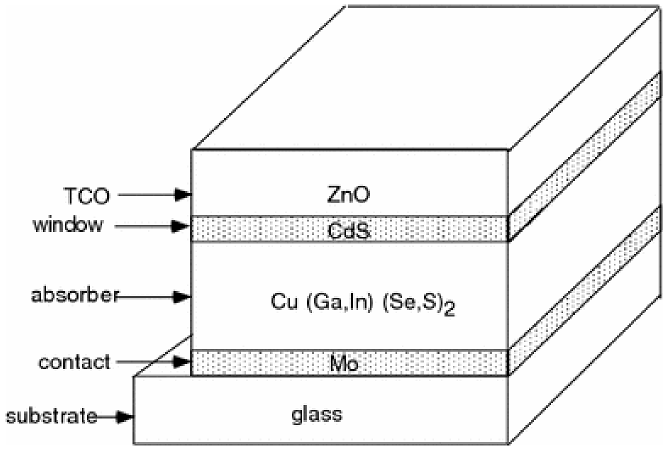

Fig.2. Schematic of a thin film CIGS solar cell

Simulation results giving efficiency above 25% are also published. Though its efficiency is high but still it difficult to commercialize due to the availability of resources and particularly the rare metals Indium (In) and gallium (Ga) that ads to the cost of CIGS based technology (Andersson, 2000).

3.2.3 Cadmium Telluride (CdTe) solar cells

CdTe has a direct bandgap with 1.5eV an ideal absorber material for high efficiency with low cost. It absorption coefficient (~10 5 /cm) is very good, a layer thickness of a few micrometer is sufficient to absorb ~ 90 % of the incident photon. Conversion efficiency of 19.6 % has been reported (Green, 2014).

3.2.4 Tandem (multi-junction) solar cell

The aim of multi-junction solar cells is to exploit and convert all the incident photon from the sun into electricity. Because the major factor of energy loss is due to the gap between the photon energy and the bandgap energy Eg of absorber material.

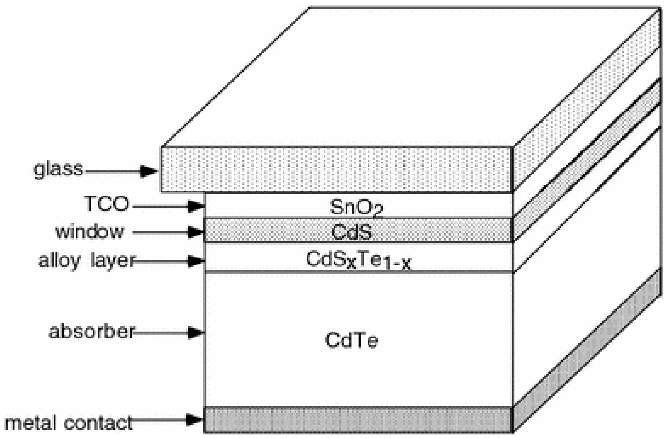

Fig.3. Device schematic for a cadmium telluride cell

A tandem (multi-junction) solar cell is the combination of two or more solar cell and an intervening buffer layer between two cells. Each cell absorbs the corresponding wavelength and the resultant efficiency increases. The highest efficiency with 44.7% has been reported recently for a concentration of 297 suns (Dimroth, 2014).

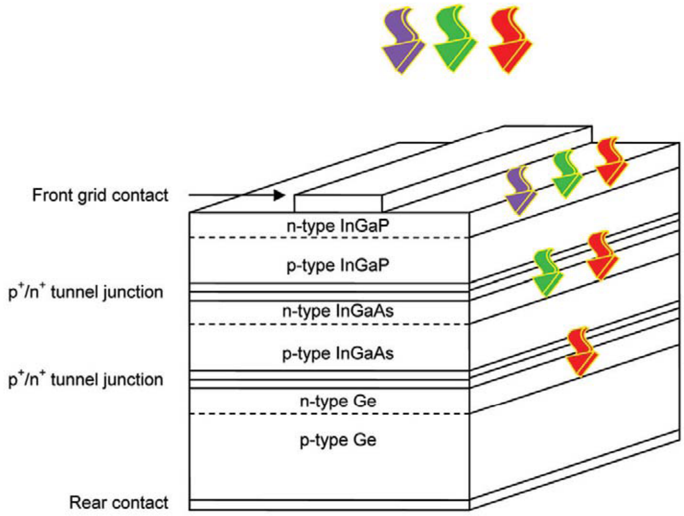

Fig.4. A simplified schematic of a three-bandgap tandem solar cell. The bandgap of each cell decreases from the front to the back, giving both spectrum splitting and photon selectivity.

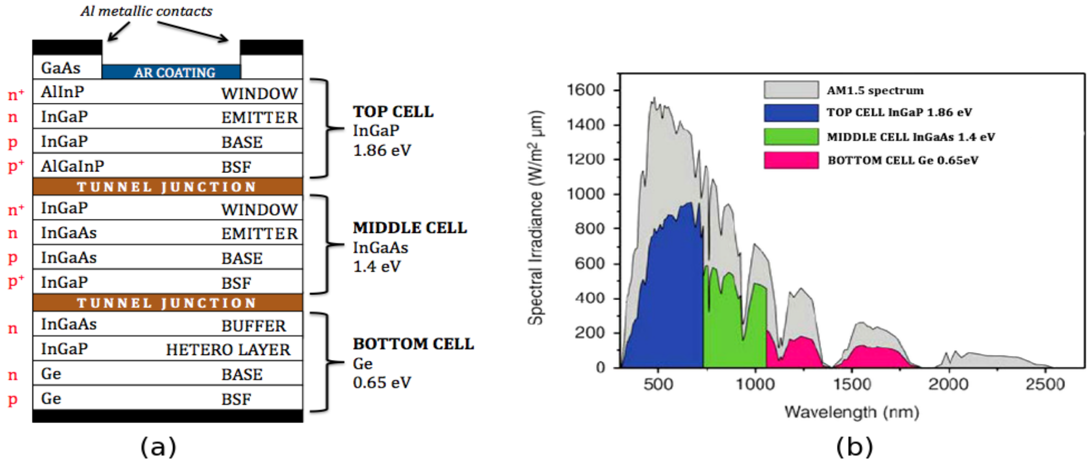

Fig.5. The structure of a MJ solar cell. There are six important types of layers: pn junctions, back surface field (BSF) layers, window layers, tunnel junctions anti-reflexive coating and metallic contacts. (b) Graph of spectral irradiance vs. wavelength λ over the AM1.5 solar spectrum.

3.2.5 Other Solar cell Technologies

Apart from the activities outlined above, a number of other kind of organic-non organic and mixed solar cell developed. The efficiency of organics is lower than other, but they are catching up at a fast pace, due to it cheap material availability and processing. Many centres like Mitsubishi chemical, Konarka, Heliatek and Solarmer Energy Inc. work on organic solar cell and have claimed efficiencies above 8.13 %, Organic thin-film with efficiency of 10.7 % is reported (Robert, 2011). Dye sensitised solar cell with efficiency of 11.9%, (Komiya, 2011) and with a mini-module, 9.9% is reported (Morooka, 2009). A low cost thin film-solar cell $Cu_2ZnSn(S,Se)_4$ abbreviated as CZTSSe solar cell have gain a highest research attention. 12.0% efficiency for a small area copper-zinc-tin-sulphide/selenide (CZTSS) cell that is fabricated by IBM and measured at the Newport Technology and Application Centre (Winkler, 2013). The research and development in the field is booming, the challenges to improve the energy conversion efficiency, as well as to improve the durability and stability of the devices.

3.3 Dedicated tools for understanding PV solar cells

Numerical modeling is increasingly used to obtained insight in to the details of physical operation of PV solar cells. Several modelling tools have been developed to measure the different parameters of solar cells. Different research groups and universities uses different type of PV softwares. Some of the most commenly used softwares are discussed and the possibilites as well as the shortcomming are discussed.

3.3.1 SCAPS

A Solar Cell Capacitance Simulator (SCAPS) is a one dimensional solar cell simulation programme developed at the Department of Electronics and Information Systems (ELIS) of the University of Gent, Belgium. Many researchers have contributed to it's development (Burgelman, 2013). It is designed as a general polycrystalline thin-film device simulator. SCAPS is used for modeling CIS, CGS, CIGS and CdTe based solar cells. The current virsion avalible is 3.2, and our discussion based on 3.2.

It is easy to enter a new problem for new users. Up to seven (7) semiconductor layers can be added to the device and all the required physical parameters can be graded in a new window if required. Some parameters are temperature dependant like effictive density of states and the thermal velocity and other parameters such as the band gape and mobility are independent of temperature. Shockly-Read-Hall (SRH) formalism is used for recombination at the interface states and in deep bulk level and their occupation.

SCAPS can be used for measuring spectral responce, J-V, C-V, C-f and Q-V. Each measurement can be calculated for light or dark condition and as a function of temperature. All the simulation and measurements are shown on screen for each intermediate voltage or wavelength. This intermediate solution can then be saves to a file. After completing the measurements it can be saved and can be compare with other measurements and simulations (Marc Burgelman, 2004).

3.3.2 AMPS-1D

Analysis of Microelectronics and Photonics Structures (AMPS-1D) is the one dimension (1D) program written by S. Fonash and co-workers of Pennsylvania State University (University) It was engineered to be a very general and versatile computer simulation tool for the analysis of device physics and device design. It is a one-dimensional (1-D) device physics code, which is applicable to any two terminal device. It can be used for diode, sensor, photo-diode, and photovoltaic device analysis.

It is possible to work on several problems simulation simultaneously in a separate window, to inter or define a new problem is an easy task. It has a clear and intuitive user interface and also help function. It support up to 30-layers in which each layer having its own sets of parameter. Some parameters are temperature dependent and other are temperature independent like (effective density of states, band-gap, mobility). For each layer up to 50 deep donor and acceptor level can be assigned. Exponential band tails states are also possible to define in AMPS. To simulate uniform and graded junctions for layers are possible.

Absorption coefficient, spectrum intensity and wavelength have to be interred manually which is an issue, if it read these data from the file will be more user friendly.

When all the requirements and definition for the layers are completed and the simulation requirements are fulfilled, the user can calculate J-V, spectral response measurements for both light and dark and when the case is submitted to the queue and they will calculate all the parameters and will save it. Once the results are calculated, they can be analysed with any plotting program and the results will be compared and analysed.

3.3.3 AFORS-HET

It is a numerical simulation of solar cells and measurements. AFORS-HET stands for Automat FOR Simulation of HETerostructures. The discussion is based on version 2.4.1.

It can be used for modeling of an arbitrary 1D sequence of semiconducting layers and interfaces, EQ equilibrium, steady-state DC, small sinusoidal pertubation AC and general transient TR calculation mode. It can be used for arbitrary parameter variation and parameter fitting, band diagram, local cell currents, recombination, phase shift. In DC measurements I-V, QE etc can be easily measured (HZB). In AC measurements impedance IMP, capacitance-Voltage C-V, Capacitance-Temperature C-T can be measured.

3.3.4 PC1D

PC1D was developed in Sandia National Labs by Basore and co-workers. It was further developed by UNSW Australia. It is widely used for Si cells as a standard and widely spread in PV research community. It also used for thin-film cells.

To define a new problem in PC1D is quite simple. It has a very clean user interface. The cell and layer structure is shown on the screen, and by clicking on a parameter its values can be altered. It supports up to five semiconductor layers which are really less in the case of CIGS/CIS thin-film solar cells.

The common recombination mechanisms Auger, band-to-band and trap-assisted tunneling (Hurkx model) are implemented. In case to introduce a deep level, only one deep level can be introduce. Space charge connection with deep level is not defined.

The parameters that can be simulated are J-V characteristic curve, spectral response measurements and transients. The result can be viewed in a separate window and the data can be copied and saved.

3.3.5 ASA

Amorphous Semiconductor Analysis (ASA) is especially designed for amorphous silicon devices and was written by M. Zeman, M. Kroon, J.Van den Heuval and other co-worker at the Deflf University of Technology. ASA does not use a graphical user interface but all the discussed programs has this facility.

To define a problem and fed into the ASA is not an easy job, you will always need a manual. To define a problem, commands are written in an ASCII input file, each command start with a keyword and is follow by the parameter value.

On the other hand ASA is a very flexible program too, the number of layers as well as the number of discretization nodes is large.

3.4 Some examples of PV device simulation using SCAPS

3.4.1 Effect of CdS buffer layer thickness

The thickness of n-CdS layer tainted from 10 nm to 90 nm with a 20 nm step. The 10 nm thickness gives a decent IV curve whilst the 90 nm give a worst IV curve. The graph of Fig.6 shows I-V curve for different thicknesses of the CdS buffer layer. The value of Voc and Jsc decreases slightly, with increase of CdS buffer layer thickness, high photon would lost due to thicker buffer layer which will absorb energy caring photon before reaching to the absorber layer. Thicker layer will also cause decrease of quantum efficiency. The optimum thickness should be 40-50 nm.

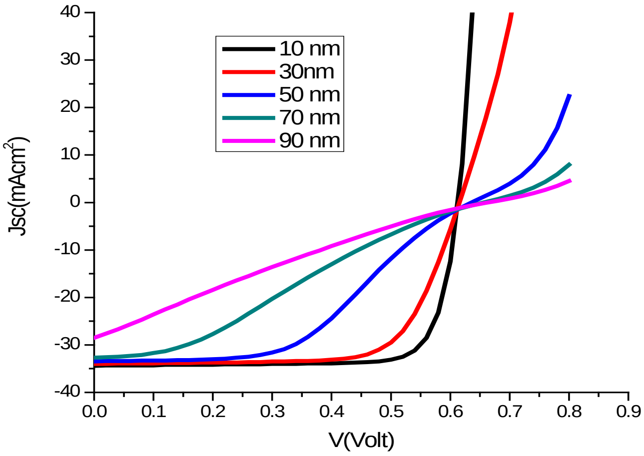

Fig.6. Cell performance with various CdS thickness

3.4.3 J-V characteristic of a PV device

The current-voltage curve is given in Figure 7. For dark it will give a minimum value of current that is due to the minority carriers. By illuminating the cell by 1-Sun, Air Mass 1.5 global spectrum, on a horizontal plane the PV process starts and due to the charge carriers produced by incident photons will cause current *(Riordan, 1985)* [6-7] *(Partain, 1995)*

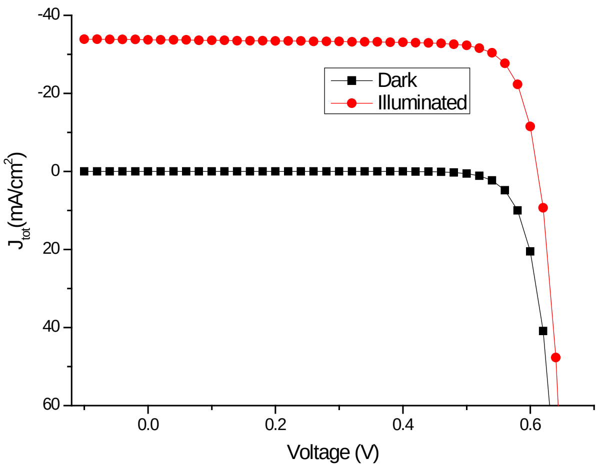

Fig. 7. J-V characteristic of a PV device for dark and illumination

3.4.4 Quantum Efficiency Analysis

The conversion efficiency of a photovoltaic (PV) cell, or solar cell, is the percentage of the solar energy shining on a PV device that is converted into electrical energy, or electricity. Improving this conversion efficiency is a key goal of research and helps make PV technologies cost-competitive with more traditional sources of energy. The Quantum efficiency, QE (%) graph is given in Figure X3. It explains the details about quantum efficiency QE (%). The QE is the ratio of the number of charge (electron-holes) carriers collected by the solar cell to the number of photons of a given energy incident on the solar cell (Stephen Fonash, 2010) [9].

It is a function of wavelength and can also be represented as a function of energy. The quantum efficiency is 1 or 100% when all the photons absorbed by the absorber layer and all the resulting carriers are collected. The mathematical description is given in the introduction. The conversion efficiency of a photovoltaic (PV) cell is the percentage of the solar energy shining on a PV device that is converted into electrical energy. Improving this conversion efficiency is a key goal of research and helps make PV technologies cost-competitive with more traditional sources of energy. The spectrum for variation in Gallium contents is given in Figure 1. The absorber layer absorbs those photons whose wavelength is either equal or greater than the bandgap Eg of the absorber material (Hanif Ullah, 2013) [10].

The low energy photons cannot be absorbed and the high energy photon will contribute in thermalization process. Due to different loses like spectral mismatch, shading losses, incomplete absorption and collection losses will make decrease the efficiency (Soga, 2006) [11].

4 The Global Engineer

4.1 Dual formation Engineering & Related economy

In a world where exists a dualism between the increase global energy demand and depletion of resources together with the pernicious effects of the climate change, make that the use of renewable energy should be displayed and practiced in all areas and countries. A way to help the disseminating of these techniques is not only showing his ecological validity, but also their economic efficiency. A necessary element in this framework is a positive return that has to be emphasize by engineering, that are and ultimately responsible of the decision maker process in the implement of technology.

Engineering students should be aware of the most efficient technologies for generating green electricity but also they should be able to submit the related economical features to investors. Therefore a basic knowledge of economic techniques for justifying the investments is essential. To promote the dissemination of this technology for both small businesses and individuals, engineers have to show companies the related economic studies and be able to advise them as a way to diversify the business and achieve the return on assets. In case of domestic economies investment in renewable energies can be presented as a long-term, easy and safe investment that do not require any specific financial or technological knowledge.

In this global scenario new competencies are required for modern engineers regarding generation of green energy through PV installations. These competencies should include both technical and economical knowledge. Technical knowledge related to existing technologies and how to install and calculate the energy production of a PV plant and financial awareness for presenting return analysis and other financial parameters of PV installations. In particular we have developed an example of a medium size PV installation located in Spain. This example could be adapted to other locations by taking their respective solar irradiation data.

4.2 Regarding PV solar energy as an investment

To make clear the profitability variation of an investment in a photovoltaic power plant in Spain we will apply the capital budgeting criteria. We estimate the return of a photovoltaic installation of 20 kWp mounted over a warehouse roof or any other roof with a surface of 200 square meters around, the installation starts activity at the beginning of year 2012, because at the moment in Spain are waiting for new legal regulation.

The energy production of a PV system is the product of the peak power of the installation and the average of Peak Sun Hours (PSE) in Spain; taken as 1.494 h. Technical specifications for solar panels warn power degradation estimated in 0.5% each year, this characteristic has been taking in account in our analyses.

The applied tariff for solar PV electricity generation has been the current tariff published for 2012; and it has make use of prevalent legislation; and later the solar PV installation is studied with a lifetime of 25 years, because the PV modules manufacturer guarantee an electricity production of PV modules higher than 80 % after 25 years. In the tariff have been taking in account an inflation rate of 2% yearly. So the incomes for the two first years are:

$$Income\ Year_{2013} = 15.0938€ \times 298.8 = 4{,}510.03€$$

$$Income\ Year_{2014} = 14.4258€ \times 297.1 = 4{,}586.20€$$

The expenditures considered in the solar PV installations are insurance and maintenance. With the aim of include inflation these payments were conditioned to yearly incomes, and prevailing market conditions. In Spain these charges are estimated to be 3% of income for the maintenance and 6% of income for insurance. Total expenditures are 9% and are calculated:

$$\begin{aligned} Expenses_{2013} &= (4{,}510.03€ \times 3\%) + (4{,}510.03€ \times 6\%) = 405.90€ \\ Expenses_{2014} &= (4{,}586.20€ \times 3\%) + (4{,}586.20€ \times 6\%) = 412.76€ \end{aligned} \quad (1)$$

To estimate the capital outlay prevailing market conditions have been used, for a solar PV power plant of polycrystalline silicon of 20 kW peak power and is 60,000.00€.

Cash Flow is estimated as the difference between incomes and expenses, again for years 2013 and 2014 are:

$$\begin{aligned} Cash\ Flow_{2013} &= 4{,}510.03€ - 405.90€ = 4{,}104.12€ \\ Cash\ Flow_{2014} &= 4{,}586.20€ - 412.76€ = 4{,}173.44€ \end{aligned} \quad (2)$$

After estimating the Cash Flow for the 25 years of lifetime for the PV plant, we can obtain the Net Present Value (NPV). The NPV is the difference between the value of incomes and the expenses from an investment, up to date at the investment time, thus the NPV provides an estimate of the net financial benefit provided to the organization if this investment is undertaken (Jackson J. , Promoting energy efficiency investments with risk managememnt decision tools, 2010). A positive NPV means a positive surplus indicating that the financial position of the investor will be improved by undertaking the project. Obviously, a negative NPV would indicate a financial loss.

$$NPV = -D + \sum_{j=0}^{n} \frac{CF_i}{(1+i)^j} \quad (3)$$

Where D is the capital outlay, is the interest rate, and n is the technology life. With a rate of 5%

$$\begin{aligned} NPV = -60{,}000.00€ &+ \frac{4{,}104.12€}{(1+5\%)^1} + \frac{4{,}173.44€}{(1+5\%)^2} + \cdots \\ &+ \frac{6{,}130.29€}{(1+5\%)^{25}} = 8{,}278.98€ \end{aligned} \quad (3)$$

Emphasis must be given to three results in NPV estimation:

1. The NPV recognize that a euro today is worth more than a euro tomorrow.
2. NPV depends on the forecasted Cash Flows from the project and the expected cost of capital.
3. NPV presents values measured in today´s euros.

We have obtain a NPV positive that means that this investment provide net benefits to the firm. In Figure 1 has been represented the NPV for cost of capital form 0% to 11%. We found a positive NPV to 6.23%. After this cost the NPV is negative

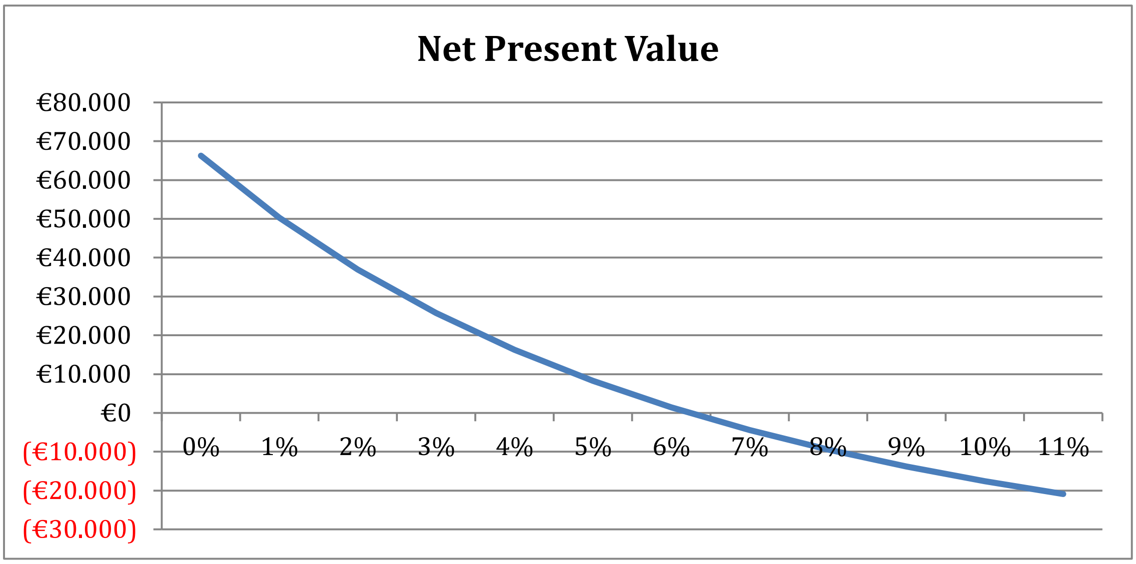

Fig. 1. NPV for a 20kWp photovoltaic plant in Spain.

When the NPV is zero, it is precisely the called Internal Rate of Return (IRR). The IRR is defined as the rate of interest that equates the NPV of a series of Cash-Flow to zero. Mathematically the IRR satisfies the equation: (Hossain, Woods, & Bala, 2005)

$$0 = -\mathrm{D} + \sum_{j=0}^{n} \frac{\mathrm{CF_i}}{(1+\mathrm{IRR})^{j}} \tag{4}$$

IRR is widely accepted and used in the appraisal of projects because it is an indicator of the expected return of profitability of the project; the IRR is easily compared with the banking worth rates or the cost of the funds used to finance the project. The result we have obtained indicates that for a below 6.28% cost of capital, the investment create net profits for the company.

4 Summary

Funded by the EU, IDEAS programme aims to establish long-term collaborations between EU and Asia countries. In our case we describe the work developed for doctorate Pakistan students in the Universitat Politècnica de València (Spain). The work has focused on renewable energies from two complementary points of view; design and simulation of devices and capital budgeting techniques.

5 Acknowledgements

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3-D Propagation Model for Dense Urban Street Canyon Propagation Environments

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Conference Key Areas: Engineering Design, Innovation in EE, Propagation model.

Abstract

In this paper, a 3-D scattering channel model for communication in streets and canyons is developed. Uniformly distributed scattering objects are assumed in a semi-ellipsoid shape region centered at the MS. The BS is assumed outside the scattering semi-ellipsoid. Antennas at both the ends of communication link are assumed omni-directional. Using the derived geometric stochastic channel model, mathematical expression for spatial statistics of the channel observed at both the ends of the communication link are derived. Based on the obtained theoretical results, a comprehensive analysis is given. Further, with the purpose to validate the proposed model, a comparison of the obtained results with famous models in the literature is presented. The proposed characteristic equation and results are useful to understand the behavior of propagation mechanism in urban streets and canyons communication environments. Such stochastic geometry based theoretical results can be used as a reference for field measurement campaign.

I.INTRODUCTION

For development of a communication system, various investigations, tests and assessments are required for its design and performance analysis. Such analysis usually require detailed information of the resources of the communication system, like capacity demand, link reliability, data transmission rate, modulation techniques etc. To satisfy such requirements, a good understanding of the behavior of radio propagation channel is highly required. For all such analysis, properties of radio propagation channels between each side of communication channel must be deeply understood. Scientists have contributed a lot in this respect. Yet proper knowledge of the multipath propagation environment is required to study the behavior of spatial domain parameters for improving the performance of the communication channels. The spatial characteristics of the mobile radio channels are beneficial in determining certain parameters i.e., the angular spread, angular constriction and direction of maximum fading, average fade duration, spatial correlation and coherence distance of the channel [1, 2]. In this regard, several 2-Dimensional/3-Dimensional geometrical propagation channel models were developed which describes the spreading of multipath components to characterize channel parameter. Literature shows that the propagation channel can be modeled by site information and complex measurements (i.e., in case of deterministic models) but statistical models give much more simpler and accurate measurements for modeling channel for any cellular environment [3]. On comparing results of 2-D with 3-D scattering models, literature shows that 2-D models are very simple to compute, but they don't generate channel's characteristics precisely. On the other hand, 3-D models provide very accurate results. The elevation plane in scattering environments are essential to be considered because spreading of multipath channels after being reflected from vertical objects has been seen to spread along vertical plane at 20° [4, 5].
A statistical channel model proposed by Liberti et al. in [6] represents the scattering object. This model uses a scatterer; confined in an ellipse having each end of communication link i.e., (BS and MS) positioned on its foci. A model proposed by Petrus et al. in [7] represents the scattering object uniformly dispersed inside a circle with MS positioned at its center. This model considers a BS region, vacant off scattering objects, thus works only with macro-cellular environments. PDF's of AoA is derived in [8], using

scattering object dispersed inside field of ellipse/circle. Arias et al. in [9] presented an elliptical model that employs micro-cellular environment. A statistical model used for scatterers, uniformly dispersed like previous ones, is also proposed in model [10]. Ertel et al. presented this model, which is typically used for all cellular environments and derives marginal AoA PDF, marginal ToA PDF, besides with joint PDF's of AoA/ToA. In [11], Insaf et al. proposed a statistical channel model and presented a close form expression; the Joint/ Marginal PDF's of AoA and ToA. Apart from models that use uniform distribution for modeling scattering objects, there are some that employ Gaussian distribution as presented in [12, 13, 14, 15, and 16]. Gaussian scatter density around the MS for deriving spatial temporal statistics of communication channel is presented in [12]. This model can control the vicinity in which scattering object lie by adjusting its standard deviation. The model presented in [12], proposed to be applicable for all types of cellular environments. Authors in [13] proposed a scattering channel model with Gaussian distributed scatterers around the BS, having both MS and BS placed inside the circular geometric region. This statistical model derives the joint PDF of AoA/ToA, the marginal PDF of ToA and marginal PDF of AoA at BS. It is used for outdoor microcellular and indoor microcellular environment using Rayleigh and exponential distributions calculations, respectively. Proposed in literature [14, 15], scattering object lies inside the MS field, having Gaussian distribution and BS bearing a directional antenna. Moreover, the spatial statistics of scattering channel either at BS or MS can be computed for all cellular environments. The eccentric scattering model [16] can also be used to model scatterers either by uniform or by Gaussian distribution feature, yet can be applicable for all types of cellular environments. The said model visualizes the angular statistics of scattering channel precisely.

In macro and micro-cell surroundings, the prominence of the inclusion of elevation plane in a model is prominent when the signals are reflected from rooftop and towering buildings. Hence, more distinct spatial and temporal statistics are presented when modeling the scatterers in three-dimension in the vicinity of MS. Various 3-D models that allows wave spreading in both the planes i.e., (Azimuth and elevation planes) are illustrated in literatures [4, 5, 17, 18, 19]. A statistical channel model in [17] used for macro-cellular environment, derives the relation between the power spectral density and angular statistics of propagation channel seen at BS only. Janaswamy proposes in [4] a scattering channel model that comprises high raised antenna at BS outside, and low raised MS antenna inside the spheroid. This model presents multipath waves spreading in azimuth and elevation planes which can be seen from Base-station and Mobile Station both in the form of analytical expressions. Baltzis et al. in [5] proposed a simple 3-D macro-cell model, assuming the scatterers uniformly spread inside the circular disk with low MS station and high BS station outside the disk. Inference of angle spread is presented in [5] consequence to multipath components on azimuth and elevation planes. This model is beneficial for evaluating performance of transmission channel from MS to BS. In [18], Alsehaili et al. proposes an ellipsoid shaped region, wherein distribution of scatterers is uniform; assuming the region enclosing the two stations. This model derives angular distribution of received multipath waves. Moreover its result is compared with a model based on ray tracing technique to certify the model. Authors in [19] proposed a generalized scattering model having MS employed at the center of semi-spheroid geometry by assuming scatterers, uniformly distributed in the vicinity of MS and elevated high directional antenna employed at BS outside semi-spheroid. This model derives the joint/marginal PDF of the AoA seen from both the communication links i.e. MS and BS.

Various propagation models characterize the urban street channels. Few of them are discussed in [20, 21]. But they modeled statistically not geometrically. In [22] Riaz et al. proposes a 3-D statistical model that comprises of uniformly distributed scatterers placed inside semi-ellipsoid around MS, employed for urban streets and canyons environments. The model also derives the angular statistics (i.e. marginal PDF's) of multipath signals obtained at each station. Nevertheless; still there is a scope to conduct the research for developing realistic 3-D channel model for the dense urban streets and canyons.

This research aims at the development of a 3-D propagation model for street and canyon environments. The rest of this paper is organized as follows: In Section II we have discussed the proposed 3-D model. The derivation of joint and marginal PDF's of the AoA seen at the MS and BS for azimuth and elevation angles along with theoretical results is produced in Section III. At the end in Section IV, the observations made on theoretical results are concluded.

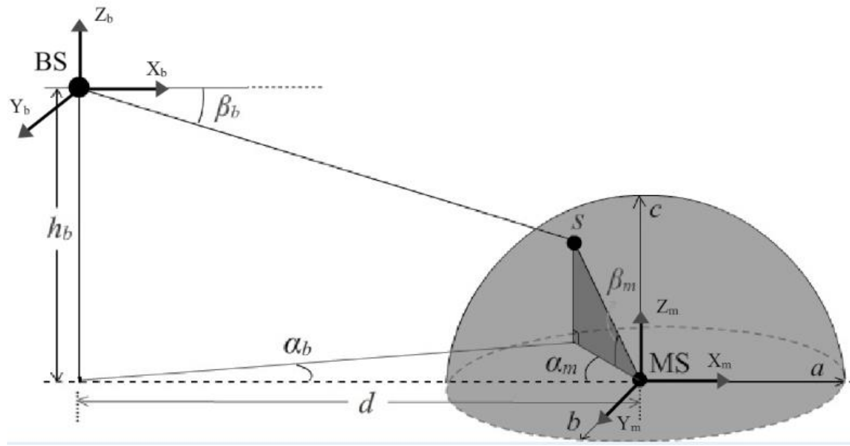

Fig. 1: Proposed 3-D scattering channel model for a microcell environment

II. 3-D MODEL PROPOSED

A 3-D scattering channel model for communication in streets and canyons is modeled shown in fig. 1. This model is designed based on few assumptions listed below,

1. MS is placed inside a semi-ellipsoid region with scatterers uniformly distributed inside this region around MS.
2. Power being incident on scatterers, are assumed to be reflected equally in all directions.
3. Multipath signals received at MS are assumed to arrive with same identical strength from horizontal and vertical planes.
4. The propagation between two stations (i.e. BS and MS) is assumed to occur through single scattering object.
5. The scattering objects have equal scattering coefficients in addition to uniform random phases.

This proposed model targets the communication scenario of streets and canyons in a microcell environment. This model assumes uniformly distributed scatterers confined inside a semi-ellipsoid. A low elevated MS is placed at the center of semi-ellipsoid and a high elevated BS whose height is considered to be greater than the average rooftop level of surroundings, is placed outside the semi-ellipsoid geometry at distance *d* away from MS. The proposed model is termed as 3-D because it defines the proposed scattering channel model in 3-dimension (i.e., a, b, c) represented by 3 different axis (i.e., x-axis, y-axis, and z-axis). Cartesian coordinates and Spherical coordinates of scattering objects with respect to MS is (*d*, *0*, *0*) and (r_m, α_m, β_m) respectively. While those with respect to BS are (*0*, *0*, h_b) and (r_b, α_b, β_b). The transformation relationships among the various coordinates systems are given by:

$$x = r \cos\beta \cos\alpha \quad (1)$$

$$y = r \cos\beta \sin\alpha \quad (2)$$

$$z = r \sin\beta \quad (3)$$

$$x_b = x + d, \quad x_b = r_b \cos\beta_b \sin\alpha_b \quad (4)$$

$$y_b = y \;, \quad y_b = r_b \cos\beta_b \cos\alpha_b \quad (5)$$

$$z_b = z + h_b, \quad z_b = r_b \sin\beta_b \quad (6)$$

A 3D ellipsoid can mathematically be expressed as,

$$\frac{a^2}{x^2}+\frac{b^2}{y^2}+\frac{c^2}{z^2}=1 \quad (7)$$

The volume of semi-ellipsoid can be expressed as

$$V=\frac{4}{3}\pi abc-V_{ep} \quad (8)$$

Where, V_{ep} is the volume of excluded portion due to intersection with ground plane. The volume of semi-ellipsoid can thus be expressed as,

$$V=\frac{2}{3}\pi abc \quad (9)$$

The distance r_m is the distance between the origins of MS to the boundary of semi-ellipsoid and can be computed as

$$r \;\; = abc\times\{a^2c^2\cos^2\alpha \;\; \cos^2\beta \;\; +b^2c^2\cos^2\beta \;\; \sin^2\alpha \;\;\; +a^2b^2\sin^2\beta_m\}^{\frac{-1}{2}} \quad (10)$$

Fig. 2 Shows the result of amount of scatterers in a particular physical direction. The region around BS is considered as free of scattering objects due to the reason that the BS is equipped with high-elevated omni-directional antenna, whose height h_b is greater than the average rooftop level of the buildings in its surrounding.

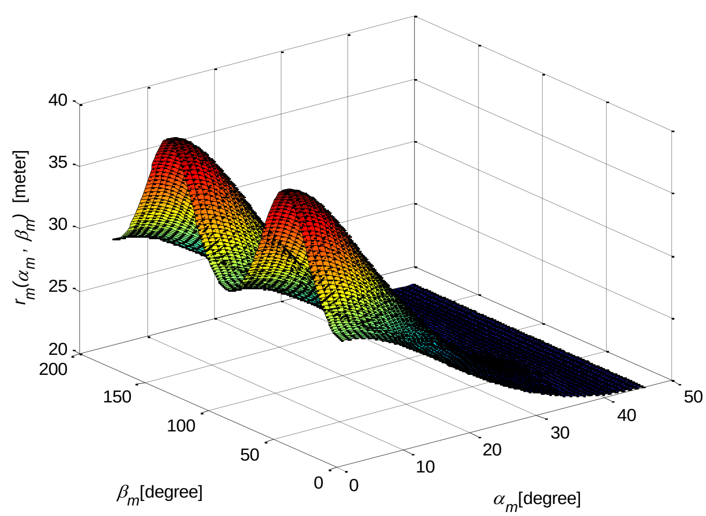

Fig. 2:-Number of scatterers present in a particular direction (h_b=100 m, d=400 m, a=40 m, b=30 m, c=20 m)

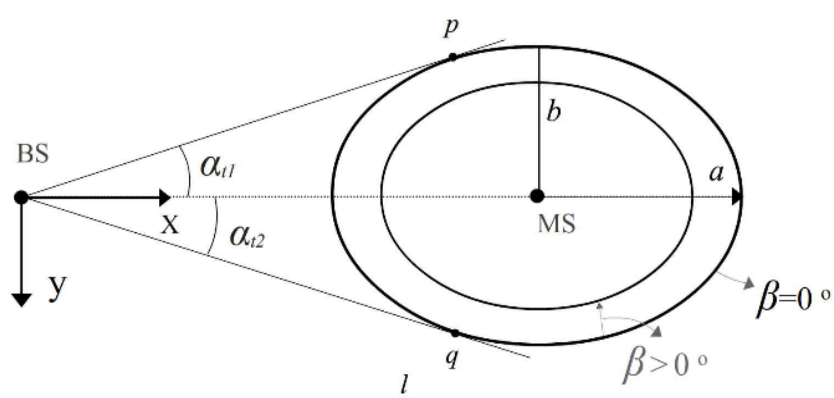

Fig. 3:-Top view of our proposed channel model

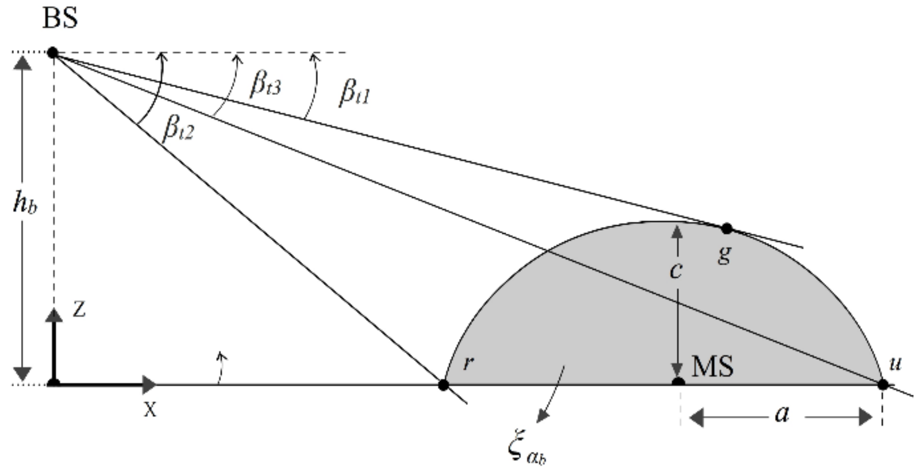

Fig. 4:- Proposed 3-D scattering channel model's side view

Fig. 3 shows the top view of our proposed model. It consists of the BS, the scatterers and the MS, Here, we assume α_{t1} and α_{t2} two azimuth threshold angles that touch the semi-ellipsoid at point's *p* and *q* tangent at zero degree elevation i.e., $\beta=0°$. It is assumed that scatterers lies inside these two angles in majority and decreases as its elevation angle increases from $\beta=0°$.

$$\left.\begin{matrix}\alpha_{t1}{}^{+}\\ \alpha_{t2}{}^{-}\end{matrix}\right\} = \begin{cases}\Delta, & \beta_m < \tan^{-1}\left(\dfrac{c}{d}\right)\\ 0, & otherwise\end{cases} \tag{11}$$

.
where,

$$\Delta = \tan^{-1}\left(c^2d^2 \pm \left(b^2c^2d^2\nabla - a^2b^2\nabla^2\right)^{\frac{-1}{2}}\right) \tag{12}$$

and

$$\nabla = c^2 - d^2\tan^2\beta_m \tag{13}$$

Fig. 4 considers the side view of our proposed model. The elevated angle β_b seen from the BS can rotate at different elevated angles to touch the boundary of our ellipse. β_{t1} touches at point g, β_{t2} touches at point *'r'*. β_{t1} and β_{t2} are elevated angles that encloses the whole geometry of semi-ellipsoid. By following numerous geometrical laws we calculated and achieved expressions of these elevated angles as below

$$\beta_{t1} = \tan^{-1}\left(\frac{h_b d - \left(h_b{}^2a^2 + b^2\left(d^2 - a^2\right)\right)^{\frac{1}{2}}}{d^2 - a^2}\right) \tag{14}$$

and

$$\beta_{t2} = \tan^{-1}\left(\frac{h_b}{d-a}\right) \tag{15}$$

The elevation angle β_{t2} touches the ellipsoid at point u and is expressed as

$$\beta_{t3} = \tan^{-1}\left(\frac{h_b}{d+a}\right)$$

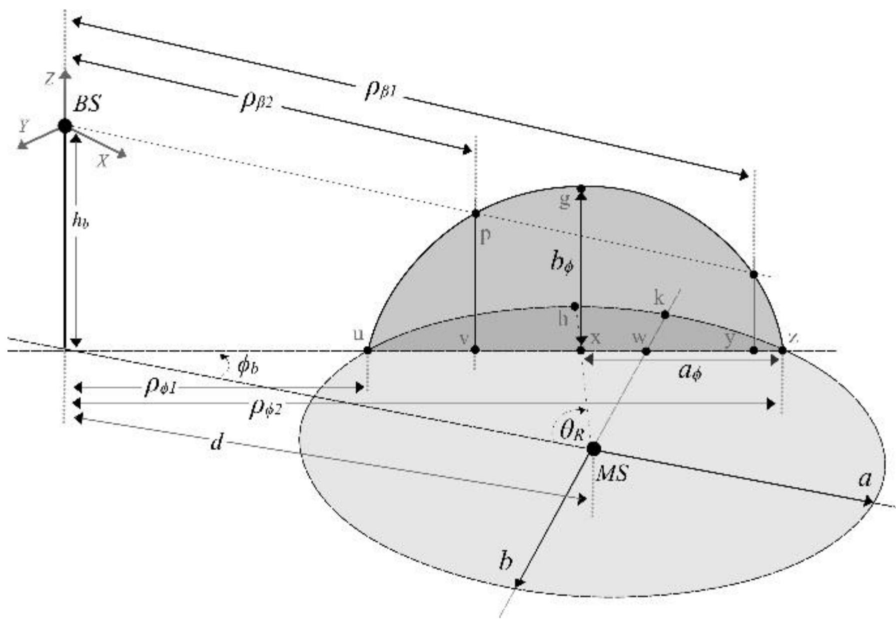

Fig. 5:- Cross-sectional view of proposed model.

The distribution function of uniformly distributed scatterers is,

$$f(x_m, y_m, z_m) = \begin{cases} {}^{1}/_{V}, & (x_m, y_m, z_m) \\ 0, & otherwise \end{cases} \tag{17}$$

where, V represents the volume in which scatterers can be enclosed as stated in (9)

$$V = \frac{2}{3}\pi abc \tag{18}$$

Fig. 5 shows the cross-sectional view of the model. Here, a_ε and b_ε are two axes of ellipse (i.e., major and minor), respectively that is seen vertical faced scenario for a fixed α_b (i.e., azimuth angle). These come out to be

$$a_\varepsilon = \frac{ab}{b^2\cos^2\alpha_b + a^2\sin^2\alpha_b}\{b^2\cos^2\alpha_b + a^2\sin^2\alpha_b - d^2\sin^2\alpha_b\}^{\frac{1}{2}} \tag{19}$$

and

$$b_\varepsilon = \frac{1}{ab} \times \{a^2b^2c^2 - b^2c^2\gamma^2\cos^2\theta_b - a^2c^2\gamma^2\sin^2\theta_b\}^{\frac{1}{2}} \tag{20}$$

where γ equals to

$$\gamma = (d^2 + \frac{1}{4}(\rho_{\emptyset 1} + \rho_{\emptyset 2})^2 - d(\rho_{\emptyset 1} + \rho_{\emptyset 2})^2 \cos\alpha_b)^{\frac{1}{2}} \tag{21}$$

In Fig. 5, angle Θ_R can be expressed as

$$\theta_R = \sin^{-1}\left(\frac{(\rho_{\emptyset 1} + \rho_{\emptyset 2}) \sin \alpha_b}{2\gamma}\right) \tag{22}$$

The distance from the BS to the center of ellipse in the above diagram is d_ε, expressed as

$$d_\varepsilon = \sqrt{{h_b}^2 + \left(\frac{\rho_{\emptyset 1} + \rho_{\emptyset 2}}{2}\right)^2} \tag{23}$$

and

$$\theta_\varepsilon = \tan^{-1}\left(\frac{2h_b}{\rho_{\emptyset 1} + \rho_{\emptyset 2}}\right) \tag{24}$$

by tedious simplification , we get (25), (26) and (27).

$${\rho_{\beta 1}}^{+} = \begin{cases} \frac{-1}{a^2\sin^2(\alpha_b-\theta_\varepsilon)+b^2\cos^2(\alpha_b-\theta_\varepsilon)} \times \{d_\varepsilon(a^2 \sin(\alpha_b - \theta_\varepsilon) \sin\theta_\varepsilon - b^2 \cos(\alpha_b - \theta_\varepsilon)\cos\theta_\varepsilon) \\ \qquad + ab\left(a^2\sin^2(\alpha_b - \theta_\varepsilon) + b^2\cos^2(\alpha_b - \theta_\varepsilon) - {d_\varepsilon}^2\sin^2\alpha_b\right)^{\frac{1}{2}}\} & ; \alpha_{t2} \le \alpha_b \le \alpha_{t1} \\ 0 & ; therwise \end{cases} \tag{25}$$

$${\rho_{\beta 2}}^{-} = \begin{cases} \frac{-1}{a^2\sin^2(\alpha_b-\theta_\varepsilon)+b^2\cos^2(\alpha_b-\theta_\varepsilon)} \times \{d_\varepsilon(a^2 \sin(\alpha_b - \theta_\varepsilon) \sin\theta_\varepsilon - b^2 \cos(\alpha_b - \theta_\varepsilon)\cos\theta_\varepsilon) \\ \qquad - ab\left(a^2\sin^2(\alpha_b - \theta_\varepsilon) + b^2\cos^2(\alpha_b - \theta_\varepsilon) - {d_\varepsilon}^2\sin^2\alpha_b\right)^{\frac{1}{2}}\} & ; \beta_{t2} \le \beta_b \le \beta_{t1} \\ \frac{h_b}{\tan\beta_b} & ; \beta_{t2} \le \beta_b < \beta_{t3} \\ 0 & ; otherwise \end{cases} \tag{26}$$

$$\left.\begin{matrix} {\rho_{\emptyset 1}}^{+} \\ {\rho_{\emptyset 2}}^{-} \end{matrix}\right\} = \begin{cases} \frac{-1}{(a^2\sin^2\alpha_b + b^2cos^2\alpha_b)} & ; \alpha_{t2} \le \alpha_b \le \alpha_{t1} \\ \qquad \times \left(d(-b^2\cos\alpha_b) \pm ab(a^2\sin^2\alpha_b + b^2\cos^2\alpha_b - d^2\sin^2\alpha_b)^{\frac{1}{2}}\right)^{-1} & \\ 0 & ; otherwise \end{cases} \tag{27}$$

III. SPATIAL CHARACTERISTICS OF THE RADIO CHANNEL

In this section, we derive the joint and marginal pdf's of the AoA seen at the MS and the BS in Section III-A and B, respectively

III-A. PDF of AoA at MS

Here we are interested in deriving the angular domain statistics at both ends of communication channel. The Joint PDF seen from MS corresponding to elevation and azimuth angle and r_m can be expressed as,

$$p(r_m, \propto_m, \beta_m) = \left. \frac{f(x_m, y_m, z_m)}{|J(x_m, y_m, z_m)|} \right|_{\substack{x_m = r_m \cos\beta_m \cos\alpha_m \\ y_m = r_m \cos\beta_m \sin\alpha_m \\ z_m = r_m \sin\ \beta_m}} \quad (28)$$

where, $J(x_m, y_m, z_m)$is Jacobean transformation and is simplified to,

$$J(x_m, y_m, z_m) = \begin{vmatrix} \cos\beta_m \cos\alpha_m & -r_m \cos\beta_m \sin\alpha_m & -r_m \sin\beta_m \cos\alpha_m \\ \cos\beta_m \sin\alpha_m & r_m \cos\beta_m \cos\alpha_m & -r_m \sin\beta_m \sin\alpha_m \\ \sin\beta_m & 0 & r_m \cos\beta_m \end{vmatrix}^{-1} \quad (29)$$

After tedious simplifications, the above equation becomes as

$$J\left(x_{m,} y_m, z_m\right) = \frac{1}{r_m^2 \cos\beta_m} \quad (30)$$

By substituting (29) and (16) in (27), we get the Joint PDF as

$$p\left(r_{m,} \alpha_m, \beta_m\right) = \frac{r_m^2 \cos\beta_m}{V} \quad (31)$$

On integrating the above equation over r_m, a closed-form expression for the Joint PDF of AoA for both angles, (i.e. elevation and azimuth) is computed.

$$p(\propto_m, \beta_m) = \frac{1}{V} \int_0^{r_m} r_m^2 \cos\beta_m \, dr_m \quad (32)$$

$$p(\alpha_m, \beta_m) = \left. \frac{r_m^3 \cos\beta_m}{3V} \right|_0^{r_m} \quad (33)$$

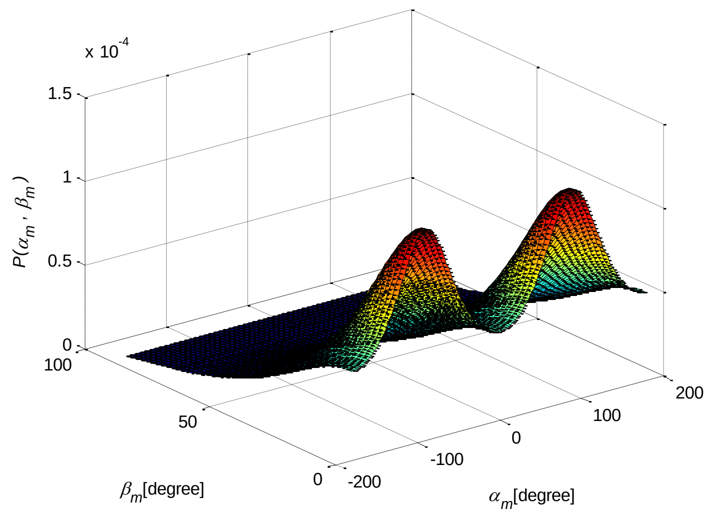

Fig. 6:-Joint PDF of the AoA seen at the MS (*h_b*=100 m, *d*=400 m, *a*=40 m, *b*=30 m, *c*=20 m)

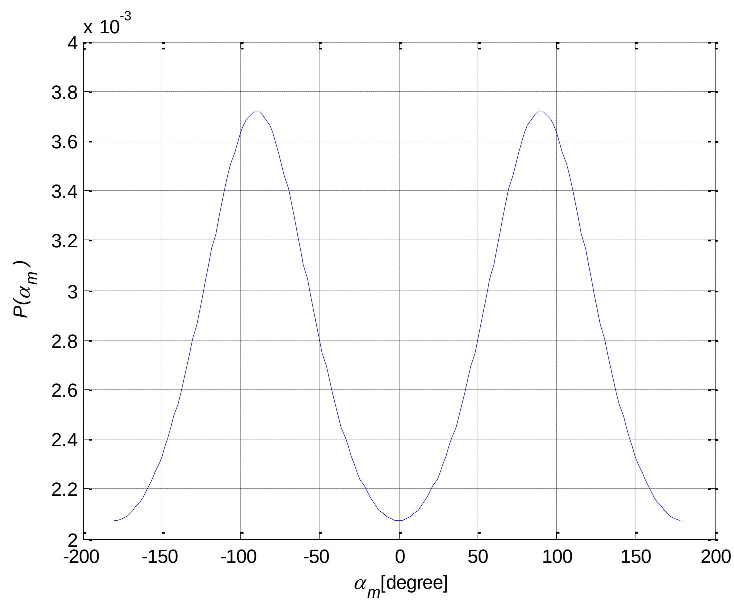

Fig. 7:-Marginal PDF of AoA in the Azimuth Plane observed at MS (*h_b*= 100 m, *d*= 400 m, *a*= 40 m, *b*= 30 m, *c*= 20 m)

On substituting value of r_m and V given in (10) and (17) into the above equation we get Joint PDF of AoA seen at MS.

$$p(\alpha_m, \beta_m) = \frac{2a^4b^4c^4\pi \cos\beta_m}{9} \left\{ a^2c^2\cos^2{}_{\alpha_m}\cos^2{}_{\beta_m} + b^2(c^2\cos^2{}_{\beta_m}\sin^2{}_{\alpha_m} + a^2\sin^2{}_{\beta_m})\}^{\frac{-3}{2}} \right\}$$

(34)

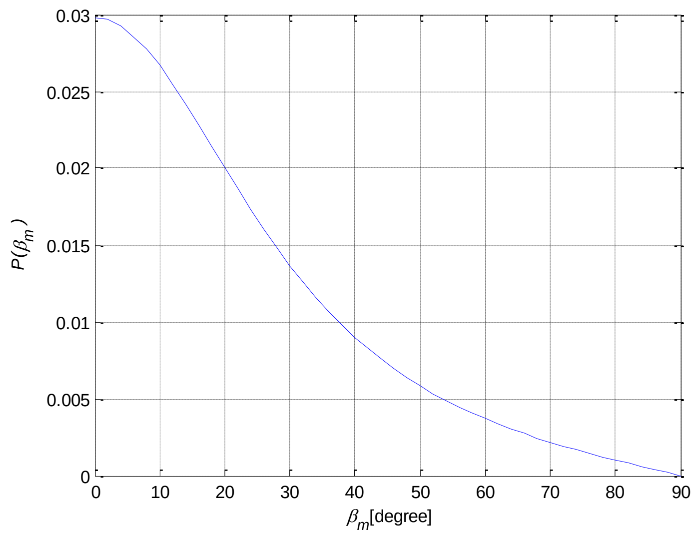

Fig. 8:- Marginal PDF of the elevation plane observed at MS (*h_b*=100 m, *d*=400 m, *a*=40 m, *b*=30 m, *c*=20 m)

The Marginal PDF of AoA in Azimuth plane can further be integrated by simply integrating the above equation over the Elevation angle on applying appropriate limit as

$$p(\alpha_m) = \int_0^{\frac{\pi}{2}} p(\alpha_m, \beta_m) d\beta_m \tag{35}$$

The preceding equation can be rewritten in closed form as

$$p(\alpha_m) = \frac{4(a^2b^2)^{\frac{3}{2}}c^2\pi}{9(a^2 + b^2 + (a^2 - b^2)\cos 2\alpha_m)} \tag{36}$$

Fig. 7 is a plot, which shows the obtained marginal PDF of AoA in Azimuth plane observed at MS. It can be observed that the probability of arrival of signals is different in different directions. The dimension of scattering volume can be adjusted based on certain physical parameters to model a certain street or canyon orientation. This plot is taken for 400 m distance separation between the two stations and with dimensions of scattering volume as *a*=40 m, *b*= 30 m, *c*=20 m.

To derive the Marginal PDF of AoA over Elevation plane for certain azimuth angle with these limits as under

$$p(\beta_m) = \int_{-\pi}^{\pi} p(\alpha_m, \beta_m) d\alpha_m \tag{37}$$

Fig. 8 shows the probability of arrival of signals is significantly high for low elevation angles. Thus, this result validates the proposed 3-D model based on the experimental results given in [15], that the spread of signals in elevation plane is measured up to 20°.

$$p(\beta_m) = \int_{-\pi}^{\pi} \frac{2a^4b^4c^4\pi\cos\beta_m}{9} \left(\{a^2c^2\cos^2{}_{\alpha_m}\cos^2{}_{\beta_m} + b^2(c^2\cos^2{}_{\beta_m}\sin^2\alpha_m + a^2\sin^2{}_{\beta_m}\right)^{\frac{-3}{2}} d\alpha_m \tag{38}$$

The solution cannot be obtained in closed-form; however, by using numerical integration techniques we have provided its plots.

III-B. PDF of AoA at BS

The Joint PDF seen from BS corresponding to elevation and azimuth angle and r_b is expressed as

$$p(r_b, \propto_b, \beta_b) = \left. \frac{f(x_b, y_b, z_b)}{|J(x_b, y_b, z_b)|} \right|_{\substack{x_b \\ y_b \\ z_b}} \tag{39}$$

The result of Jacobean transformation $J(x_b, y_b, z_b)$ is expressed in (40).After tedious simplifications, the above equation becomes as

$$J(x_{b,} y_b, y_b) = \frac{1}{r_b^2 \cos\beta_b} \tag{41}$$

The distribution function of scatterers turns out as

$$f(x_b, y_b, z_b) = \begin{cases} {}^{1}/_{V}\,, & (x_b, y_b, z_b) \\ 0, & otherwise \end{cases} \tag{42}$$

By substituting (40) and (42) in (39), we can achieve the expression for joint density function

$$p(r_{b,} \alpha_b, \beta_b) = \frac{r_b^2 \cos\beta_b}{V} \tag{43}$$

On integrating above equation over r_b, *a* closed-form expression for the joint PDF of AoA for both angles (i.e. elevation and azimuth) is computed,

$$p(\propto_b, \beta_b) = \frac{1}{V} \int_{\rho_{\beta 1}}^{\rho_{\beta 2}} r_b^2 \cos\beta_b \, dr_b \tag{44}$$

$$p(\alpha_b, \beta_b) = \left. \frac{r_b^3 \cos\beta_b}{3V} \right|_{\rho_{\beta 1}}^{\rho_{\beta 2}} \tag{45}$$

On substituting value of r_b and V into the above equation, we achieve the result as

$$p(\alpha_b, \beta_b) = \frac{\left(\rho_{\beta 2} - \rho_{\beta 1}\right)^3 \cos\beta_b}{3V} \tag{46}$$

We obtain marginal PDF of AoA with respect to azimuth plane by integrating (47) over elevation angle

$$p(\alpha_b) = \int_{\beta_{t1}}^{\beta_{t2}} p(\alpha_b, \beta_b) d\beta_b \tag{47}$$

$$J(x_b, y_b, z_b) = \begin{vmatrix} \cos\beta_b \cos\alpha_b & -r_b \cos\beta_b \sin\alpha_b & -r_b \sin\beta_b \cos\alpha_b \\ \cos\beta_b \sin\alpha_b & r_b \cos\beta_b \cos\alpha_b & -r_b \sin\beta_b \sin\alpha_b \\ \sin\beta_b & 0 & r_b \cos\beta_b \end{vmatrix}^{-1} \tag{40}$$

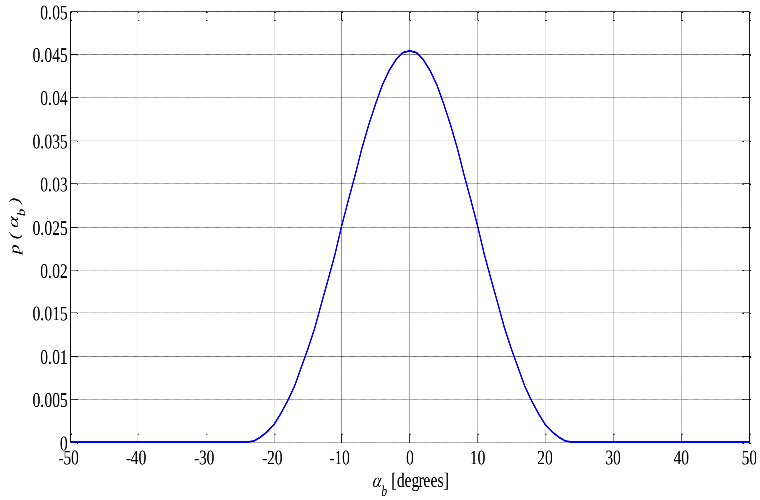

Fig. 9:-Marginal PDF of AoA in the Azimuth Plane observed at BS (*h*$_b$= 100 m, *d*= 400 m, *a*= 40 m, *b*= 30 m, *c*=20 m).

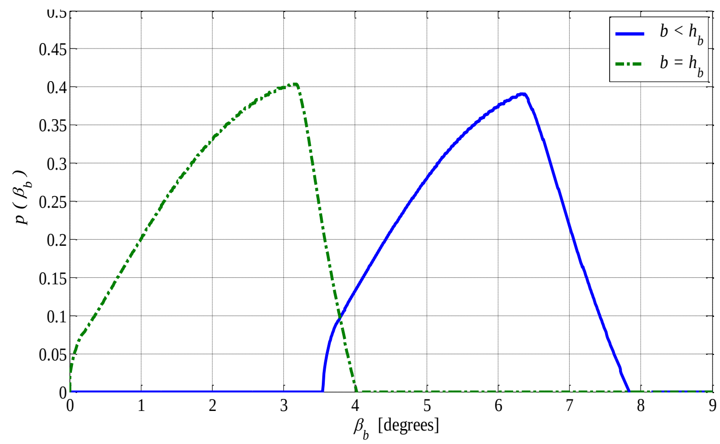

Fig. 10:- Marginal PDF of AoA in the Elevation Plane observed at BS (h$_b$=100 m, *d*=400 m, *a*=40 m, *b*=30 m, *c*=20 m)

Marginal PDF of AoA in Azimuth plane is observed at BS in fig. 9. It has higher values in the direction of LoS and its value decreases as we observe away from LoS direction.

By integrating the obtained joint PDF of AoA observed at the BS over the Azimuth angle for its appropriate limit we get

$$p(\beta_b) = \int_{\alpha_{t1}}^{\alpha_{t2}} p(\alpha_b, \beta_b) d\alpha_b \tag{48}$$

Fig. 10 shows the PDF of AoA in elevation plane observed at the BS. Where the effect of amount of scatterers in elevation plane can be observed on the PDF. Different results are showed for different height of antenna at BS. It is clearly evident that the scattering objects in elevation plane has significant importance, therefore it is essential to model the scattering region in 3D space.

V. CONCLUSION

We have developed a 3-D scattering channel model for communication in streets and canyons. Uniformly distributed scattering objects have been assumed in a semi-ellipsoid shape region centered at the MS. The BS has been assumed outside the scattering semi-ellipsoid. Antennas at both the ends of communication link have been assumed Omni-directional. Using the derived geometric stochastic channel model, mathematical expression for spatial channel and temporal statistics of the channel observed at both the ends of the communication link has been derived. Based on the obtained theoretical results, a comprehensive analysis has been given. Furthermore, with the purpose to validate the proposed model, a comparison of the obtained results with famous models in the literature has been presented. The proposed characteristic equation and results has been useful to understand the behavior of propagation mechanism in urban streets and canyons communication environments. Such stochastic geometry based theoretical results can be used as a reference for field measurement campaign. The obtained results are also helpful in designing vertical or planner antenna arrays for generating precise directional beams.

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Internationalization of the PhD Program in Design, Manufacture and Management of Industrial Projects

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Conference Key Areas: Internationalizing the engineering curriculum, Engineering Design, Education and Research
Keywords: PhD, Research, Internationalization

Abstract

The PhD Program in Design, Manufacture and Management of Industrial Project of the Polytechnic University of Valencia (Spain), promoted by the School of Design Engineering (ETSID in Spanish), is focused on the scientific and technical training of professionals of the industry, with the aim of designing new products, manufacture and manage large projects. In this paper the degree of internationalization of the doctoral program is analyzed through enrollment by foreign students in the last five years, mainly students from Latin-American universities.

1 Introduction

New technologies, innovative processes and new materials used in different industrial sectors, require proper training of future graduate student to be able to acquire the knowledge, skills and abilities required.

The main objective of the PhD Program in Design, Manufacture and Management of Industrial Projects [1] promoted by the ETSID is the professional specialization in different industrial areas for the design and development of new products, manufacturing, and management of industrial processes [2].

To achieve these objectives, a multidisciplinary approach with direct application to the industry of different scientific and technological areas is necessary. For this reason, the different research lines of the program include both that related to industrial technologies (product design, project management, manufacturing processes, advanced manufacturing, graphics technologies, digital desig ....) such as different areas of the scientific knowledge (physics, electronics, robotics ...) applied to the industry and its processes [3].

The involvement and contribution of various departments as well as the experience gained in the development of previous postgraduate programs in product design, manufacturing and project management, allows a new broad and interdisciplinary PhD program.

In this contribution, the degree of internationalization of this PhD program is analyzed. We performed a study of the enrollment for the past five years determining the country of origin of all foreign students. Additionally, some examples of PhD thesis topics recently developed by foreign students (mainly Latin-American students) are shown.

2 Internationalization of the PhD program

As stated above, with the intention of determining the degree of internationalization of this PhD program, the enrollment for the past five years has been analyzed. First, we have identified if the PhD is Spanish or foreign, obtaining the results shown in Figure 1.

The average Spanish students enrolled each academic course is 22.8 (58.2% of the total), while the average number of foreign students enrolled each academic course is 16.4 (41.8% of the total), indicating a high degree of internationalization. In the present academic course 2013/14, almost half of the enrolled students are foreigners. In the past five years a total of 196 students have been enrolled in this PhD program, 82 of whom are foreigners.

In Figure 2, the country of origin of foreign students enrolled in the doctoral program is shown. These students come primarily from Latin American countries, 89% of all foreigners, while from Europe come only the 7%. The country of origin of foreign students is mainly Colombia followed by Venezuela and Mexico. European foreign students come mainly from Italy and Portugal.

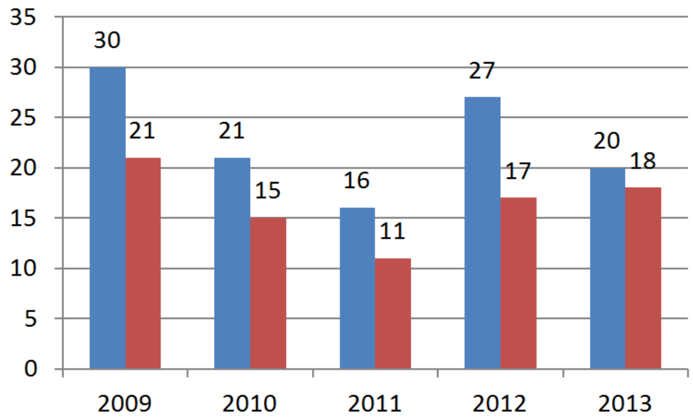

Fig.1. Number of Spanish students (blue) and foreign (red) enrolled in the doctoral program the last five years.

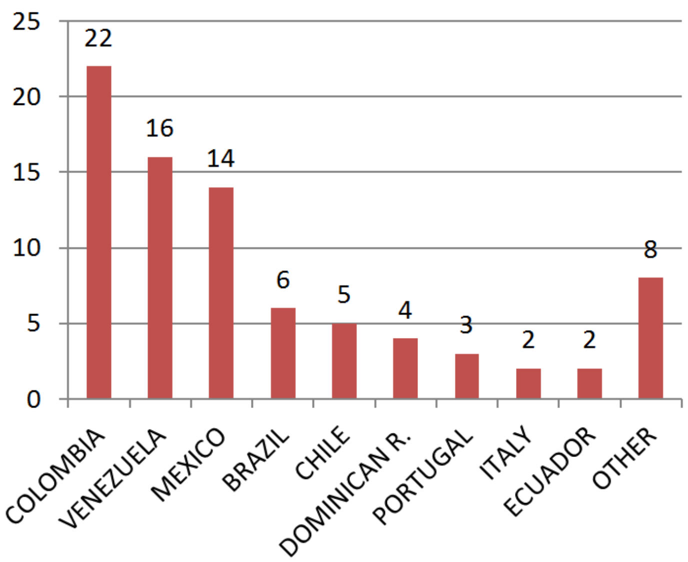

Fig.2. Number of foreign students enrolled in the last five years divided by country of origin.

3 Some examples

There are several PhD theses consequence of the internationalization of this program. In particular, the field of Design has been able to produce different research lines in multiple areas by encouraging industrial development of products and emerging new companies in countries such as Venezuela, Colombia, Mexico, Chile, Argentina, Brazil and Portugal among others.

Specifically, we can find some recent examples of PhD theses related to studies and research projects whose aim has primarily been the generation of companies that are able to exploit the natural resources, the skills and abilities of communities and development of industries from products with tradition artisanal or small local production.

We will mention some of these PhD theses indicating the country of origin of the student:

- *La capacidad de diálogo entre la Piedra Natural y el Ser Humano, para el diseño y desarrollo de nuevos productos (The capacity for dialogue between Stone and the Human Being, for the design and development of new products)* [4]: This ThD thesis developed by a Portuguese student was focused on the Natural Stone sector. Different aspects were analyzed, namely types of raw materials, state of the industry, process considerations, assessment of design in the products, management methodologies, and product development sector, among others (Fig. 3).

Fig.3. Design and development of new products in natural stone.

- *Análisis de los aspectos metodológicos para el desarrollo de los productos de joyería contemporánea: una observación en Latinoamérica y Europa (Analysis of methodological aspects for the development of contemporary jewelery products: an observation in Latin America and Europe)* [5]: The main objective of this thesis developed by a Colombian student was the analysis of the processes of design and development of contemporary jewelery products in Latin America and Europe (Fig. 4).Based on the study carried out in order to assess the presence of new materials or the employment of traditional materials in new technology and symbolic applications in contemporary jewel in connection with wishes and desires of consumers in two specific geographic areas: Latin America and Europe, highlights the matching fact around resources such as wood (49.6% and 50.5% respectively), as an important source of value creation, with which both contexts are positively identified. On the other hand, regarding other materials, the Latin american consumer prefers those of natural origin such as seeds (65,1%), horn (62.1%) and artificial materials such as carbon fiber (67.8%), polymers (63.4%) and synthetic fibers (61.5%) in their jewellery products. Yet the European consumer largely opts by the use of metals such as steel (55.7%), titanium (55.4%) and platinum (54.7%), as materials of choice in jewels that already owns and/or would like to acquire beyond the traditional gold and silver. The keys are more related to the type of use, application and technology used to respond to new readings and dynamic interaction between user, product and its context.

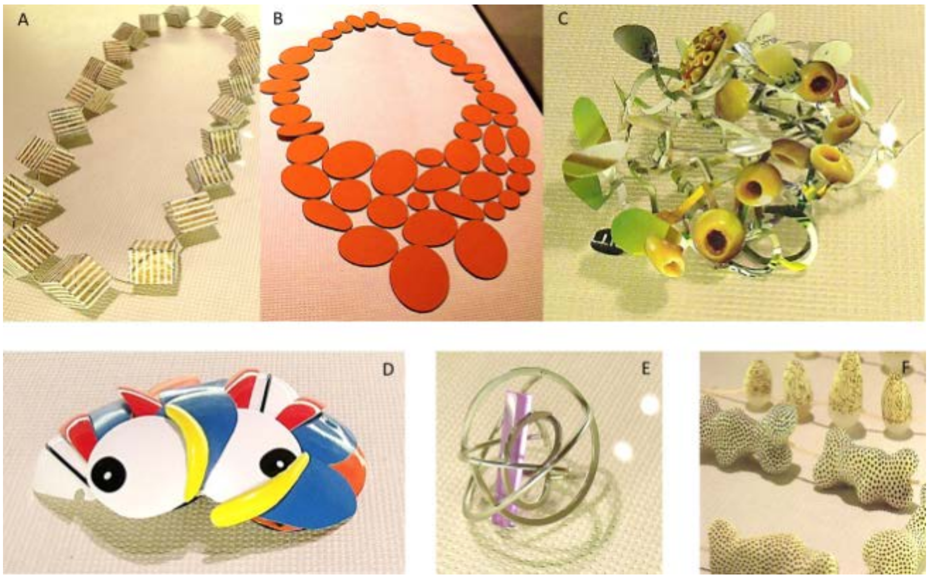

Fig.4. Traditional and inusual materials (metal, wood, paper, polymers) applied in contemporary jewellery

- *Estudio de la prospección del uso de la fibra de tucumã-i (Astrocaryum acaule) para el desarrollo de productos semi-industriales* (*Study prospecting using fiber tucumã-i (Astrocaryum acaule) for the development of semi-industrial products*) [6]: This PhD thesis was developed by a Brazilian student. Tucumã-i fibre (Astrocaryum acaule) is a natural vegetable of the Brazilian Amazon untapped and a little known. It is characterized by sustainable production and adaptability to different types of products such as textiles, household and decorative. However, is not identified in scientific universe, relevant data about its application in products by the most advanced processes such as industrial or semi-industrial. The few existing records that describe the practices developed in the fibre are the empirical and handcraft. Therefore, a market research through technical and scientific support of the design can validate the attributes of innovation and differentiation offered by fibre, justifying their possible adaptation to a more advanced technique and making possible new forms of use. The prospective study of the natural fibre of tucumã-i (Astrocaryum acaule) for the development semi-industrial products, used design as a support tool for obtaining information that identified possible courses of action, understood the problem , looked at the opportunities and limitations of the object under investigation for a better approach to use in this context, considered also important aspects and competitive in order to reach new markets with the positioning of designers, experts in related areas to the topic and potential customers.

Fig.5. Productos desarrollados con fibra de tucumã-i.

4 Conclusions

In this contribuition the degree of internationalization of the doctoral program is analyzed through enrollment by foreign students in the last five years, mainly students from Latin-American universities. In the past five years, more than 40% of enrolled students were foreigners from countries like Venezuela, Colombia, Mexico and Brazil. Additionally, it has shown some examples in the field of Design of PhD theses developed by foreign students. Besides these theses that have been or are being developed by foreign students, various online magazines as "rdis.upv.es" [7] and several research projects with Latin American universities from Argentina, Brazil, Chile, Colombia, Mexico and Venezuela have been performed. Presently, we are also interested in increase the internationalization of the PhD program in Europe, so we are contacting with European researchers in industrial Design and other related topic applied to the industry.

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Analysis of the outgoing student mobility at the Faculty of Business Administration and Management of the Universitat Politècnica de Valencia: the effects of the crisis

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Conference Key Area: Management of International Offices and Mobility. World financial crisis and EE. International Cooperation Programs.

Abstract

Academic exchange programs of higher education students have widely developed in Europe during the past decade, boosted by the Erasmus philosophy, which has become a reference worldwide. Our objective was analyzing the success of these exchanges before and after the economic crisis, based on the figures of the Universitat Politècnica de València (UPV). For this purpose, we compared the outgoing mobility numbers in the field business throughout the academic years 2002-2003 to 2012-2013, to the rest of schools and faculties of the UPV, taking into account their respective sizes. We also evaluated the academic results of these exchanges at the main destinations of Spanish outgoing students. The results show an important enhancement of the mobility numbers which remains sustained during these years of crisis, even though the restrictions in the different universities.

1 Introduction

Higher education institutions offer nowadays a good number of international experiences or study abroad programs [1] and there has been a considerable increase in the number of participating students. The most popular are Erasmus-Academic and Erasmus-Internship, but some higher education institutions have their own mobility programs, such as the UPV, with its Promoe program which enables student academic exchanges outside the European region.

The Erasmus Programme (European Community Action Scheme for the Mobility of University Students) is a European Union (EU) exchange programme introduced in 1987. Erasmus+, or Erasmus Plus, is the new programme combining all the EU's current schemes for education, training, youth and sport, which was launched on January 2014. Since 1987, over two million students have participated into the Erasmus program, which aimed at promoting a high-skilled labour force, endorse a better cultural integration and contribute to construct a sense of European identity [2].

Previous research about effects on students of higher education mobility programs is scarce, yet some studies have proved that studying abroad increases the probability of an individual of working in a foreign country by about 15% points [3]. Another study concluded that studying abroad under Erasmus can be viewed predominantly as a means of academic improvement, as this program put a strong emphasis on academic achievement [4].

On a different theme, Spain is coping with a rather complicated economical situation since 2008, when the economy started showing signs of deceleration. According to official data about the Gross Domestic Product (GDP) of the Instituto Nacional de Estadística (INE), the Spanish economy entered in recession in 2009, with decreases of the GDP that have prevailed until the last trimester of 2013. Unemployment rates during this period have also increased dramatically, reaching a 26.3% in 2012. In addition, the measures undertaken by the Government have involved severe budget cuts that have affected the financing of higher education institutions as well as the financing of the Spanish part of the grants to the main academic exchange program in higher education, Erasmus.

This study aimed at analyzing the evolution of the number of students engaged in international exchange programs at the Faculty of Business Administration and Management of the Universitat Politécnica de València. It aimed as well at determining if any change in the trend is observed during the considered interval of time, coinciding with the years in which the crisis has been affecting the Spanish economy.

2 Methodology

Firstly, we reviewed the scientific literature which is relevant to the issues studied in this paper. Data base searches of peer reviewed papers about international exchange programs in higher education institutions were done using the computer search tool of the UPV, the *Polibuscador*. The relevant papers found were examined and the contents assisted us in introducing and designing our study.

Secondly, data for the quantitative study was collected. Student mobility numbers and data about academic achievement abroad were collected from the official sources of the UPV: International Offices and Official Memories. The period considered was from the academic year 2003-2004 to 2012-2013. During this period, 15,758 outgoing students have been involved in student academic exchanges at the UPV.

Third, data analysis consisted of four phases. The first phase was to record the collected data using data bases. The second step involved the use of descriptive statistics to facilitate further analysis. The third phase consisted in analyzing the evolution of student mobility by observation of the trends and the statistic results obtained in the previous phase. Fourth and lastly, we contrasted the observed trend with the behaviour of the main macro economical variables, especially GDP.

3 Outgoing student mobility

We analysed the mobility data of the Universitat Politècnica de València (UPV) and we studied the evolution of the mobility of Business students, comparing it to the mobility of the rest of schools and faculties of the UPV. In addition we also evaluated the academic achievement of our Business students during their studies abroad. The period studied covers from the 2003-2004 to 2012-13 academic year, so as to observe how the economic crisis has affected, in our case, the mobility of students.

3.1 Evolution of the outgoing student mobility before the crisis: 2003-2004 to 2007-2008

Table 1 shows the different schools and faculties of the Universitat Politècnica de Valencia, ordered by size (from smaller to bigger) according to the average number of total students enrolled. It also shows the number of students sent under an exchange programme each academic year, the total number of outgoing students during this period, and the rate of outgoing students over the average total number of students. It can be observed that mobility increased yearly. No relationship between the number of the rate of mobility of students and the size of the school or faculty is appreciated. Thus, a medium centre as the Faculty of Fine Arts (Facultad de Bellas Artes) is the leader in relative mobility, closely followed by another medium size centre as the Higher Technical School Telecommunication Engineering (Escuela Técnica Superior de Ingeniería de Telecomunicaciones). Instead, the Higher Technical School of Construction Management (Escuela Técnica Superior de Ingeniería de la Edificación), has the lowest mobility rate. We must emphasize though, that the high employment rate of students from this School during this period, could have acted as a brake on the internationalization of its students.

Table 1. Student´s mobility by academic year (2003-04 to 2007-08)

School or Faculty (Centre)	Average total students before crisis	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	Total outgoing	% Mobility before crisis
ETSI Geodésica, Cartografía y Topográfica	991	13	23	27	37	36	163	16.45%
ETS Ingenieros Telecomunicación	1,746	78	78	104	105	126	595	34.08%
Escuela Politécnica Superior de Gandía	2,707	96	104	108	131	155	702	25.93%
Facultad de ADE	1,686	41	48	59	58	68	333	19.75%
Escuela Politécnica de Alcoy	2,196	41	58	76	65	51	367	16.71%
Facultad de Bellas Artes	2,099	123	116	128	110	123	728	34.68%
ETS Agronómica y del medio Rural (ETSIA and ETIA)	3,484	87	88	87	126	156	631	18.11%
ETS Ingeniería Informática	3,661	60	69	93	106	121	542	14.80%
ETSI Caminos Canales y Puertos	2,859	48	61	87	75	92	450	15.74%
ETS Gestión de la Edificación	2,847	59	45	35	42	43	259	9.10%
ETS Arquitectura	3,502	104	116	133	155	174	815	23.27%
ETS Ingenieros Industriales	3,616	153	188	168	166	173	1,016	28.10%
ETS Ingeniería del diseño	4,028	143	147	175	141	172	953	23.66%
Total UPV	**35,422**	**1,046**	**1,141**	**1,280**	**1,317**	**1,490**	**7,554**	**21.33%**

Source: Own elaboration

Table 2 shows the rates of annual growth of the mobility at the different schools and faculties of the UPV. The annual average increase in these years was very high in some centres, coinciding with years of the economic boom, with the consolidation of the Erasmus Programme, and the implementation of new degrees at the UPV, as the degree in Geodesy and in Business Administration and Management. The average rate of growth of the total mobility at the university was 10.6% although there were many oscillations.

Table 2. Annual growth rates of mobility at the UPV (2002-03 to 2006-07)

School or Faculty (Centre)	03-04/ 02-03	04-05/ 03-04	05-06/ 04-05	06-07/ 05-06	Average growth
ETSI Geodésica, Cartografía y Topográfica	225.0%	76.9%	17.4%	37.0%	89.1%
ETS Ingenieros Telecomunicación	23.8%	0.0%	33.3%	1.0%	14.5%

School or Faculty (Centre)	03-04/ 02-03	04-05/ 03-04	05-06/ 04-05	06-07/ 05-06	Average growth
Escuela Politécnica Superior de Gandía	24.7%	8.3%	3.8%	21.3%	14.5%
Facultad de ADE	70.8%	17.1%	22.9%	-1.7%	27.3%
Escuela Politécnica de Alcoy	0.0%	41.5%	31.0%	-14.5%	14.5%
Facultad de Bellas Artes	7.9%	-5.7%	10.3%	-14.1%	-0.4%
ETS Agronómica y del medio Rural	10.1%	1.1%	-1.1%	44.8%	13.7%
ETS Ingeniería Informática	22.4%	15.0%	34.8%	14.0%	21.6%
ETSI Caminos Canales y Puertos	20.0%	27.1%	42.6%	-13.8%	19.0%
ETS Gestión de la Edificación	15.7%	-23.7%	-22.2%	20.0%	-2.6%
ETS Arquitectura	31.6%	11.5%	14.7%	16.5%	18.6%
ETS Ingenieros Industriales	1.3%	22.9%	-10.6%	-1.2%	3.1%
ETS Ingeniería del diseño	27.7%	2.8%	19.0%	-19.4%	7.5%
Total	**18.3%**	**9.1%**	**12.2%**	**2.9%**	**10.6%**

Source: Own elaboration.

Business students' mobility had a very high annual growth, with a rate of 27.3%. This reflects the international nature of these studies. We must take into account that in the considered period the degree of Business Administration and Management had been recently established (1998) at the UPV. The annual growth was more moderate in other schools that have a long history and they mantained very high mobility rates over the period, as ETSI Telecommunications, School of Gandía, ETS Architecture, Industrial or ETS Alcoy.

3.2 Evolution of the outgoing student mobility during the crisis: 2008-2009 to 2012-2013

Table 3 shows the same data as Table 1 considering the period of the crisis.

we can observe the relative mobility increase in the studied period during the crisis, reflected, in the UPV´s average increase from 21.33% to 24.2% reported. However, the total number of students decreases in UPV. The causes, in addition to those resulting from the crisis, we can also find the results of a new policy, implementing by the UPV, to reach efficiency, offering quality degrees.

No relationships between mobility centers are appreciated due to their size. This period is the School of Gandía which has more relative mobility, followed by ETSI Telecom and ETS Architecture

Table 3. Student´s mobility by academic year (2008-09 to 2012-13)

School or Faculty (Centre)	Average total students crisis	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	Total outgoing	% Mobility Crisis
ETSI Geodésica, Cartografía y topográfica	849	46	56	55	60	21	238	28.03%
ETS Ingenieros Telecomunicación	1,185	97	94	63	65	62	381	32.15%

School or Faculty (Centre)	Average total students crisis	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	Total outgoing	% Mobility Crisis
Escuela Politécnica Superior de Gandía	2,034	147	168	162	163	118	758	37.27%
Facultad de ADE	2,072	55	98	96	114	88	451	21.77%
Escuela Politécnica de Alcoy	2,196	46	61	65	97	69	338	15.39%
Facultad de Bellas Artes	2,270	127	133	126	132	118	636	28.02%
ETS Agronómica y del medio Rural	2,640	154	86	98	157	145	640	24.24%
ETS Ingeniería Informática	2,706	121	117	122	127	93	580	21.43%
ETSI Caminos Canales y Puertos	3,053	108	139	99	123	144	613	20.08%
ETS Gestión de la Edificación	3,157	60	61	70	72	72	335	10.61%
ETS Arquitectura	3,562	212	217	198	264	181	1072	30.10%
ETS Ingenieros Industriales	3,470	179	184	198	207	233	1001	28.85%
ETS Ingeniería del diseño	4,713	164	231	225	276	265	1161	24.63%
Total	**33,907**	**1,516**	**1,645**	**1,577**	**1,857**	**1,609**	**8,204**	**24.20%**

Source: Own elaboration.

The average increase in these years is very uneven and varies greatly between centers and also between years. An overall drop in the last year analyzed was observed. However, despite the widespread declines the UPV grows annual average of 2.2% in the crisis period.

Table 4. Annual growth rates of mobility at the UPV (2008-09 to 2011-12)

School or Faculty (Centre)	09-10/ 08-09	10-11/ 09-10	11-12/ 10-11	12-13/ 11-12	Average growth
ETSI Geodésica, Cartografía y topográfica	21,7%	-1,8%	9,1%	-65,0%	-9,0%
ETS Ingenieros Telecomunicación	-3,1%	-33,0%	3,2%	-4,6%	-9,4%
Escuela Politécnica Superior de Gandía	14,3%	-3,6%	0,6%	-27,6%	-4,1%
Facultad de ADE	78,2%	-2,0%	18,8%	-22,8%	18,0%
Escuela Politécnica de Alcoy	32,6%	6,6%	49,2%	-28,9%	14,9%
Facultad de Bellas Artes	4,7%	-5,3%	4,8%	-10,6%	-1,6%
ETS Agronómica y del medio Rural	-44,2%	14,0%	60,2%	-7,6%	5,6%
ETS Ingeniería Informática	-3,3%	4,3%	4,1%	-26,8%	-5,4%
ETSI Caminos Canales y Puertos	28,7%	-28,8%	24,2%	17,1%	10,3%
ETS Gestión de la Edificación	1,7%	14,8%	2,9%	0,0%	4,8%
ETS Arquitectura	2,4%	-8,8%	33,3%	-31,4%	-1,1%
ETS Ingenieros Industriales	2,8%	7,6%	4,5%	12,6%	6,9%

School or Faculty (Centre)	09-10/ 08-09	10-11/ 09-10	11-12/ 10-11	12-13/ 11-12	Average growth
ETS Ingeniería del diseño	40,9%	-2,6%	22,7%	-4,0%	14,2%
Total	8,5%	-4,1%	17,8%	-13,4%	2,2%

Source: Own elaboration

Business students maintain their growth in the number of students engaged in an exchange programme. The general trend at the UPV was of a continued increase as can be seen observing the values, although in these years of crisis, there were are also large oscillations.

3.2 Academic results abroad

The academic results of students during the academic exchange are important not only for students but also for the institution. Students make an extra effort to adapt to another institution, having to develop their academic work in another country with a different culture and attend school in a different language. These results may show us the level of their academic skills and the level that is required in other European universities.

Table 5 shows the academic grades achieved by Business students during their studies abroad. It seems clear that the success rate is high because the average mark is 7.85. The country where students achieved the lowest grades was Belgium, followed by Slovenia, the Netherlands, Ireland, and Portugal, but in each case the average grades were always over the pass.

Table 5. Business students marks studying abroad (Academic year 2010-2011 to 2012-2013)

Country	Year 2010-2011	Year 2011-2012	Year 2012-2013	Average mark
Germany	6.24	7.24	7.07	6.85
Argentina		10.00		10.00
Australia	7.65			7.65
Austria	8.60	8.05	7.58	8.08
Belgium	5.63	6.40	5.29	5.77
China		8.80		8.80
Colombia	6.25			6.25
Denmark	7.72	8.13	8.50	8.12
United States of America	8.86	8.94	8.72	8.84
Slovakia	9.59	9.50		9.55
Slovenis	5.54	6.60		6.07
Spain	7.60	8.30		7.95
France	6.64	6.49	5.57	6.23
Finland			9.80	9.80
Holand	6.36	6.72	6.50	6.53
Hungary	8.70	8.73	9.21	8.88
Ireland			6.60	6.60
Italy	6.93	8.02	7.60	7.52
Korea			10.00	10.00

Country	Year 2010-2011	Year 2011-2012	Year 2012-2013	Average mark
Poland	8.15	8.37	8.76	8.43
Portugal	5.48	7.72		6.60
United Kingdom	7.38	8.74	7.77	7.96
Czech Republic	8.05	8.31	7.52	7.96
Romania		9.30		9.30
Singapur	7.26	8.04	7.93	7.74
Sweeden	7.23	7.38		7.30
Switzerland	6.10	5.63	10.00	7.24
Average				**7.85**

Source: Own elaboration

4. Conclusions

Through the data analyzed from UPV, we can see that the mobility of Spanish students before crisis grew and achieved the consolidation of academic exchange programs. The society represented in the students and the companies that employ them after completing their studies receive international experience as a necessary tool to improve the knowledge of another language, intercultural skills, adaptability to other settings, etc. [5]. Also, a lot of studies reflect the increased employability of students doing an exchange [6].

This relationship with employability justifies the development and strong growth observed during the years in which the economic crisis has had its greatest effects, especially in the employment rate of young people. Universities, and UPV in concrete have maintained their internationalization efforts [7] to strengthen its efforts to keep alive the exchange programs and managing them successfully. Thus, the relative mobility of all centres increased during the crisis and the increase average at the UPV is almost 4 percentage points.

In our study, we have not observed any relationship between mobility rate and size of the centres. We believe that the closer relationship is specific to each degree, which allows its overseas development features, and in that sense the degree of Business ranks high.

Business students actively participate in exchange programs, and also, as we have seen in the results, do well academically, therefore we understand that the process of adaptation and level of preparation is good.

We understand that universities should continue promoting exchange programs in order to further contribute to the employability of our students. The effect of these policies on employability in Spain can be an important line of future research.

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Internationalization of Aerospace Engineering at ETSID: Maths in English

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Abstract

Internationalization is a very important axis at Technical University of Valencia (Universitat Politècnica de València, UPV) and in particular at the Design Engineering School (ETSID). Indeed, this school started its internationalization focus at the end of the eighties when the Erasmus programme was launched. Since then, and in addition to the standard exchange of students, ETSID has taken a number of actions such as transatlantic actions, double degrees or instruction of some subjects in English with the aim of facilitating the reception of incoming students as well as preparing outgoing students to work in a foreign language environment. This last mentioned experience received a strong support when the Regional Government of Valencia proposed that the five public universities of the Valencian Region delivered some degrees in English, two of which belonged to ETSID: BEng Aerospace Engineering and BEng in Industrial Electronics and Automation Engineering. In this paper we analyze the students output in the subject of Mathematics I in Aerospace Engineering, by distinguishing between students within and out of this programme, during 2012/13. Opinion of students is discussed, too.

1 Introduction

Bologna process was designed with the aim of getting a system of university academic degrees easily recognizable and comparable throughout Europe. It promoted mobility of students, teachers and researchers [1], and Spain engaged this project by establishing the adequate foundations to implement it with professional capacities recognized [2].

This process incorporated the European dimension into higher education. In this line, the Regional Government of Valencia started up a pioneer experience during 2010/2011: the High Academic Performance Groups, for which we will use hereafter the Spanish acronym ARA (*Alto Rendimiento Académico*) groups [3].

The purpose of these ARA groups was to support and attract the brightest students with the best skills so that they might achieve a high academic performance, thus promoting their training as highly-qualified professionals.

This project was established in collaboration with the five public Universities of this region and there were 17 degrees involved. The Technical University of Valencia (*Universitat Politècnica de València*, UPV), highly committed to increase its quality and promote internationalization [4], is taking part through the following Bachelor Degrees: Business Administration and Management, Biotechnology, Computer Engineering, Aerospace Engineering, and Industrial Electronics and Automation Engineering. The two last named degrees are delivered at the Design Engineering School (*Escuela Técnica Superior de Ingeniería del Diseño*, ETSID) [5].

We will focus on the Mathematics performance of students at the BEng Aerospace Engineering degree which comprised 124 students during 2012/13 from which 52 belonged to the ARA group.

Throughout this paper we will call non-ARA group to the one formed by the other 72 students. Teaching was conducted in Spanish in the non-ARA group while ARA students had English as means of instruction.

2 The ETSID setting

UPV adapted all its degrees following the new Spanish regulations according to which Bachelor degrees should have 240 ECTS.

In this way, the 5 year Aerospace Engineering degree of ETSID became a 4 year degree. This meant a deep transformation of some subjects. Mathematics I at first year was one of them and was reduced from 15 ECTS (10.5 credits Theory/Problems & 4.5 cr. Lab Practice) to 12 ECTS (9 cr. Theory/Problems & 3 cr. Lab Practice), [6].

In this way laboratory classes of Mathematics I at ETSID suffered a reduction of 33.33 percent in the number of credits assigned which was overrun by extensively using the educational platform developed by UPV, PoliformaT, [7,8]. In fact, this transformation meant an opportunity to improve and modernize the learning outcome of our students. In this setting of transformation of subjects, reduction of credits and introduction of the educational platform, the ARA programme landed.

On the other hand let us note that in order to make the ARA group more appealing to students, some complementary activities and actions were included such as:

a) At least 50% of the core subjects would be taught in English – Mathematics I being one of them.

b) Participation in these groups would be recognized in the Diploma Supplement [9].

c) It would be taken into account for mobility grants.

d) Seminars for the development of transversal competencies, lectures by renowned experts and visits to relevant companies would be offered.

3 Results

As aforementioned the language of instruction was English and Spanish in the ARA and non-ARA group, respectively. There was no further difference in what concerns classes, laboratory practice sessions, assignments, exams,…

Both groups had 28 laboratory weekly sessions with two individually realized tests under controlled environment, and at least one assignment before each of the four written exams covering the four blocks that conform Mathematics I. These blocks consist of calculus of one real variable, linear algebra, calculus of several variables and (numerical, power and Fourier) series.

Students had additional opportunities so that they were able to show that they had achieved the corresponding competencies in each of these exams in case of failure in due time.

After completing the 2012/2013 academic year we compared the results obtained in Mathematics by the students of both groups. Table 1 collects them.

Table 1. Grades: Percentage of students achieving each grade by group

Grade	Fail	Pass	Good	Excellent	
ARA	17%	21%	44%	17%	100%
non-ARA	11%	28%	43%	18%	100%

We may observe from Table 1 that 61% students of ARA and non-ARA group achieved a ‘Good’ or better grade, there not being a big difference in their outcome.

The following figure makes easier to compare graphically the above results.

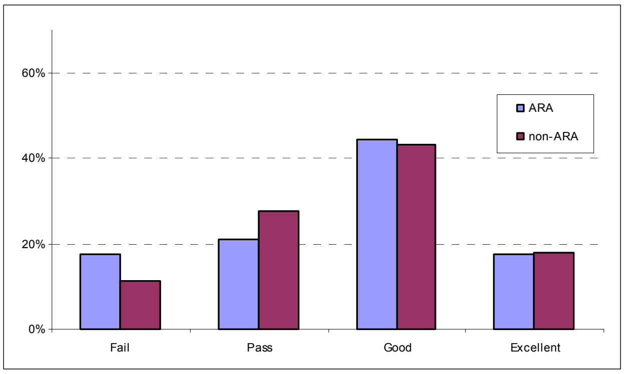

Figure 1. Grades: Percentage comparison of relative values respect each group

During the previous academic year 2011/12, the ARA group had shown a better performance than the non-ARA group [10]. As we can see this situation has not held during 2012/13.

Thus there seems not to be a clear difference in the performance between both groups in what concerns acquisition of mathematical competencies.

Gathering both groups altogether their results are shown in Table 2 and Figure 2.

Table 2. Grades: Percentage comparison respect to the global group

Grade	Fail	Pass	Good	Excellent	
ARA	7%	9%	19%	7%	42%
non-ARA	6%	16%	25%	10%	58%

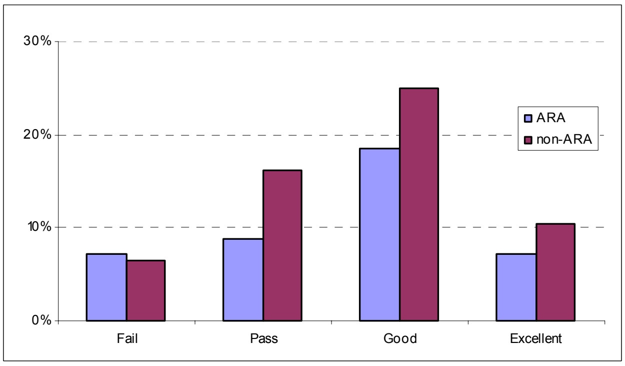

Figure 2. Grades: Percentage comparison respect to the global group

From these representations it follows that a greater percentage of students have failed in the ARA group despite the fact that there are more students in the non-ARA group,

Table 3 and Figure 3 visualize the grade distribution in the ARA and non-ARA groups.

Table 3. Grades distribution by groups

Grade	Fail	Pass	Good	Excellent	
ARA	53%	35%	44%	41%	42%
non-ARA	47%	65%	57%	59%	58%

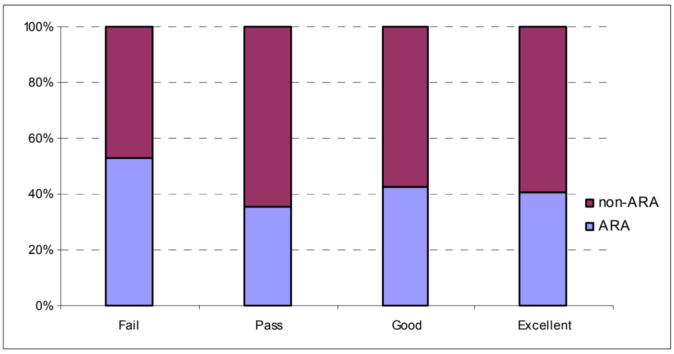

Figure 3. Distribution of ARA/non-ARA students by grades

Thus the results cast a shadow on the original perception that ARA-students should have higher degrees, [10]. During 2012/13, the general results do not confirm this hypothesis.

4 Students opinion

Besides analyzing the results obtained by both groups we have also asked about the opinion of students concerning the creation of the ARA group.

This information has been obtained through the tool 'Polls' of the UPV platform PoliformaT which enables to make surveys in an anonymous way. Students may respond or not to this poll but if done they are allowed to do it only once.

The students opinion about receiving classes is collected In Table 4. This question was answered by 45% of students, 29% of ARA group and 56% of non-ARA group.

Table 4. Do you think it is interesting to receive Mathematics classes in English in the first year?

	ARA(42%)	Non-ARA(58%)	Global
Yes	25%	13%	38%
No	2%	19%	21%
Progressively increasing	2%	39%	41%
	29%	71%	100%

The following two questions are related to the level of Mathematics (Table 5) that they had when entered the university.

Table 5. Which was your grade in Mathematics when you entered the university?

	ARA(42%)	Non-ARA(58%)	Global
Pass	0%	4%	4%
Good	2%	14%	16%
Excellent	25%	55%	80%
	27%	73%	100%

The general level of Mathematics in these groups of Aerospace Engineering is very satisfactory but especially in the ARA group, where only 2% of the total number of students did not have the ‘Excellent’ level.

In what concerns knowledge of English we received the following answers (Table 6) where we use the Common European Framework of Reference for Languages, abbreviated as CEFR [11], which is the standard guideline used to describe achievements of learners of foreign languages across Europe and whose proficiency is described by six levels: lowest A1 and A2, intermediate B1 and B2, highest C1 and C2.

Table 6. Which was your level of English when you entered the university?

	ARA(42%)	Non-ARA(58%)	Global
None or poor	0%	16%	16%
A1/A2	2%	11%	13%
B1/B2	16%	35%	51%
C1/C2	9%	11%	20%
	27%	73%	100%

ARA group students have not improved their English level in general terms, only 2% of them have done so whereas 4% of non-ARA group students express that they have improved their level.

Finally, we have also consulted their opinions about ARA groups, see Table 7.

Table 7. Please tick one of the following statements

	ARA(42%)	Non-ARA(58%)	Global
I have been attending the ARA group and I would make it again	27%	0%	27%
I have been attending the ARA group and I would NOT make it again	0%	0%	0%
I have been attending the ARA Group and I think there is no difference	8%	2%	10%
I have not been attending the ARA Group and I would like to join	1%	14%	15%
I have not been attending the ARA Group and I would like to keep so	0%	15%	15%
I have not been attending the ARA Group and I would like to have some progressive teaching in English without joining the ARA group	1%	32%	33%
	38%	62%	100%

In view of Table 7 it seems pretty clear that ARA group has been accepted by all students. Even those who are not within the ARA group would rather join it or at least a group with some kind of progressive immersion into English instruction. Only 24% (10/41) of these students have clearly expressed their wish of keeping off an ARA group.

5 Conclusion

We would like to emphasize the fact that the methodology, exercises developed at class, the use of the educational platform PoliformaT and the exams that the students took in Mathematics I were identical in both groups, the only difference between both groups was the language of instruction.

After the implementation of the ARA project in BEng Aerospace Engineering, the results obtained in Mathematics I have been very good for the set of students conformed by the ARA and non-ARA groups. The dropout rate reduced to just 2% and the success rate (passed/registered) has become 86%, far from just acceptable. Results for the ARA group in particular were similar, with a dropout rate of 4% and a success rate of 83%.

All this leads us to conclude that the ARA group is being successful in the subject Mathematics I and clearly prepares students to follow Erasmus exchanges or ulterior graduate studies in foreign universities as well as to work in multinational environments.

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Oral examinations – A way to turn them into a good counterpart of the written ones

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Abstract

As soon as the number of students registered in a given matter turns out to be fairly high, oral examinations are generally considered as a non-affordable assessment procedure. Therefore, the benefits this kind of assessment could provide are unavoidably rejected. However, under the Bologna approach, and the need and convenience of setting a comprehensive assessment system, the authors have revised barriers and difficulties and have devised a way to take things on. For three years now, they have been performing oral examinations in subjects with more than 200 students registered, and the outcomes have been equally positive and encouraging. The paper presents the key points that have made oral examinations a successful tool – organization, software application to support the whole procedure, etc. Outcomes are also evaluated. Finally, conclusions are presented. As it will be highlighted, in spite of the several difficult aspects oral examinations imply, the positive ones are much larger, and the real reason why authors plan to keep them in the long-term.

1 Introduction

The new drive the Bologna process is bringing onto the engineering teaching methodologies is widely known [1], [2], [3] . Degree courses in Spain are today in their fourth academic year, and the first batch of Bologna engineers is about to finish their studies and leave the University. And we all hope that the changes, always difficult, that have been implemented in these new degrees will yield the expected outcomes as the new engineers begin their real professional life [4].

The new foundations for engineering courses have influenced either the teaching-learning activities or the assessment activities. Both sides are well known, in the first one, special emphasize has been focused on active methods in class. Besides the traditional ordinary one-direction lecture, from lecturer to students, group activities, seminars and projects, have been successfully undertaken. Likewise, on the assessment side, a wide range of different activities have begun to be implemented; and the traditional ordinary long written exams are now complemented by, to mention only a few, short frequent exercises, tests, on-line trials and presentations.

Such a comprehensive scope in teaching and learning seeks, no doubt, an integral students' formation. All their capabilities are cultivated, either the scientific and technical direct ones, or the social and motivational transversal ones.

Within this context, yet, authors still miss one puzzle piece. Today students have to face oral assessments indeed. But in the overwhelming part of cases, they are presentations they have purposely worked on in advance. They have been developing a particular project for a given time, they have worked on the presentation and after their speech, they are assessed on that. Generally, it is a group task and thus there is a high group component in the whole process.

A different complementary oral assessment activity to balance the one mentioned above would be a straight, simple, quick and individual oral examination. This is not a new thing - as people say, time ago, engineering students were only a few, and this kind of examination was as common as the written exams. But high registration figures today seem to make it not feasible in terms of time and/or examiners.

In order to overcome such difficulties, authors have devised a procedure to perform oral individual examinations to large group of students. The procedure is based on two pillars – a clear method, and a practical software application. Both elements are described below.

2 The method

Having been running for three years now, the examination method is quite tuned, and quite debugged as well. However, its fundamentals keep being the same as those in its beginnings. In summary they are the following. The particular case presented in this paper refers to the subject *Fluid Mechanics* (4.5 ECTS, 3 hours/week, second semester, second year, Mechanic Engineering degree course, about 200 students per year).

A large amount of questions

This is essential. Lecturers have written as many questions as possible, and they keep doing revising and enlarging tasks all the time. The aim is having ready, at any time, an increasingly larger arsenal of questions. At the moment total number of questions is about 500, and they are organized in 13 topics (Table 1).

Different kind of questions, but short

Questions may cover all contents developed in the subject, and from any possible point of view. They could ask about definitions, explanation of concepts or equations, guidelines to apply equations to practical cases, numerical answers in problems, etc. The common feature for every question is that it must be short. The student must know the answer, or how to answer, or must not. If the answer is correct, it will be quick. There is no time available for elaboration or calculations, or even for thinking too much. It is not needed. Some example questions are shown in Fig.1.

Individual examination

Students take the examination, one by one. Each one is asked three to five questions. The questions are always randomly selected, but the examiner may choose the topic. Generally, the time needed for each student to take the exam is no longer than ten minutes, so students are scheduled and called at a rate of five or six per hour.

The assessment

The examiner assesses each question separately, as soon as the student answers it. Assessment should focus on the answer's contents and accuracy, no matter the student's personality or way of speaking. Marks for each question range from 0 to 10. As a helping guideline, the application provides the examiner a short check-list to decide the final marks for each question. The final assessment for the examination is directly taken as the average marks from all questions answered.

One essential element in the assessment process is that the application enables the examiner to write annotations, as long as desired, about the particular aspects of the answer to each question. This way, different things like the criteria followed, special hits or mistakes, or even the student's attitude and shown capabilities can be registered and left available for future revisions or explanations.

Table 1. Number of questions available for Fluid Mechanics

Topic	# Questions
Fluid properties	20
Fluid statics	20
Fluid kinematics	70
Differential fluid dynamics	20
Integral fluid dynamics – mass balance	20
Integral fluid dynamics – energy balance	55
Integral fluid dynamics – linear momentum balance	30
Integral fluid dynamics – angular momentum balance	30
Pressure flow	80
Pumps	45
Hydraulic transients	30
Open-channel flow	45
External flow	35
TOTAL	500

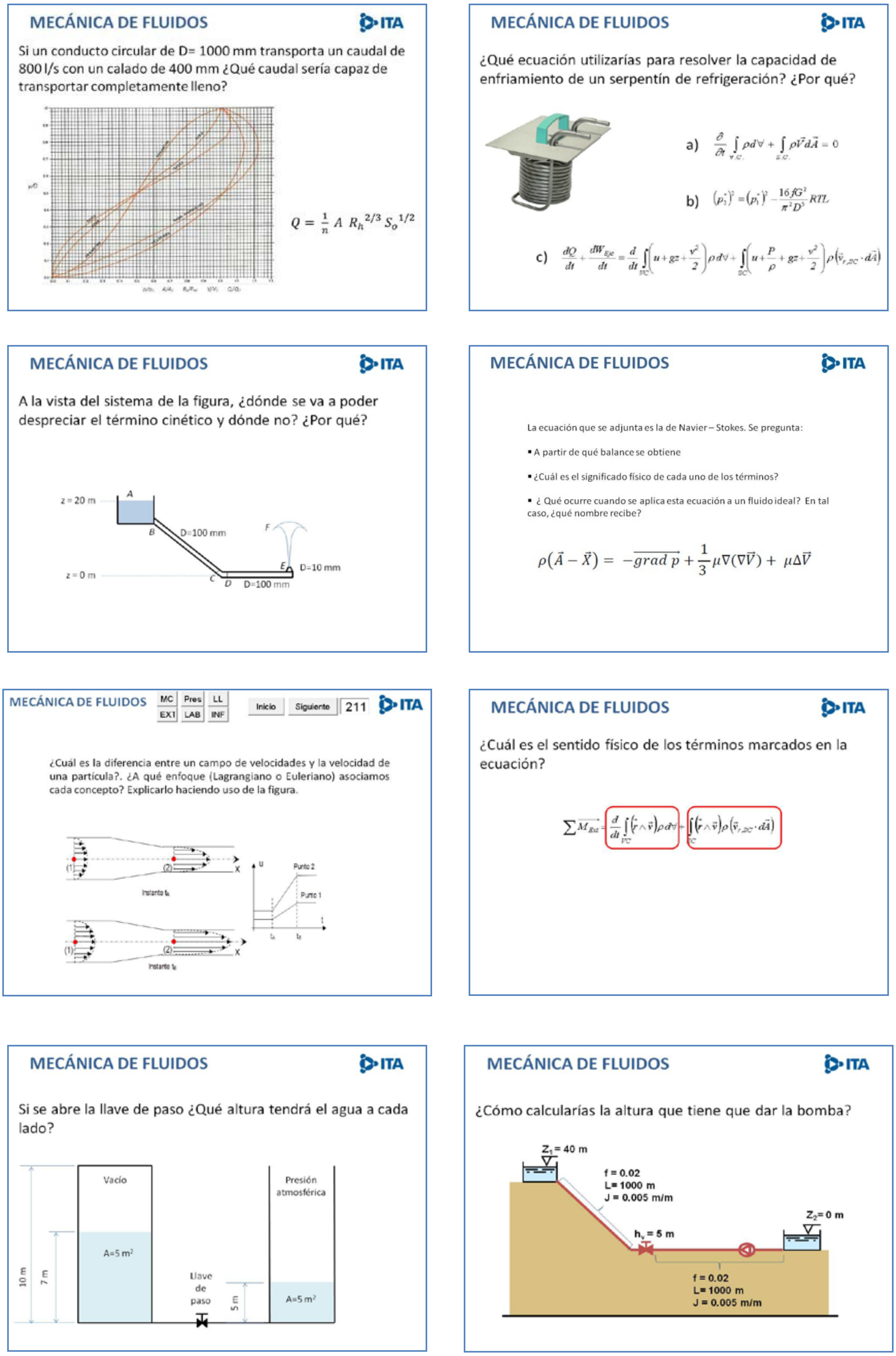

Fig. 1. Some example questions

3 The software application

The common element that makes possible the whole process is the web-based software application developed by ITA [5]. Fig. 2 shows the way it connects all the parts involved.

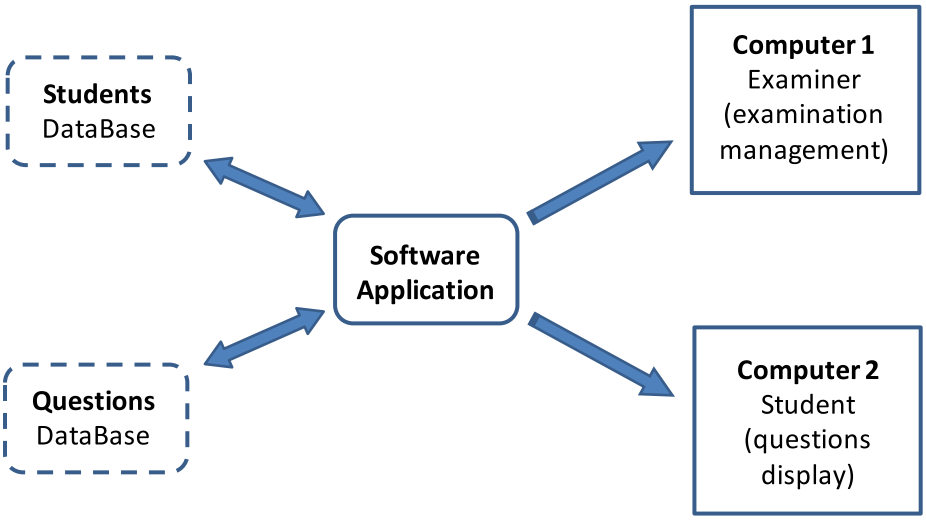

Fig. 2. Software application scheme

The process begins as the examiner logs in the application through his/her personal laptop (Computer 1 in Fig. 2). From that Computer 1, the examiner manages the process all the time. As a student begins the exam, the examiner selects his/her name from the students database and access the examination management screen (Fig. 3). That screen shows, on the one hand, other student's assessments in the subject so far, and on the other, the available topics to make questions.

As the examiner decides to make a question, it is selected by the application and sent to the room's computer (Computer 2 in Fig. 2). Computer 2 is connected to the video projector and the question (Fig. 1) is then shown in the screen of the examination room.

While the student is answering, the examiner can take notes. Finally, the examiner rates the answer, and another question may be asked. All questions and answers made to each student are available and editable, during the whole student's examination (Fig. 4).

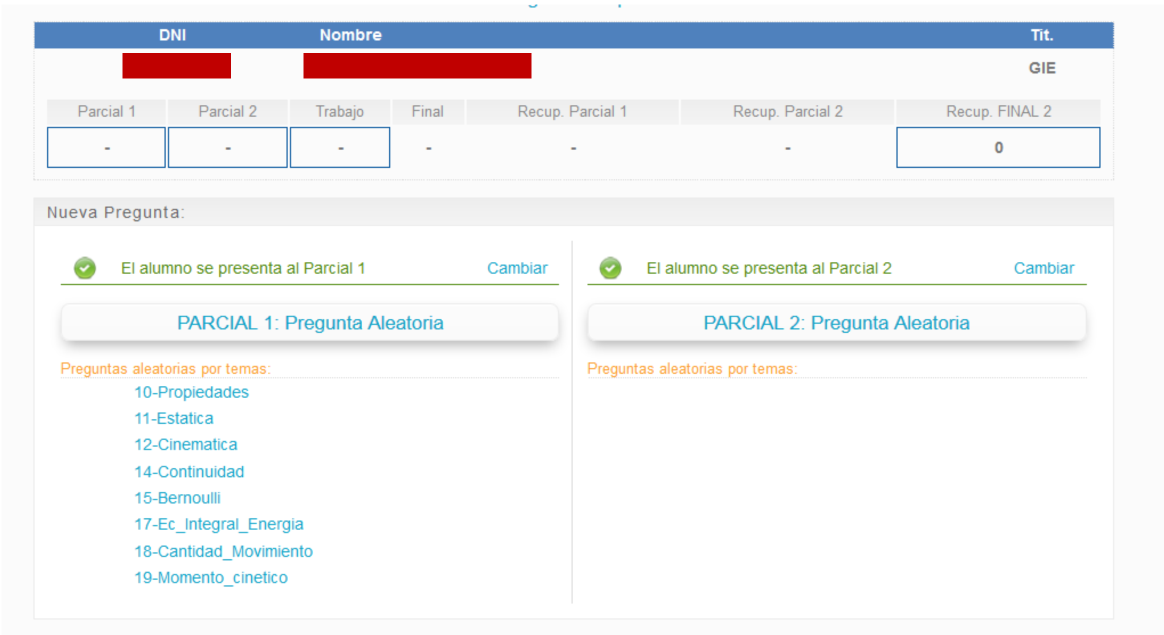

Fig. 3. Management screen for the examiner

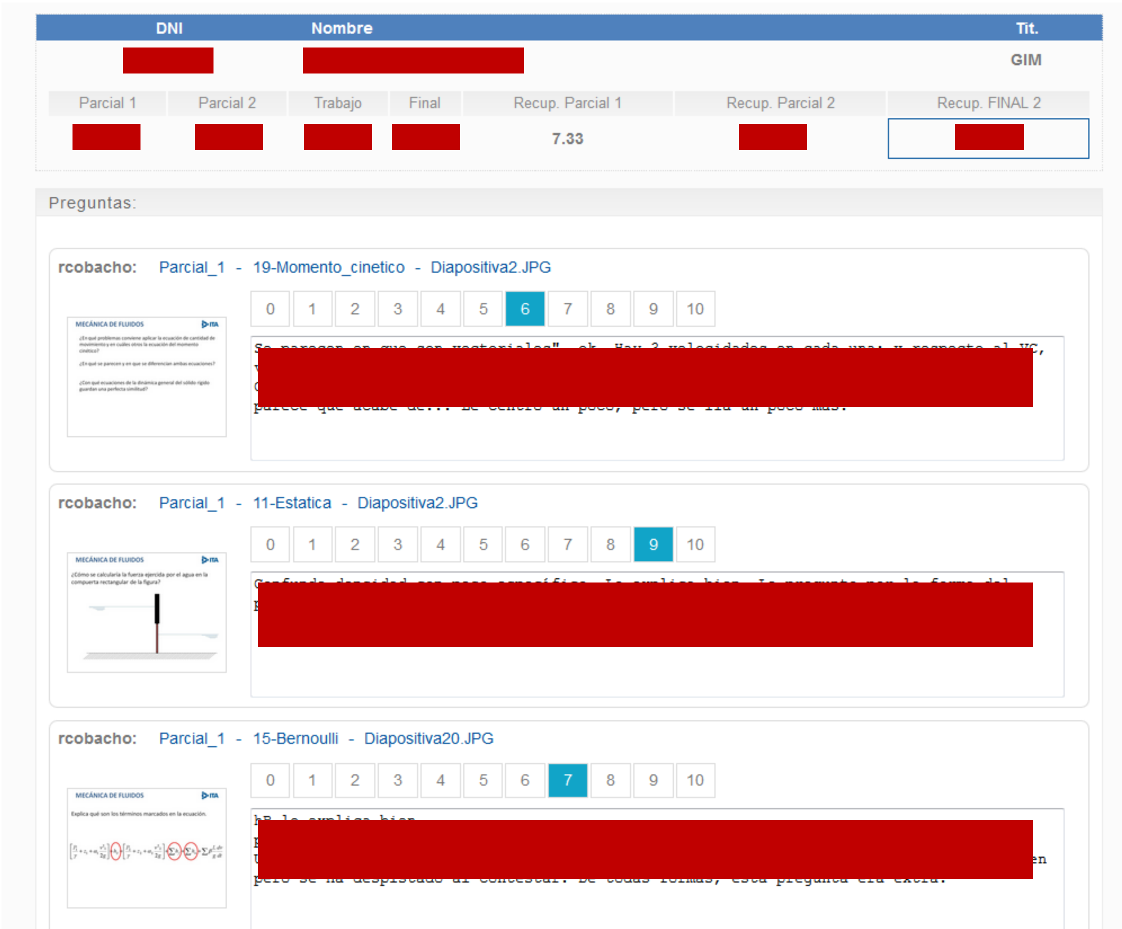

Fig. 4. Assessment screen for the examiner

4 Results

This method for oral examination was tried by authors three years ago, as a sort of pilot testing. Many uncertainties existed at that time, and many doubts arose about its effectiveness and feasibility. However, as advanced above, all those worries have been being fixed with time, and the method has become a well-established one in the engineering grade subjects explained by authors. Two aspects are worthy to be presented here: a general analysis on the marks obtained by students, and a short consideration on the effort needed to start it off and keep it on.

Students assessment analysis

During the academic year 2012-13, about 200 students took the subject Fluid Mechanics in the Mechanical Engineering degree course. The subject was divided into two parts, and the global assessment for each part consisted in three different type of trials – written examination, oral examination and personal exercises / lab practices.

Table 2 shows the average marks obtained by students in both examinations (written and oral) in each part of the subject. Unlike probably expected, it can be clearly noticed that marks from the new oral examination are not lower than those ones from the old-traditional written ones.

Table 2. Comparison between marks from written and oral examinations

	Written examination		Oral Examination	
	Students	Avg. Mark	Students	Avg. Mark
Part 1	175	4.62	178	5.47
Part 2	178	5.76	173	5.71

More relevant, Fig. 5 and Fig. 6 show the plotted individual marks for each student in Part 1 and Part 2, respectively. To make things clearer, the students (horizontal axis) have been ordered according to the written exam marks, which are represented by a continuous line. On the same chart, individual marks from the oral exam are represented by small x.

In both two cases, and before further statistical analysis, no clear relationship between marks obtained in each kind of examination seem to exist. Furthermore, the scattered plot for the oral examination marks shows a couple of areas (dots clouds) in the left-bottom and right-upper corners of the chart. That means that a non-negligible number of students that got high marks in the written exams obtained poor marks in the oral ones, and vice-versa. The subsequent conclusion is that oral examinations are definitely covering a particular face of the subject, missed by the written ones. And that remarkably, all in all, both examinations provide a good final balance.

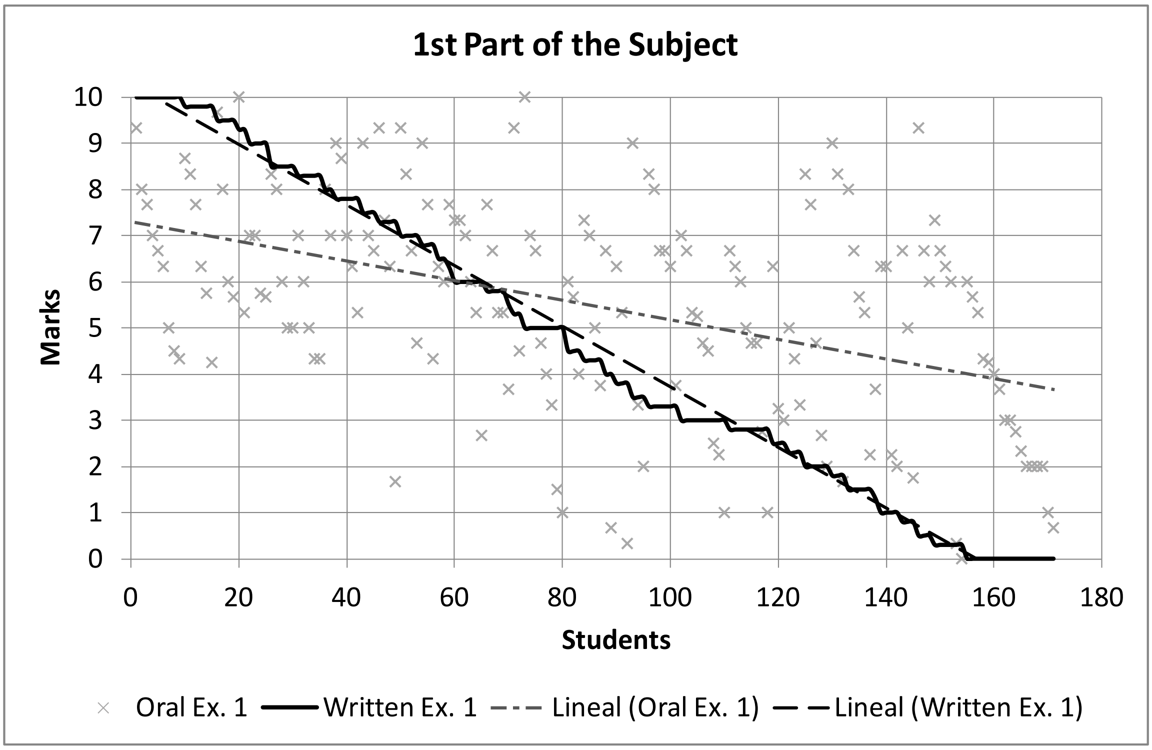

Fig. 5. Students individual marks for the subject's Part 1

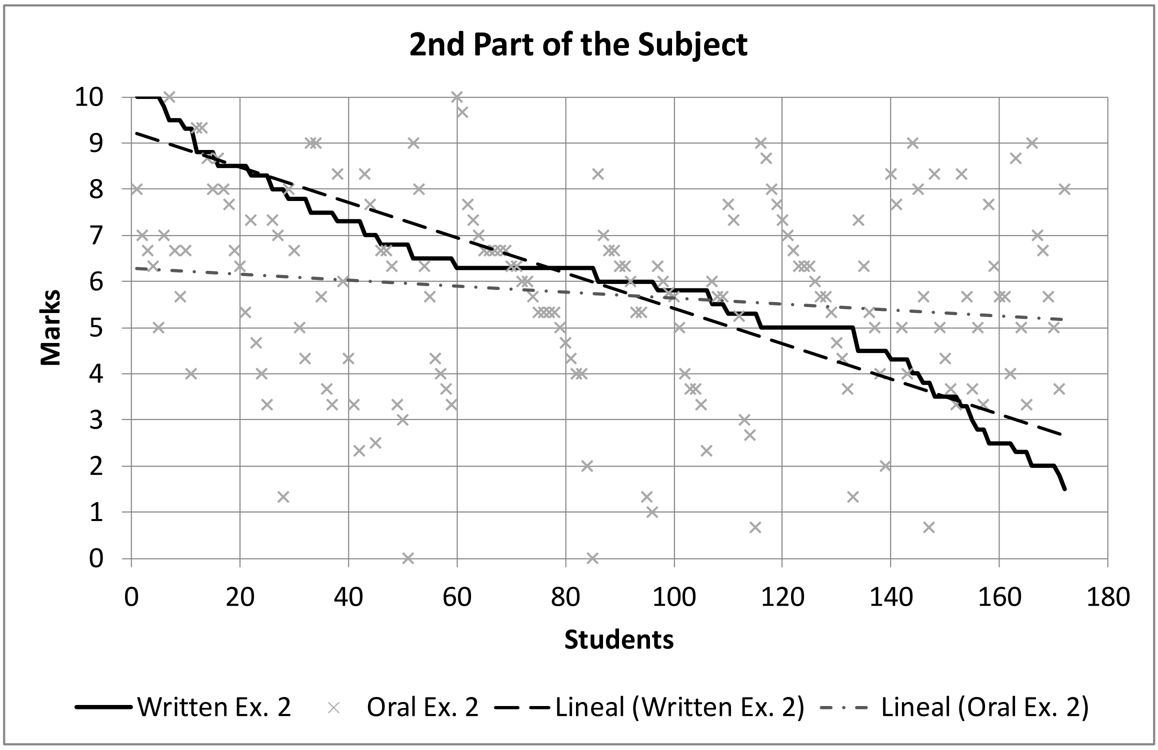

Fig. 6. Students individual marks for the subject's Part 2

Examination resources

Resources needed to carry out the oral examinations described in this paper widely vary between the first implementation year and the rest. No doubt, getting the application into operation requires a good deal of effort, time and, also, money, in case that lecturers involved are not as skillful in software programming as necessary.

Preparing the initial set of questions is also time-consuming. However, the lecturers' teaching experience eases the duty to a large extent. Also, that task can be easily performed in short whiles, so it can be compatible with ordinary teaching and research work.

Once the first year has successfully passed, the needs for future oral examinations largely decrease. One possible final concern, the total examination time can be summarized according to the last examination authors had in April 2014 – more than 200 students were assessed by two lecturers at the same time, in less than two full days.

5 Conclusion

Traditional individual oral examination is a proper and an adequate assessment method for engineering students. Taking advantage of an own web-based application, authors have developed a procedure to carry in on, in accordance to the Bologna process guidelines. As presented in this paper, because of the assessment performance itself, as well as the results obtained by students, it can be considered as an efficient and valuable method, fully complementary to others.

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Water supply sectorization according to water and energy efficiency

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Abstract

Water losses represent one of the major problems in water distribution system (WDS) management. To reduce and control theses volumes, distribution networks are divided into district metering areas (DMA's) (small parts the network is divided into, thus allowing easy management) in accordance with empirical procedures. In this paper, a systematic methodology that provides new approaches to the design of DMA distribution networks in order to minimize water and energy consumption is proposed. For this purpose, the knowledge acquired in the Master's Degree in Hydraulic Engineering and Environment has been applied to a real case.

1 Introduction

One of the requirements to reach the Master's degree in Hydraulic Engineering and Environment from the Polytechnic University of Valencia (UPV) is the completion of a Final Master's project (FMP), where general theoretical concepts acquired during the course are applied, and in particular the specialization module, in this case Urban hydraulics.
With this premise, Salguero (2011) addressed one of the main problems in the management of WDS: Uncontrolled leak flow rate (IWA, 2000). This uncontrolled leak flow rate, colloquially known as leakage, is that which escapes from the system without being controlled or delivered to the user.
It is well known that leaks depend on pressure or state of infrastructure (AWWA, 1990). For the amount, they represent a remarkable magnitude volume, and its proper determination has been the subject of many papers. For example, the Environmental Protection Agency (EPA, 2009) conducted a study that showed the leak rate in different cities. In all, the leaks ranged from 35.15% in Williamsport (Pennsylvania) to 15.20% in Memphis (Tennessee). Leak rates can exceed 50% of the total as in Bytom, Poland (Wojciech and Krzysztof, 2012) or in third world countries (ADB, 2008; Kingdom et al, 2006). Nationally, leaks in Spain total 26% of the annual volume supplied in supply networks (INE, 2012), and in the city of Valencia that value is slightly higher (29.84% of total volume) if leaks are considered as real and apparent losses (unauthorized consumption, theft or illegal uses and undercounting of meters), values that could not be broken down (Murgui et. al., 2009).
To control and reduce these volumes the sectorization technique is used, among many others. This control method is a globally widespread and commonly used technique on water distribution systems (WDS) for control and leak detection (Water Authorities Association and Water Research Centre, 1985). Its key objective is to facilitate network monitoring (locating anomalies such as breaks, leaks or pressure deficiencies) by its division into smaller networks with different hydraulic behaviour (WHO, 2001; Giz and Vag, 2011; Thornton, 2004 and Thornton et. al., 2008).
But the main disadvantage of sectorization is that there is no standard procedure for its design. Usually, the partitions must be defined empirically, often influenced by the infrastructure manager's experience.
In this paper, a new approach is presented that will help the sectorization of WDS design. A method of calculation based on the energy concepts (Boulos, 2010;Cabrera, 2010), which results in a clear definition of each of the sectors inside the network. Delineation which will minimize the uncontrolled leak flow rate with subsequent leak detection actions.

To show the results obtained by the proposed methodology, it has resorted to two WDS. A first synthetic network composed of 65 pipes and 38 consumption nodes, whose use aims to show the calculation processes and the steps followed easily. And a real distribution system, modeled on EPANET (Rossman, 2000) of more than 20,000 inhabitants and 75 km of pipelines, which will display the results achieved.

2 Theoretical definitions

2.1 The technique of sectorization

WDS sectorization is a common and global technique used in control and leakage detection. Basically it consists of dividing the network into smaller subnets, called sectors or DMAs (District Metered Areas). It becomes a strategic option that reduces the area of inspection for the detection and localization of anomalies such as bursts, leaks or pressure deficiencies (WHO, 2001; Giz and Vag, 2011; Thornton 2004 and Thornton et al, 2008).

Once divided into hydrometric network sectors, it is easier to evaluate the circulating flows and therefore the level of leakage, especially in night periods. Therefore, sectorization is considered to be one of the most effective actions in terms of leak detection and its subsequent location and repair.

In general, implementation and commissioning of sectorization can be summarized in a very global manner in two steps:

- Close adjacent sectors connecting pipes, by closing the off valves installed at these points.
- Installation of water meters at the entrance and exit pipelines of every sectors.

Once the sectors' contours and the entry of water have been established, the examination process and the consequent detection of the volume leaked can be performed.

Nevertheless, the greatest complexity of this technique resides in the design of the sectorization. There is more than one solution and there are several criteria involved (topography of the city, demand, number of valves, water quality in each sector, pressure requirements, economic investment, etc.). But it can be said that much of the sectorization is defined according to practical criteria from the point of view of its final execution, not following a general established procedure.

Most of the studies agree that it should be defined according to natural boundaries (main roads, railway lines, etc.) or with the objective of minimizing the number of valves to close (Giz and Vag, 2011). Moreover, some other approaches recommends that DMAs in urban areas must have between 500 and 3,000 service connections (Morrison et al, 2007), or limit the lengths of the encompassed pipes (between 4 and 30 km, DVGW, 2003).

There are few studies that address the automatic design of sectorizations (most of the time heuristic approaches are taken without particular general procedure). Among them, we can highlight the contributions of graph theory-based algorithms for WDS sectorization (Tzatchkov et al, 2006; Nardo, 2010), some others designed two DMA partitioning methods based on machine learning, with both graphical and vector information considered (Izquierdo et al., 2009 and Herrera et al., 2010).

This paper proposes a calculation method that considers a WDS as an undirected graph (elements which consist of two parts, where the pipes are the lines and consumption nodes are the vertices of these) (Kesavan and Chandrashekar 1972; Gupta and Prasad 2000), and use of a multi-agent system provides the definition of those sectors that, in addition to meeting the overall objectives of the sectorizations, achieves greater water and energy efficiency. The water improvements are quantified by the Water Audit (IWA, 2000) and the goal of sectorization is to minimize the leaked volume. In addition, energy improvements (which are quantified with the use of the energy audit, Cabrera et. al., 2010), involves the reduction of the total energy consumption required to meet demand with pressures higher than the minimum threshold pressure and the minimization of the energy lost by leaks. It should be remembered that the use of the energy audit requires the availability of a calibrated supply network model.

2.2 A first solution to the energy problem

In water distribution networks, the energy supplied to the system may come from the elevation of the reservoirs which provides water into the network (“natural energy”) or from the shaft work supplied by pumps (“artificial energy”. It has been stated (Cabrera et al, 2010) that the energy supplied to the grid is equal to the energy which leaves the system at the consumer's tap (“useful energy”), leaks (“outgoing energy through leaks”) and energy dissipated in friction due to piping, or regulatory elements. Another similar work (Boulos and Bros, 2010) considers the energy dissipated in three terms as transport, control and consumption. In the first, friction losses (diffuse) in pipes and small regulatory elements (elbows, reducers, etc) are included. The second includes those that are introduced in the system deliberately (valves). Furthermore, together they designate the useful energy and leakages as energy lost in the supply points).

The friction energy dissipated in each pipe in the network is measured (Cabrera et.al, 2010) as:

$$E_f(t_p) = \gamma \cdot \sum_{t_k=0}^{t_k=t_p} \left(\sum_{j=1}^{n_l} q_j(t_k) \cdot \Delta h_j\,(t_k) \right) \cdot \Delta t_k \qquad (1).$$

where n_l is the number of lines in the network, $\Delta h_j(t_k)$ are friction losses (m.w.c.) in line j at time t_k this term is the difference in piezometric heads between the initial and final nodes), $q_{uj}(t_k)$ and $q_{lj}(t_k)$ are, in line j, the flow rate necessary to satisfy the users demand and the flow rate that finally is lost through leaks, respectively. Therefore, the total flow rate in line j, $q_j(t_k)$, is the sum of the two previous values.

And from the above equation, the power dissipated by friction in pipe j is obtained as:

$$P_{fj} = \gamma \cdot q_j \cdot \Delta h_j \qquad (2).$$

Furthermore, the outgoing power of the system at node i (or, what is the same, the effective power and the power loss in leakage) can be obtained with the following expression:

$$P_{i-Output} = \gamma \cdot (q_{ui} + q_{li}) \cdot h_i \qquad (3).$$

where q_{ui} and q_{li} are respectively the flow rate delivered to users ($m^3\ s^{-1}$) and the leaked flow rate (m3s-1) in the pipes adjacent to node i (and therefore associated with this node) and h_i is the piezometric head (m.w.c.) at node.

The minimum useful power at node i ($P_{i-min,useful}$), is defined as the strictly necessary power in the ideal case in which all the consumption nodes had the minimum head pressure ($h_{mi} = z_i + (P_m/\gamma)_i$).So, the minimum useful power at node is:

$$P_{i-min,useful} = \gamma \cdot q_{ui} \cdot h_{mi} \qquad (4).$$

where q_{ui} is the flow rate delivered to users (m3s-1) at node i and h_{mi} is the minimum required piezometric head (m.w.c.) at node i (considering that the pressure at every node i is equal to the threshold P_m/γ (m.w.c.).

With the description of these three powers’ definitions, we can calculate the energy efficiency (Boulos & Bros, 2010), a dimensionless parameter whose value range is between 0 and 1. Due to the requirement to deliver the water above a defined minimum pressure value (P_m/γ), there is a certain amount of energy dissipated (and whose saving is impossible) that prevents the efficiency from adopting the unit value. Energy efficiency is defined as:

$$\eta_e = \frac{P_{i-min,useful}}{P_{i-Output}} = \frac{\gamma \cdot q_{ui} \cdot h_{mi}}{\gamma \cdot (q_{ui} + q_{li}) \cdot h_i} \qquad (5).$$

A similar indicator to the one described as the excess of supplied energy (I_1, Cabrera et. al., 2010), and that both quantify the inefficiency of a system.

2.3. Hydraulic simulation model of the distribution network

To simulate the hydraulic behavior of distribution networks have been developed simulation models with EPANET (Rossman, 2000). Notably, these models also consider the effect of leakage.

The leaks are assumed to be uniformly distributed, and grouped at the nodes proportionally to the length of the converging pipes (Almandoz et al., 2005). Leaks are represented as atmospheric relief valves (emitter coefficient), at each node of the network (like the water flow consumed). The design of each emitter has been made according to the following statement (Rossman, 2000):

$$q_{li}(t_k) = C_E \cdot \Delta H^{\propto} \quad (6).$$

Where CE (m3-α/s) is the emitter coefficient assigned to each node of the system, ΔH (m) represents pressure drops experienced by the water when passing through the hole and alpha is the exponent of the emitter. With the above expression, the leaks in the model are dependent on pressure (pressure driven demand). Leaks are not typically represented in this way because most hydraulic simulation software represents water consumption as independent of pressure (driven demand).

3. Methodology

A method for locating areas where energy efficiency is lower, that is, where the pressure difference between the nodes and the service threshold is greater has been developed. It consists of a calculation process that seeks to minimize the following objective function:

$$e = \sum_{j=1}^{N_c} \sum_{i=1}^{N_n} abs(x_i - c_j) A_{ij} \quad (7).$$

where:

N_c =number of cluster o sectors (DMAs)

N_n =number of nodes

A_{ij} = is 1 if the element belongs to the sector, and zero in other cases

x_i =energy efficiency of element i

c_j =energy efficiency of the elements that make up sector j

To consider this methodology, the following three concepts should be taken into account. First, and in order to address the topological and connectivity aspects, the distribution network is considered as an undirected graph (Kesavan and Chandrashekar 1972, Gupta and Prasad 2000), i.e., one in which the lines do not have a defined direction (or in other words, a priori the direction of flow is not known). It should also be emphasized that the vertices are the consumption nodes. Second, and because of the complexity and volume of the calculations to be performed, use of a multi-agent system is required. An agent is a system able to act independently according to changes in the environment and to interact with others (Maturana et. Al., 2006). They work together to form an intelligent agent system, managing to adapt to the environment and its subsequent modifications to meet the objectives set.

Finally, the Prim algorithm (Prim 1957) determines which of the lines connected to a node has the lowest energy efficiency and therefore it is included in the sector.

The calibrated model of the network and the minimum length that each sector must contain are the input data required by the calculation process (Fig 1.). As a result it gives the definition of a clusters of pipes and nodes whose distributions corresponds to the clusters with the lowest energy efficiency, and the following steps are:

1. ***Do***
2. ***For i=1 to nodes number.*** Start at node i and introduction of this in the calculation set
3. ***Selecting the adjacent lines*** *and opposite nodes not included in the group of nodes that compose the calculation set.*

4. ***While j=1 to number of adjacent lines. Calculation of the energy efficiency of pairs line-node selected***.
5. ***End While***
6. ***Introduction to the calculation set of the pair that has the lowest energy efficiency.***
7. ***Calculation of the energy efficiency of the new calculation set.*** *This way, you can check if the energy efficiency is improved due to the new pair introduced.*

   IF (energy efficiency)$_{k+1}$< (energy efficiency)$_k$ and L>Lmin

   The value of the new energy efficiency and the subset of elements that compose it is stored. Go to step 6.It aims to find the group of elements with the lowest energy efficiency from the initial node i chosen. Similarly, a criterion of minimum length is set to avoid very small sectors. Therefore, for each iteration (for each starting node i) a calculation set which has a lower energy efficiency is obtained.
8. ***End for***. As a result, a subset of elements (energy efficiency)$_k$ with the lowest energy efficiency of the n (number of nodes) iterations performed is obtained.
9. ***The lines and nodes encompassed in this subset are excluded.***
10. ***While remaining pipe length>Lmin***

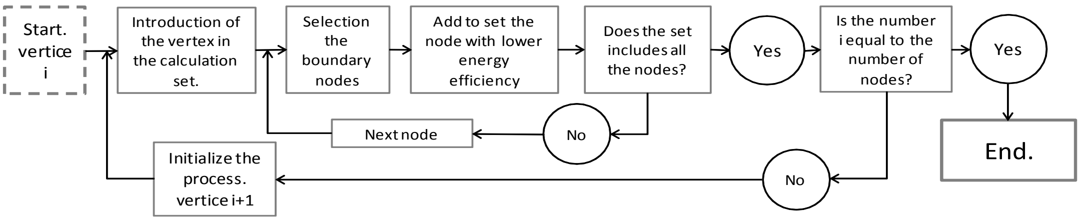

Fig. 1. Flow chart that represents the calculation process

Now, while the division of the entire distribution network into different clusters is performed, the final sectors should be isolated from each other. To define the final sectorization it should be considered which interconnecting piping should be closed to achieve the minimum supply routes.

Although the general objectives in any sectorization are essentially the same, the difference between applying the methodology proposed in this paper or sticking to practical criteria resides in the distribution of the minimum achievable pressures. A design by practical criteria (Figure 2; right) can provide as a result a more heterogeneous pressure distribution. On the other hand, the sectorization defined by energy criterias (Figure 2; left) shows more homogeneous pressures in each sector. The latter allows further reduction of the pressure and therefore, the leaked volume.

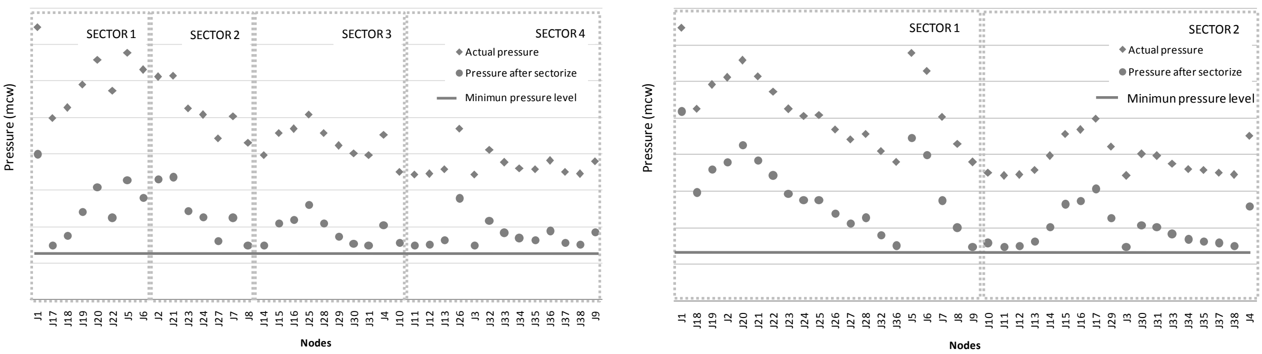

Fig. 2. Pressures in sectorized network by methodology presented (left) and by practical performance criteria (right)

4. Application

4.1. Synthetic network

To show the application of the proposed method, a simple gravity-fed synthetic mesh network has been used (Figure 3). The network is composed of 38 consumption nodes and 65 pipes of different diameters and a reservoir from which the system is supplied. Below you can see a diagram of the network and the nomenclature designating the constituent elements:

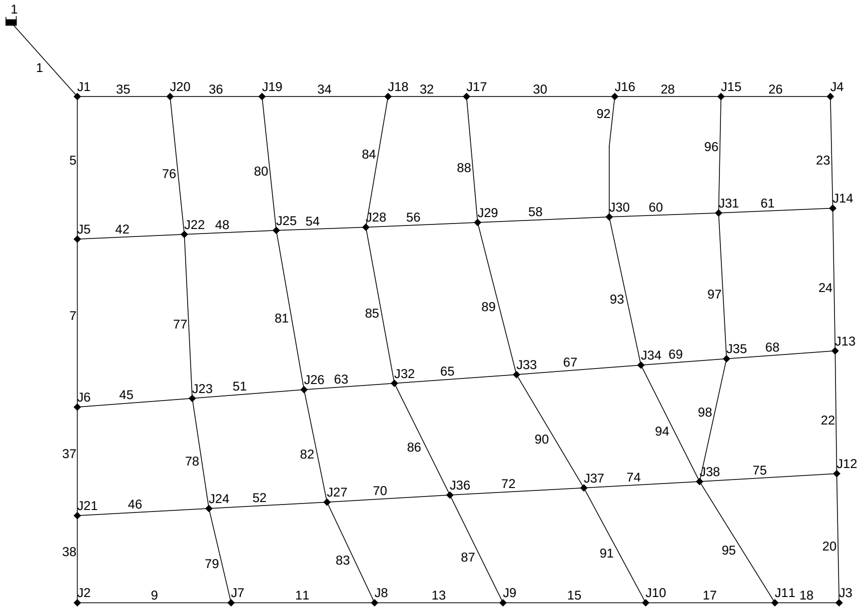

Fig 3. Study network

The simplifications adopted in the synthetic network are:

- All nodes are located at an altitude of 0 m,
- The reservoir elevatin is 40 m.
- As for the pipes, there is a primary arterial network of 200mm and a secondary arterial network of 110mm. The distribution network consists of 90 and 75mm pipes. All pipes have the same roughness 0.1 mm.
- The volume injected into the network is 13,133 m^3/day.
- The volume consumed is 8,536 m^3/day. This consumption is uniformly distributed among the nodes, which implies a nodal demand of 2.6 l / s (without time modulation).
- The difference between water injected and water consumption is considered as leaked volume of 4,596 m^3/day (It can be stated that the performance of the network is equal to 65%).
- Water leaks have been included in the model as fictitious valves at each node, and then the coefficient of each emitter has been calculated (Almandoz et. Al., 2005).
- The additional condition that the resulting length of each sector must be at least 12% of the total length of the network has been considered.
- The minimum operating pressure is set at 25 m.c.w.

<u>Results</u>

The result is the definition of four clusters, as shown in Figure 4. Initial energy efficiencies for each of them are, respectively, 52%, 65%, 68% and 70%.

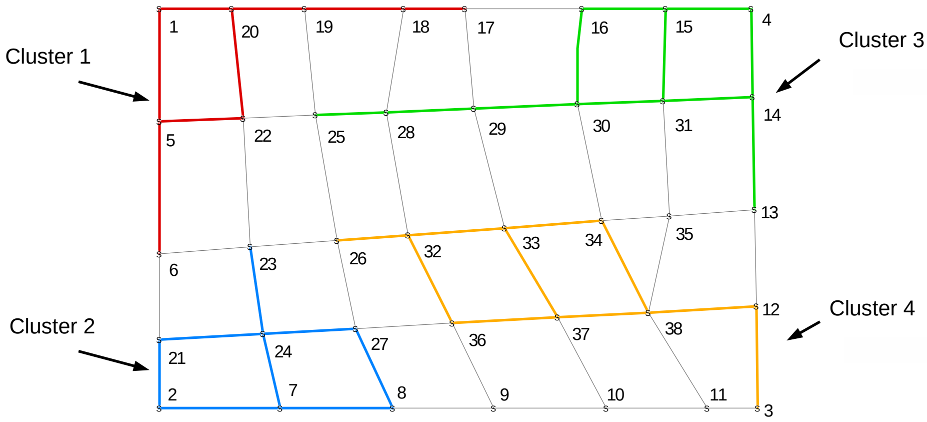

Fig. 4. Clusters obtained after calculation procedure

The distribution of these four clusters (Fig. 4.) can be considered as an approximation of the location of the end sectors. For this we shall, with the use of the simulation model developed, check which of the interconnecting piping between the different clusters can be closed, complying at all times with the minimum operational pressure and the minimum number of supply points to each sector. Fig. 5 shows the final network sectoring, in which supply points to the sectors are marked (flowmeter) and the pipes closed (Closed pipe).

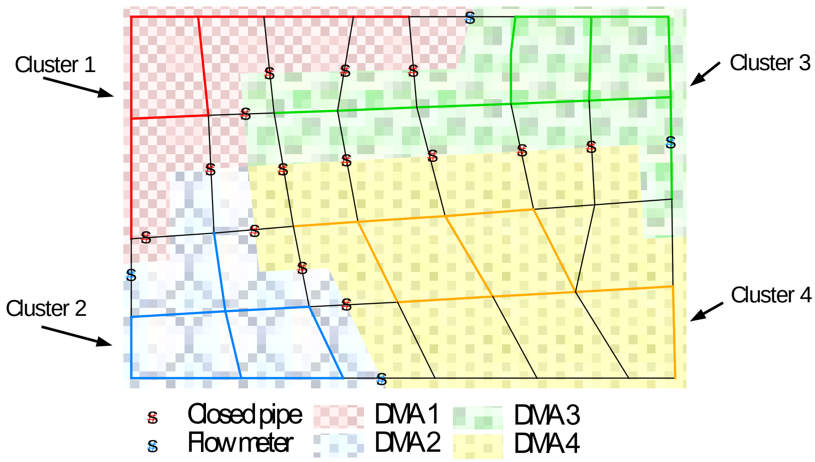

Fig. 5. Result of the network sectoring

After the final definition of network sectoring, you can study the variation of water and energy data comparing the two scenarios presented (before and after this proccess).

Table 1 shows the results obtained. Closed pipes are producing great headlosses and thereby are reducing the mean pressures. As a consequence of that, uncontrolled leaked volume (Q_{leak}) is also reduced. The difference between this minimum uncontrolled leaked volume when comparing these two scenarios represents the water saving obtained (Table 1)

This phenomenon shows that the application of a pressure management campaign, for example installing pressure reducing valves, subsequent to the sectorization would not make it possible to reduce the same volume as if it were done when the network was without sectorization.

Table 1. Water data before and after network sectoring

	P average (mcw)	Q inject. (l/s)	Q inject. (m³/día)	Q cons. (l/s)	Q leak (l/s)	Q leak Min (l/s)
BEFORE						
DMA 1	37,63	31,09	2686,18	20,81	10,28	
DMA 2	36,69	27,62	2386,37	18,2	9,42	
DMA 3	35,9	36,18	3125,95	23,41	12,77	
DMA 4	35,19	57,1	4933,44	36,39	20,72	
Network	36,15	151,99	13131,94	98,8	53,19	45,29
AFTER	P average (mcw)	Q inject. (l/s)	Q inject. (m³/día)	Q cons. (l/s)	Q leak (l/s)	Q leak Min (l/s)
DMA 1	37,72	31,11	2687,9	20,81	10,3	
DMA 2	34,12	27,23	2352,67	18,19	9,05	
DMA 3	33,13	35,62	3077,57	23,41	12,21	
DMA 4	27,63	54,73	4728,67	36,4	18,32	
Network	32,25	148,69	12846,82	98,8	49,88	48,98

Table 2 shows the energy results obtained for the case presented and for the network sectoring performed. While energy efficiency is constant (62.5% in both cases), the differences in the energy efficiency among sectors demonstrates the margin for improvement that each sector has.

The lines closed lead to higher friction headlosses (292.3 versus 149.6 kWh/day) but fewer losses due to uncontrolled leaked volume (49.88 versus 53.19;Table 1).

Table 2. Energy data

Network	TOTAL ENERGY (kWh/day) Exit through demand (kWh/d)	TOTAL ENERGY (kWh/day) Exit though leaks (kWh/d)	TOTAL ENERGY (kWh/day) Friction dissipation (kWh/d)	Min. energy on tap (kWh/d)	Energy Efficiency (%)
DMA 1	184,19	98,23	111,89	187,68	47,6
DMA 2	145,01	76,73	63,89	164,25	57,51
DMA 3	180,77	100,37	79,04	214,8	59,64
DMA 4	232,01	123,99	37,58	329,23	83,65
Sectorized network	741,92	399,28	292,32	895,95	62,5
Current network	836,25	482,91	149,61	917,98	62,5

After considering these results, it can be said that that the proposed method provides network sectors that are not only viable hydraulically but also very homogeneous as far as energy efficiency is concerned. And this results in a direct improvement in pressure management, and by extension, in water losses.

5 Case study

A population of over 20,000 inhabitants is supplied by the water distribution network shown at Fig. 6. This network is formed by 75 km of pipes with diameters between 30 and 400 mm. The hydraulic behaviour of the network has been modeled using a hydraulic simulation software, such as EPANET, in which the leakage (as pressure driven demand) has been considered.

Regarding this case, four different scenarios are considered (the first two network sectoring have been obtained following empirical criteria and the third according to energy reduction). These are:

- Case 0 – Current situation.
- Case I – Sectorization according to elevation: The pipes are grouped into sectors according to the topology of the terrain.
- Case II – Sectorization by material: A sectorization performed based on the homogeneity of the material of the pipes is considered.
- Case III – Sectorization according to energy criteria (presented methodology).

In this town, the minimum required pressure along the network is 20 m.c.w..

5.1. Results

Following the use of the presented methodology and the use of different simulation models to verify that the minimum flows and pressures guarantee the proper operation of the system, the sectors obtained are shown in Table 3.

Table 3. Sector definition

	Number of Sectors	Number of valves boundary	Number of meters
Case I	7	24	11
Case II	5	7	6
Case III	5	15	6

In Case III, the network has been organized into five clusters in which each has at least 10% of the total length of the network. Based on the clusters obtained, the five sectors shown have been defined (Figure 6) and in compliance with the minimum levels of pressure.

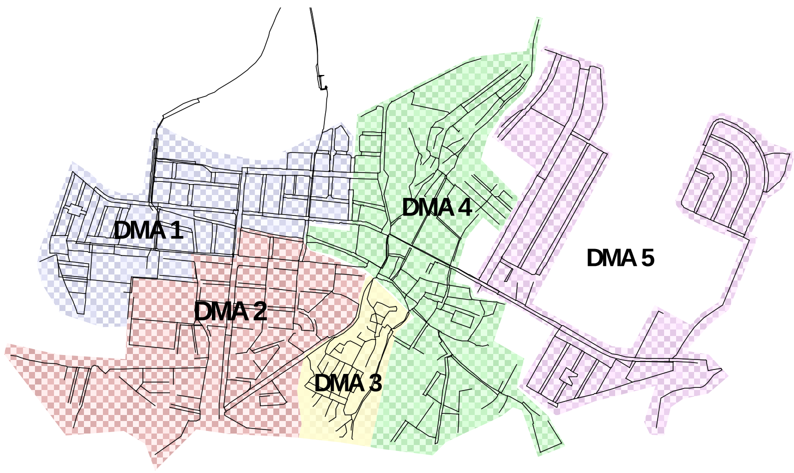

Fig. 6. Results obtained by the method proposed and final sectorization

Pressure levels at consumption points following the sectorization implementation and its cumulative distribution is shown in Figure 7.

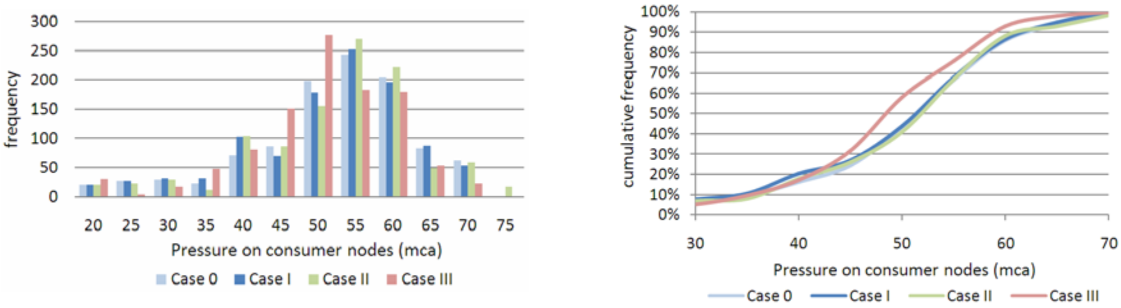

Fig. 7. Distribution of pressure and accumulated pressures.

It can be observed that the pressures are very similar in the range between 20 and 45 mca (Fig.7). However, in case III, the pressure levels are lower than the pressures obtained at the other cases for values above 50 mca. In cases I and II, it can be seen how pressure levels increase in the range 57-65 mca, and even network sectoring can generate overpressure reaching 75 meters head.

5.2. Results of the water audit

Table 4 shows consumptions and the pressures for each of the case studies. Data obtained from each of the sectors in case III is also included.

Table 4. Consumption and pressures in the cases considered

		P average (mca)	Q injected (l/s)	Q cons. (l/s)	Q leak (l/s)
Case 0		49,87	49,59	22,02	27,57
Case I		48,83	48,97	21,98	26,99
Case II		49,59	49,73	22,07	27,66
Case III		47,69	48,32	22,06	26,26
Case III	DMA 1	49,54	14,59	6,59	8
	DMA 2	50,75	11,12	5,72	5,4
	DMA 3	50,53	2,72	0,91	1,81
	DMA 4	46,8	12,28	5,84	6,44
	DMA 5	43,36	7,8	2,7	5,1

5.2. Results of the energy audit

The energy consumptions obtained are shown in Table 5, and as in the previous case, the partial results of case III are shown.

Table 5. Comparative energy data

		Useful energy (kWh/d)	Energy losses through leaks (kWh/d)	Energy dissipated by friction (kWh/d)	Min energy (kWh/d)	Energy efficiency (%)
Case 0		266,36	333,73	38,9	293,23	45,89
Case I		258,35	322,89	69,52	289,81	44,53
Case II		259,14	343,61	55,75	293,61	44,59
Case III		253,21	303,6	62,91	285,51	46,07
Case III	DMA 1	78,79	94,98	15,94	86,25	45,46
	DMA 2	70,17	63,4	33	66,72	40,05
	DMA 3	11,11	21,86	1,06	16,1	47,31

	DMA 4	65,94	75,93	9,24	72,58	48,03
	DMA 5	29,77	53,06	4,42	46,55	53,35

The use of energy efficiency as a management indicator provides a new level of prioritization in finding leaks. This indicates that the network sectoring proposed taking into account energy criteria provides greater value for Case III (46.07%) and energy losses through leaks of 303.60 kWh/d (Table 5) (the lowest value of the study).

6. Conclusions

This paper highlights the importance of combining theoretical and practical aspects to solve engineering problems. Only then can effective and efficient solutions to real problems, such as the problem caused by water leaks in water distribution systems, be achieved.

Although the total elimination of leakage is impossible, detection and quick repair becomes the goal of the infrastructure manager. This paper has proposed a methodology that adds new criteria for the design of network sectoring in water distribution networks. This makes possible to define sectors according to reduce energy consumption in the network. It comes to a no surprise if the network sectoring based on practical criteria (Cases I and II) shows less energy savings than Case III.

Furthermore, there have been two important aspects related to network sectoring that have given rise to possible future research: The application of practical criteria for system operation used to guide design may even be harmful from the hydric point of view; and that the application of this technique before a campaign of pressure management may not give optimal results.

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The role of language learning in internationalizing engineering education

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Abstract

This paper aims to discuss the role that language learning plays in internationalizing engineering education. To do so, the author will describe several tools and resources that have been implemented at UPV's School of Design Engineering to enhance the acquisition of English as a foreign language. These tools and resources are: *Multidict.net,* a multilingual online dictionary interface –together with its integral modules, *Wordlink* and *Clilstore,* which support Content and Language Integrated Learning (CLIL), developed within the EU-funded *Tools for CLIL Teachers* project–; digital storytelling, and the *InGenio First Certificate in English Online Course and Tester.* All 3 resources represent current trends in supporting language acquisition and share several things in common, i.e. fostering autonomous learning, promoting digital literacies and enhancing creativity. All 3 features will be referred to throughout the paper.

1 Introduction

Although Spanish universities are increasingly offering graduate degrees completely in English[1], there is still a strong need to support learners to help them further their foreign language proficiency. To this end, advances in ICT have no doubt played a crucial role in allowing language specialists, materials designers and software programmers to design and develop tools and resources to enhance the language learners' experience in extending their knowledge. The resources that will be referred to in the following sections have all been designed to foster learner autonomy, digital skills and creativity, four of the pillars which are necessary in successfully implementing e-learning. No student would be able to profit from e-learning platforms without prior preparation and adequate stimuli, or without a well-designed plan allowing them to take responsibility over their own learning process. They would also see their qualities and talents diminished should they not be encouraged to develop life skills, such as becoming acquainted with the latest developments in ICT, developing their communication skills and inspiring creative responses.

According to the recently published *Erasmus + Programme Guide* [1], "Multilingualism is one of the cornerstones of the European project and a powerful symbol of the EU's aspiration to be united in diversity. Foreign languages have a prominent role among the skills that will equip people better for the labour market and make the most of available opportunities." It goes on to explain that "The lack of language competences is one of the main barriers to participation in European education, training and youth programmes." In order to help UPV students become as prepared as possible to participate in mobility schemes and gain early access to international labour markets, language specialists from the Department of Applied Linguistics have designed language learning resources aimed at improving students' learning performance. In the following section we shall refer to the various methodologies underlying our language teaching approaches.

[1] At UPV's School of Design Engineering currently delivers two complete graduate degrees in English: Aerospace Engineering and Electronic Engineering.

2 Methodology

2.1 Content and Language Integrated Learning

Content and Language Integrated Learning (CLIL) was recognized as a teaching methodology by the European Commission in its Communication No. 449 on *Promoting Language Learning and Linguistic Diversity: An Action Plan 2004 – 2006,* published in 2003. According to the EU's policy on multilingualism, CLIL involves teaching a curricular subject through the medium of a language other than that normally used. In this past decade we have witnessed how CLIL has steadily rooted its teaching principles and is slowly becoming a dominant methodology in all sectors of education that are sensitive to bilingual instruction. Research and reflective practice literature is currently abundant and CLIL is being the focus of an increasing amount of empirical studies proving the methodology's worth. In line with this trend, the EU-funded *Tools for CLIL Teachers* project has developed an online authoring tool to support the implementation of CLIL. This tool, which is known as Clilstore [2], has the unique ability to automatically link every word in a text to freely available online dictionaries in over 100 languages. The texts may be fed into the tool in the form of a webpage or an uploaded Word document. Clilstore's features are particularly enhanced when videos and their transcripts are embedded into the system from one of the many streaming video applications currently available, such as *TED* or *Kahn Academy,* which offer abundant educational materials in various languages.

Multidict [3] and Wordlink [4] are the building blocks on which Clilstore is built. Multidict functions as a stand-alone multilingual online dictionary interface. Wordlink is the software which facilitates the automatic linking of every word in embedded texts within Clilstore language learning units and can also be used as a stand-alone tool for learners who wish to easily consult online dictionaries as they read through web pages.

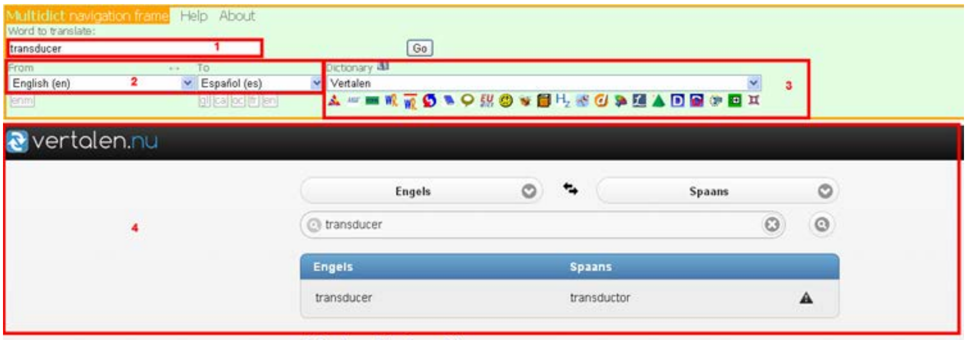


Fig.1. Multidict interface

As we can see in Figure 1, the highlighted parts correspond to the following features:

1. Word entry field.
2. Language pairs: source and target language.
3. Selection of online dictionaries. Both drop-down menu selection and icon selection.
4. Selected dictionary interface with translation

Anybody who has sought to learn a new language has most probably encountered the situation where trying to read an article on the web can be very frustrating when one comes across one or more unknown words. Having to surf around for an appropriate free online dictionary can be very trying especially if one is looking for the meaning of a given word in a specific language domain. However, with the Multidict function, this problem no longer exists. At the touch of a button students have access to online dictionaries in over 100 languages, which have been gathered into one search engine. This gives them quick and easy access to the best dictionaries available on the internet. Multidict can be used as a regular dictionary by simply typing in the word to be translated or defined, but it also provides immediate access to a wealth of monolingual and bilingual dictionaries should the first search result not be satisfactory.

When used within Clilstore, however, the Multidict interface is automatically linked to the text the learner is reading. This means that the hassle of having to type in a word to find its meaning has become obsolete. Language learners simply click on the word and the translation pops up on a dedicated part of the screen. If the word cannot be found, all that has to be done is simply to choose a new dictionary from a drop-down menu. This saves students a considerable amount of search time and makes the reading experience easier and smoother, whether they are working on a PC or a mobile device.

There are many dictionaries to choose from; some are useful to look up general words and others are more appropriate for specialised fields. For example, the IATE database is a very useful tool if one is working with EU-specific terminology, but it also comes in very handy if one is looking for technical words or terms within most vocational subjects. Another example is the *Langtolang* dictionary, which has the added value of providing a sound file with the pronunciation for most words. This is particularly helpful for beginners or for the user who is unsure of pronunciation.

There is quite an array of dictionaries to choose from, although availability does vary from language to language. The types of users who benefit the most from using Clilstore are most often users who have some basic knowledge of the target language. This means that at least a B1 reading level is advisable, especially when working with authentic material. The user who needs to look up every other word will not find many advantages here. However, a user who is at a B2 level will be able to successfully read and understand a text that normally requires a C1/C2 level and in a considerably shorter amount of time compared to reading the text without Multidict. A2 level readers who aspire to move to a B1 level will also benefit from this tool. One of the advantages of Multidict, and Clilstore alike, is that the reader can be exposed to material at a higher level of difficulty. This pushed input, with the added support of Multidict, aids the reader in the successful completion of the task.

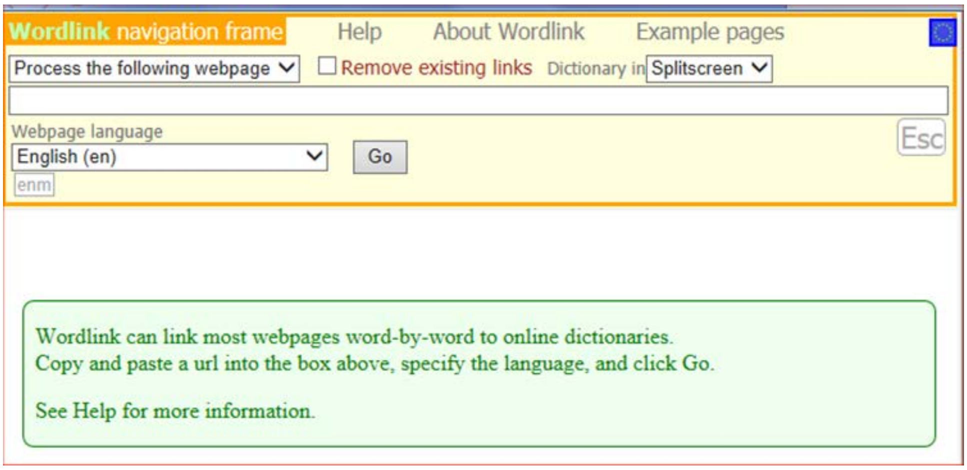


Fig.2. Wordlink interface

Clilstore integrates the Multidict and Wordlink functions into its authoring tool allowing language teachers to create media-rich didactic units for CLIL. In order for Clilstore language learning units to be most effective, however, they should contain a significant amount of text. The reason for this is that a key element of what makes Clilstore a unique language learning service is the way the software treats embedded texts. As mentioned above, at the touch of a button all words are automatically linked to the bespoke dictionary interface, Multidict, which places a large selection of online dictionaries at the learner's disposal, thereby enabling them to interrogate texts at their own pace and according to their own learning requirements. Additionally, a Clilstore unit can incorporate links to further materials or exercises directly relating to it. The wealth of existing units for various languages put a significant open access repository at the disposal of students and teachers alike.

Fig.3. The view of a unit in Clilstore once it has been selected and a learner-determined word clicked on

As we can see, the learner-selected word in the sample unit in Figure 3 is “quote”. On the right hand side of the screen 1) indicates the source language, 2) the target language, and 3) the selected dictionary.

Conceived as an approach to education in which language teaching and subject learning are combined with the teaching of content subjects, CLIL is inspired by a twofold objective. It is meant to ensure first that students acquire knowledge of curricular subject matter and secondly develop their competence in a language other than the normal language of instruction [5].

CLIL, in some of its best practice, invariably goes beyond language teaching and learning. It has become an innovative educational approach, which is increasingly taking on a distinct European characteristic, and which carries methodology as its hallmark. Its introduction is essentially a socio-pedagogical issue because unlike commonly found top-down developments within education, the driving force for CLIL is often at the grassroots and with socio-economic stakeholders [6]. One of the current challenges is therefore to design sound motivating materials to foster CLIL and engage both teachers and learners in this methodology.

When designing dual-purpose learning materials, close co-operation between the language specialist and the subject specialist becomes crucial in order to design and implement pedagogically-sound materials that serve the acquisition of knowledge in two disciplines. Due to the fact that these two disciplines –foreign language learning and the given subject matter– may rely on different approaches to knowledge acquisition and teaching methodologies, both the language and the subject-matter specialist have to design learning tasks and activities that complement each other, serve both purposes and are well balanced [7].

There are a number of teaching approaches such as task-based learning or problem-based learning that, together with more traditional methodologies, can be implemented to the advantage of both subjects in a CLIL setting.

Task-based learning involves completing everyday tasks using the target language. These tasks, conversely to exercises in a language class, normally aim at non-linguistic outcomes. They focus on meaning rather than on form and seek to achieve a practical goal [8]. In problem-based learning, on the other hand, learning is driven by challenging, open-ended problems; students engage in collaborative group work, and teachers adopt the role of “facilitators” rather than “knowledge-providers”. Problem-based learning is also believed to enhance content knowledge and foster the development of communication and self-directed learning skills [9]. In a CLIL context posing open-ended problems to our students can obviously take on many forms depending on the content subject we are intertwining with foreign language instruction. Technology, therefore, plays a major role in facilitating the key elements in order to carry out a learning task.

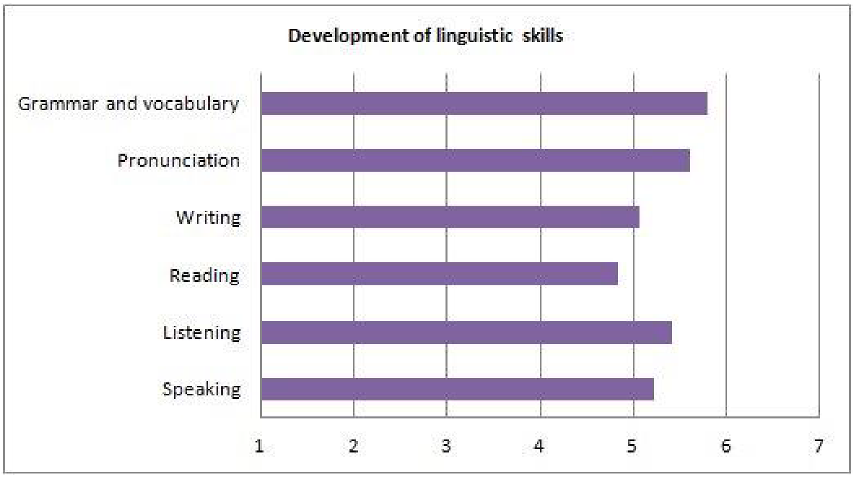
2.2 Digital storytelling for specific purposes

Digital Storytelling (DS) is a pedagogical tool that calls upon the creative streak in students and helps them "learn by doing". In general terms, DS refers to a short form of digital film-making that allows students to recreate a story relating to their field of study. It is based on "the idea of combining the art of telling stories with a variety of digital multimedia, such as images, audio, and video" [10]. Therefore, DS is a blend of the oldest and most traditional form of communication and transmission of knowledge, i.e. storytelling, and the newest and most important means of communication and of sharing information: different forms and types of digital multimedia devices. Some of the advantages of stories relate to the fact that they help build connections with the students' prior knowledge and improve memory [11], resulting in an easier and more enjoyable way to recall information and to comprehend the content and the message being transmitted by the story. According to Bruner [12] "we live in a sea of stories" but "we have our own difficulties grasping what it is like to swim in stories", and therefore we need a metaphysical support [13]. In the case of digital storytelling for educational purposes, that metaphysical helper is the teacher, who acts as a facilitator, providing students with the information they need in order to reflect and develop their own ideas and perceptions about what creating a digital story involves. Although digital storytelling has been used in education and specifically in language teaching and learning for the past few years, its use in English for Specific Purposes (ESP) has not been so widely studied. This section therefore aims to contribute to this issue by referring to a digital storytelling project for ESP carried out at the School of Design Engineering at UPV. The project was divided into the following stages: completing a pre- and a post-survey, learning about digital storytelling by completing a WebQuest, making decisions about the students' digital stories (topic, plot, software and media), sharing their stories with their classmates through the University's Learning Management System (LMS), watching their classmates' digital stories, using the forum to write comments about their own digital stories and those created by their classmates, keeping a log and preparing and presenting their "making of" to the whole class, and finally assessing both the digital stories and the oral presentations. The overall results were very encouraging as the students reported that this approach had helped them develop different skills: i.e. linguistic, research, writing, organisation, digital, presentation, interpersonal, problem-solving and critical-thinking skills. Moreover, the minor difficulties encountered on carrying out the project were soon overcome.

A myriad of linguistic skills were developed and practiced in each of the stages and activities of the project. Among those, it is important to highlight the basic linguistic skills developed when learning a new language: reading, writing, listening, speaking, vocabulary and grammar. Reading and writing were mainly practiced through the WebQuest, scripting, voice-over recording and synchronization, writing the log, preparing and presenting the "making of", using the forum, and filling in the assessment forms. As for the listening and speaking skills, they were developed in activities such as working collaboratively in groups using English as the means of communication, recording their digital story, watching the video recordings about the project, watching their classmates' digital stories, watching other examples of digital stories and delivering their making-of presentations.

An important goal of the project was to make students think critically and self-assess their learning, raising their awareness about the skills and competences to be developed while making them reflect on the way they were being developed and how useful the different tools were when trying to develop each of those competences. Upon completing the project, the 52 registered students filled in a final survey to assess the degree of perceived usefulness for the development of different skills. The survey revealed the following data: the development of their overall speaking skills obtained 4.82 points; pronunciation obtained 5.52 points; the listening skills got 5.41; reading got 4.82 points; writing got 5.06 points; and grammar and vocabulary got 5.71 points. These results are shown in Table 3. The results correspond to a 7-point Likert scale showing the students' opinions concerning the degree of usefulness of the Digital Storytelling for ESP project in terms of linguistic skill development.

Table 1. Degree of perceived usefulness of digital storytelling for the development of different linguistic skills.



As we can see, the overall satisfaction gives clear evidence that students perceived the experience as contributing towards an integrated benefit for the improvement of their knowledge of English as a foreign language.

2.3 Online learning and tuition

The third and last of the tools presented in this paper is the *InGenio First Certificate in English (FCE) Online Course & Tester.* The course is one of the several courses available within the *InGenio* content management system (CMS) developed by members of the CAMILLE R&D Group.

In 2008, UPV policy set a new requirement to be fulfilled by all of its students in order to graduate; i.e. they should be able to prove a B2 level of competence in a foreign language. This illustrates the growing awareness of the importance of foreign language learning in a technical environment such as ours, as well as an attempt to comply with the Bologna Process. However, the role of the institution goes far beyond this by providing funding schemes, in addition to providing academic staff with a considerable amount of freely available in-service courses, a clear indication of the institution's awareness of the need to offer appropriate training in the efficient use of educational technologies. Due to these two factors (the B2 level of competence and the technical character of the degrees offered by UPV), the development of the *InGenio FCE Online Course & Tester* necessarily had to comply with these two basic requirements. The materials writers, members of the CAMILLE R&D Group, designed activities that were based on contents pertaining to the student's undergraduate studies as well as complying with the format of the Cambridge FCE examination (classified as B2 of the *Common European Framework of Reference for Languages).* Because the *InGenio* authoring tool, with which the courseware has been designed and published, is flexible and allows any existing standard networked tool to be integrated, the authors were also able to create and link into the courseware a number of supplementary resources in the form of learning objects, called "Polimedia" and "Polimedia Plus", also as part of the teacher-institution cooperation scheme and shared internationally through "RiuNet" and "Politube" (UPV's repositories). These learning objects, addressing theoretical and specific contents to make them more dynamic and effective, typically comprise 10 to 15-minute sequences, recorded at specially designed recording studios, to be shared with the language learning community at large. Some other tools provided by UPV have also played an essential role during the initial stages of the first pilot experience, aimed at starting the assessment and validation of the materials included in the *FCE Online Course & Tester.* Some of these additional tools are the CMC videoconferencing platforms and Virtual Learning Environments (VLEs) known as "Polireunión" (Polimeeting) and "Policonecta" (Policonnect). Both platforms, based on Adobe Connect technology, enable teachers and students to communicate and perform various online tasks, while interacting orally and/or visually. They also enable participants to share audiovisual and written materials and resources for practice thanks to some of the utilities and tools provided. An application with similar features is being developed and will soon be integrated into the InGenio Platform, fulfilling the functions that are now being performed by external systems. The use of those platforms allows the equal treatment of both written and oral contents and provides students with opportunities to practice speaking and listening skills, these being two of the five skills included in the Cambridge First Certificate in English (FCE) official examination; the other ones being reading, writing, and use of English (grammar and vocabulary). In this respect, we agree with White [14] who firmly believes that computer conferencing systems are advantageous, since they do not require fixed times for study, help maintain a record of all interactions and allow everyone to be heard. In these situations, the teacher would adopt the role of “effective facilitator” and the group could develop a “sense of community”. This has also been our ultimate aim.

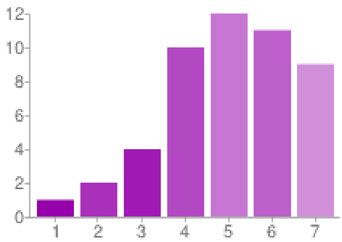
Fig.4. Sample exercise taken from the *InGenio FCE online Course & Tester*

3 Discussion and findings

The final survey administered to students after they had completed all the activities in the *InGenio FCE Online Course & Tester* revealed the following data:

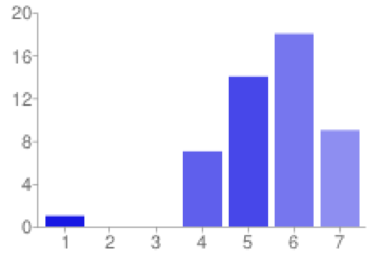
When asked whether they had found it easy to work autonomously or independently (something which is not customarily common in Spanish higher education, students largely responded that they had (64%), distributed as follows: 24% chose 5 out of the 7-point Likert scale, 22% chose 6 and 18% chose 7. A remaining 22% chose the mid situation reflecting that they were still doubtful about working completely autonomously on the online course and 14% thought that it was not easy to study English as an independent learner using online courseware (2% - option 1; 4% - option 2; and 8% - option 3).

Table 2. Responses to question: “I found it easy to work autonomously/ independently”



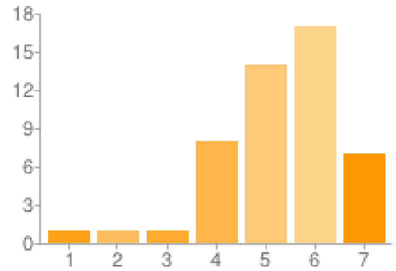
The responses to the question enquiring whether the learner had improved his or her vocabulary was completely inclined towards the positive end of the scale. Only a mere 2% disagreed with this statement, whilst 14% remained midway and a large majority of 84% stated that they had improved their vocabulary (29% - option 5; 37% - option 6; and 18% -option 7). This fact supports the idea that the materials had had a beneficial effect on vocabulary acquisition which was one of the aims set forth at the outset of the materials design process.

Table 3. Responses to question: "I improved my general vocabulary"



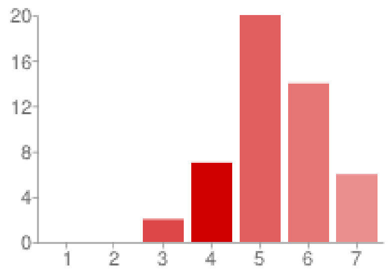
Similarly, in question 12, the responses reveal that students also agreed that they had improved technical vocabulary relating to their field of study (engineering). A negligible 6% are inclined to think that they have not improved their technical vocabulary and 16% decide to stay midway, whilst a large majority of 78% think that the course activities have to a large extent helped them become acquainted with new technical vocabulary (29% - option 5; 35% - option 6; and 14% - option 7).

Table 4. Responses to question: "I improved my technical vocabulary"



Regarding question 13, the learners' responses allowed us to verify the usefulness of the materials comprising the *InGenio FCE Online Course & Tester* in general. Only 4% of the respondents chose the negative side of the scale (option 3), whereas 82% largely agree that the courseware has largely contributed to their improving their language skills after completing all the activities (41% - option 5; 29% - option 6; and 12% - option 7).

Table 5. Responses to question: "In general, my level of English has improved after completing the online Course & Tester"



Although we have only extracted 4 very specific questions from an exhaustive 85-question final survey, these have allowed us to support our initial idea that e-Learning platforms such as the one referred to here are good options to support autonomous learning, allowing face-to-face contact hours to be devoted to activities which require the presence of a teacher, thus considerably helping to improve time management and to make the most of human interaction in the language classroom.

4 Conclusions

In this paper we have presented three language learning resources that have been implemented at UPV's School of Design Engineering to maximise the limited timeframe that students can regularly devote to improving their knowledge of a foreign language. These resources have proven to be useful in encouraging learner autonomy put in place through the *InGenio* content management system and the Clilstore service, as well as promoting digital skills and fostering creativity through the creation of digital stories relating to the student's degree content. Additionally, these resources have helped students achieve the required B2 level for graduation.

5 Acknowledgements

We would like to thank UPV for funding the *InGenio Project* and the European Commission for co-financing the *Tools for CLIL Teachers* project (ref. 517543-LLP-2011-DK-KA2-KA2MP).

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ETSID International office at 25, promoting internationalization

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Abstract

International relations are one of the pillars of the School of Design Engineering ETSID along with relationship with the industry and teaching innovation. For that reason the international office was created in 1989. In this paper we review some of the accomplishments and goals for the future.

1 Introduction

International relations, within the framework provided by the EHEA, should serve to answer the need for improvement of pedagogic and teaching methods demanded. Participation in international programs has been a tool to modernize teaching and to renew the academic standards by exchanging lecturers and students, establishing joint and dual degree programmes, validating studies from other universities and developing common educational materials. At the School of Design Engineering ETSID we are convinced that the accompanying effect of engineering degrees with a clear international focus is to improve scientific, academic and technological potential.

From the very beginning, the commitment with internationalization was one of the main interests at ETSID. Since the creation of its International Office -along with the rest of international offices at our Universitat Politècnica de València- in 1989, ETSID has been involved in the management of a number of international programmes, such as Erasmus, Tempus, Alfa, Atlantis, Erasmus Mundus... And this is also our will in the framework of the new Erasmus+ programme. This involvement has led more than 25% of our alumni to get an international experience and we have been able to host more than 200 exchange incoming students per year, almost reaching a balance which is not always easy to keep.

In this paper we are about to show some of the activities we do in order to improve our international tradition, and one of those activities is Valencia Global.

2 Erasmus and other exchange programmes

For the last LLP-Erasmus studies call, 2013/2014, 68 Aeronautical Engineering / Aerospace students, 31 Industrial Design and Product Development students, 21 Electronic Engineering and Automation students, 11 from Electrical Engineering, 26 from Mechanical Engineering, 25 Industrial Management students and 1 from the Master in Design Engineering were selected, the most popular destinations being the United Kingdom (25 students), Germany (24) and Poland (16). (Fig.1)

Why this difference between Aerospace students and the rest? Probably because, unlike the rest of degrees, most of the aeronautics/aerospace industry is located beyond Spain's borders and the students are aware of it.

In addition to those figures, 14 students participated in an Erasmus placement in a company. Also 6 more students were sent overseas -4 to the USA, 1 to Japan and 1 to the People's Republic of China-, funded by UPV in the framework of our PROMOE (Students Mobility Programme, ***PRO****grama de* ***MO****vilidad de* ***E****studiantes*).

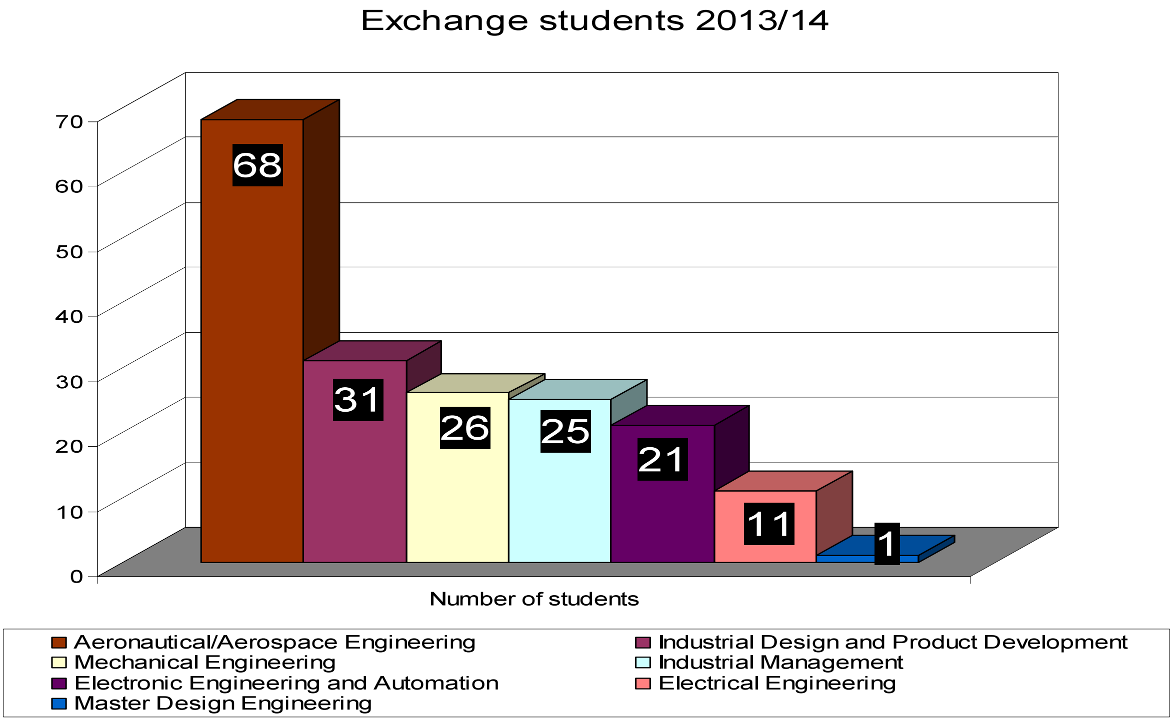

Fig.1. ETSID exchange students, 2013/2014

So, over 200 students have left ETSID for one or two semesters during 2013/14 academic year. If we consider that our School has got a range of 700/800 graduates per year, it means that over 25% of our alumni has enjoyed an international experience abroad.

On the other hand, almost 240 students have been welcomed at our School during the same period as Erasmus, Erasmus Mundus or other type of exchange students.

3 Selection process for outgoing students

In order to keep students informed of all matters relating to Internationalization we have used advertising and news on the ETSID website, to enhance this living information source generating a climate of internationalization that motivates them and to make them see how important completing part of their studies abroad can be.

At the beginning of each year, informative presentations for newcomers are made emphasizing the need for a high level of foreign language skills to optimize the performance in a future exchange. Moreover, the growing demand from many members of official language certificates causes the level of language knowledge has significantly improved among students vying for a place in exchange.

In addition to general information sessions held every year (five times during 2013) to introduce the exchange programs to the students, when receiving visits, we have taken the opportunity to ask teachers or staff members from partners' international offices to make presentations of their institution, either during teaching sessions or in *ad hoc* presentations.

Every year, public calls are made to participate in exchange programmes. Students are ranked mainly according to their academic record and foreign languages skills and the results are published. In the most recent Erasmus call for applications, the actual distribution of merits for next academic year in percentages is as follows:

- 40% represented by the average mark of the student
- 25% corresponds to the quotient resulting of dividing the number of passed credits by the number of total credits needed to obtaining the degree, only if the student has completed the first two years before starting the application period. There are two reasons for this: firstly, we only allow students who have passed half the credits of their degree and, secondly, we want to give preference to those in their last year. So, those who are not going to finish during their Erasmus exchange won't get this 25%.
- The students have to provide an official language certificate or sit a test organized by UPV's language centre. The mark of the test will have equivalence to those defined by the CEFR (Common European Framework of Reference for Languages) . Official certificates are preferred, and so they will be validated with 1 point above the same level obtained in the test. The mark of the language test or certificate makes 30% of the total result.
- Participating in our *buddy programme* (Mentor) with a positive assessment from the helped student is 5% (up to a maximum 5 students, 0.1 points per student).
- Finally, extra points are awarded to those who have attended classes in English (2 points maximum) as long as the host university has English as a teaching language.

After all that, a ranking is published and the students are summoned to a meeting to select their destinations according to their rank in the list. In previous years we had assigned destinations according to our students' list of preferences, but it took a long time and some mistakes were inevitable.

4 Incoming students

Although UPV has a decentralised scheme as regards exchanges, there is a common policy in deadlines. When the period is open and on-line applications are submitted the process for acceptance starts. After checking that all applications have their correspondent previous nomination from the sending institution, that the numbers stated in the inter-institutional agreements fit, that all requirements, including language skills, are fulfilled and that there is a balance between incoming and outgoing students, the acceptance is sent on-line to the student. But this is not different to the general proceedings every university has.

The number of exchange students that every year come to ETSID has forced us to enhance our office organisation with the help of students who, via the *Servipoli Foundation*, are recruited as part-time legal workers (3 hours a day). Also, we count on some incoming exchange students, mainly from Business administration, who do an internship at our office and whose help as receivers of documents and providers of general information is invaluable.

As the start of the classes varies from one degree to another (Master's courses, former BSc degrees and new Bologna ones), the students do not arrive all together. So, during September, we organise different information sessions in which they are advised about what they must do in order to get the student card, the intranet connection and the definitive registration in their selected modules.

Of course, the office is open to students 4 days a week in order to provide the best help we can and to solve the incredible variety of problems, sometimes surprising, that students have.

5 Other projects

Every four years, the International Office at ETSID organises this international meeting, Valencia Global, since 2002. Thus, this is the fourth edition of a successful event which allows us to meet our partners and to enhance the relationships we are proud to keep with colleagues all over the whole world.

We would like to offer an outline of our brand new triple degree agreement, UMANE, signed with the New Jersey Institute of Technology, USA, and the University of Parma, Italy, and in which also are involved Rutgers University, form the USA, and the University of Extremadura, in Spain. This project is aimed to develop a triple bachelor degree programme between these two US and three EU universities, namely the degrees involved are Laurea in Ingegneria Gestionale of Università degli Studi di Parma (UNIPR), the BS in Industrial Engineering of New Jersey Institute of Technology (NJIT), Titulo Propio de Grado en Organización Industrial of Universidad de Extremadura (UEX) and Grado de Ingeniería Mecánica of Escuela Técnica Superior de Ingeniería del Diseño (ETSID) at Universitat Politècnica de Valencia (UPV).

As a consortium, these universities are working to offer their students an undergraduate joint programme in Management Engineering, with special focus on Supply Chain and Operations Management. At the present stage, the role of Rutgers University remains strategic to provide mobility students with additional excellence in the teaching activity.

The triple degree programme includes transatlantic students' exchange (EU- to-US and US-to-EU for a full academic year) as well as EU-to-EU mobility (one semester) and will be taught in English, Italian and Spanish for which a proper language training activity is foreseen at both home and hosting institutions.

Following UPV's international strategy, ETSID is also interested in increasing the number of joint degrees; interest which, moreover, fits perfectly into the structure of consortia that the new Erasmus+ programme promotes.

We would like to mention also our European Project Semester, which we are running since 2005. In it, students carry out an interdisciplinary, industrial project in a multicultural environment, and begin to develop the cross-disciplinary language and communication skills, which are so needed in the global economy of today, as well as gaining international experience. The students participate at the beginning of the semester in preparatory courses related to design and management of engineering projects and the formation of efficient teams. As the EPS is run in many different universities and regular providers' meetings are held, it does not need an extensive explanation at this moment. Just a few numbers: around 50 or 60 applicants from all over the planet every year and only 30 or 35 can finally join the programme.

6 Conclusion

Facing the strong and sustained increase that had been occurring in recent years in demand stays in exchange for the students of the school, probably due mainly to the extinction of the former degrees and the arrival of the new ones to their final years, the International Relations Office has opted for an increase in quality focusing on the students' selection, especially on languages, although this increase in quality has been a decline in the number of outgoing students (Fig.2).

On the other hand, we have managed to slightly reduce the number of students received, reaching almost complete balance, always seeking the fulfillment of objectives.

With the main aim of increasing the quality of student exchanges, taking into account also the fact that we are going through a financial situation that affects not only mobility but also enrollment in university courses, we have increased the number of dissemination actions among the students as well as targeting international partners.

Because, as it has used to be until now, there is a strong commitment of ETSID in keeping the internationalization and over all the international relations as one of its main axes.

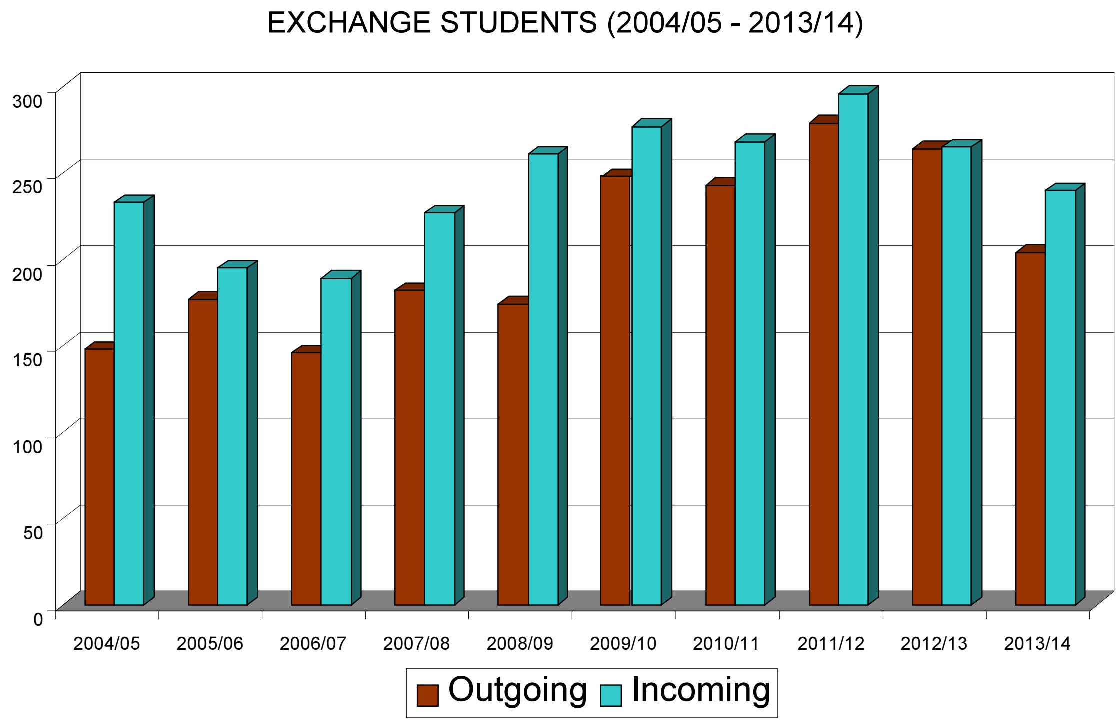

Fig.2. ETSID incoming and outgoing students, 2004/2014

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Group tutorials: Some experiences

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Abstract

Mentoring is an accompaniment and teaching support that seeks to help students adapt to the university environment, foster the development of skills and the achievement of academic goals. It is considered a crucial issue within the European Higher Education Area. In this paper, we present some proposals on Group Mentoring that our working team has developed in recent years. On-line student support, Fundamental Concepts, Support and Remedial Group Mentoring sessions were carried out aimed at avoiding students dropping out of the course, as well as facilitating urgent assimilation of the concepts that semester subjects require and increased academic performance. Secondly, we worked on the acquisition of instrumental and interpersonal skills via the application or mainstreaming tutorials and a reading/discussion workshop. Finally, the academic achievement of some goals that enable students to meet the requirements of professional practice are addressed through tutorials in which we worked with Problem-based Learning (PBL) and Puzzle Solving techniques.

1 Introduction

Our educational process begins the day we are born, and as time goes on, it continues to develop itself through personal experience and the guidance of others. This is why we usually talk about the so-called educational triangle, as shown in Fig. 1, which is comprised of family, teachers and students.

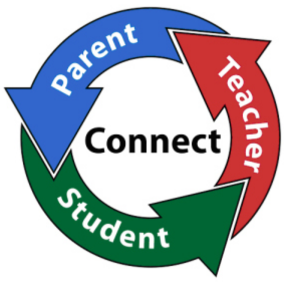

Fig. 1. Educational triangle

The school system aims to provide its students with knowledge, skills and abilities in specific areas. Within the school, teachers act as both counsellors and advisers, whereas students act as learners, therefore having to take on the responsibility of being autonomous learners.

The term "tutor" comes from the Latin word "Oris", which means "person that acts as tutor, defender, guardian." In pedagogical jargon, the usage of the verb "to mentor" is understood within the educational field as the act of helping, guiding, advising and instructing students by way of a teacher. The Larousse Encyclopaedia states that a tutor is a person in charge of orienting and advising students enrolled in a term or course or who are studying towards a degree.

In this paper, we adopt the following definition of tutoring, proposed by **Tejada and Arias** [1], as our own:

“Educational accompaniment and teaching support based on providing students with a personalised attention that facilitates a better understanding of the problems they must cope with in terms of adapting to the university environment, so that they can perform well throughout the academic year, and be able to attain the academic goals which will allow them to face the obligations required by their future professional endeavours."

2 Tutorial action within the University: Why and what for?

University tutoring responds to typical and recurrent situations from a new learning perspective. Moreover, it is also a core determinant of quality in the formative process and an answer to the pressure felt by certain students to achieve better results [2]. The added value of university tutorial action relies on treating the student as the primary focus and finding new ways of approaching and responding to the subject matter [3]. It was with good reason that we moved from the German model, whose focus is teacher-researcher, to the Anglo-Saxon one, whose main objective is to train individuals who are capable of meeting the needs of new companies and states. We must also bear in mind the need of developing new ways of teaching, which foster student transitions: from upper secondary or vocational training education to university, from general courses to those that have a more specific focus and from university to the job market. This attention to diversity seeks to limit the number of drop-outs (40% to 50% of students who enrol in university never get their degree). The current number of drop-outs supposes a loss on behalf of the university, which is valued at €3.3bn. The attention to diversity also allows us to seek out the best students, and compete with other universities as well as achieve quality acknowledgements.

So, why the need for university tutorial actions? There are many approaches and tasks regarding university tutorial actions, but these can be summed up in the following aspirations:

- To identify the academic and personal weaknesses of each student so that we can provide him/her with necessary guidance, and do so in a timely manner.
- To assist the student in his/her learning process in order to improve his/her academic performance, as well as to reduce the number of university drop-outs.
- To provide the student with guidance when faced with academic pressures.

All of the goals mentioned above must be pursued within the frame of the European Higher Education Area. In other words, they must focus on the student’s personal work and lifelong learning and mobility, and doing so within an open and multidisciplinary formation. This highlights the fact that accompaniment lends fundamental relevance in the elaboration and consolidation of one’s professional project. In addition, and as a novelty, we also implement work on skills. Skills are, on the one hand, the combination of knowledge and its application, and on the other hand, the combination of abilities, attitudes and responsibilities that are required in order to carry out tasks: 50% knowledge and 50% behaviour. If you lack knowledge, you do not know how to do things and if you do not know how to do things, you cannot prove what you know, and if you cannot prove what you know, you cannot act, as shown in Fig.2.

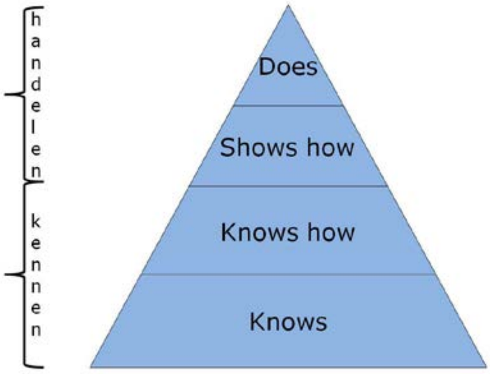

Fig. 2. Miller Pyramid

We are all tired of seeing students who memorize and systematically repeat problem-solving algorithms, and yet fail at the top level of the pyramid, when it comes to performing.

The development of professional and crossover skills demands a more personalised attention and guidance during the learning process and throughout the integration of different contents. This gives us more freedom to innovate and break the mould imposed by classic teaching methods and programs. In summary, we need and demand some form of tutorship, and must academically support and monitor the student during his/her personalised process of learning.

3 The teacher-tutor and tutorials

The university tutor cannot be the same as the secondary and upper secondary school tutor; given that his/her main role is no longer being the interlocutor between family and school. Within the university context, the tutor must be a teacher who knows the previous academic background of his/her students, has a working plan, chooses and carries out the most convenient techniques, guides the educational process, orients and advises and, in short, stimulates the ability of his/her students so that they take responsibility for their own learning and educational development. All of the above must be matched with a coherent attitude between the evaluation and the methodological approach [4].

Individual tutorship (online and one-on-one) is an interpersonal tutor-student relationship established through the interview process. The group tutorial consists of carrying out a tutorial session led by the tutor in a student group setting. Its key points are mutual support in the learning process, development of team working strategies, and efficient management of time. It has a triple dimension: instructive (teacher's role), human (given that an integrative education is what is actively sought out) and administrative (teachers often overstep their official duties).

The first tutor-student interview is crucial, because its main goal is to get to know the student: his personal and professional situation, his motivations and expectations, his study routines and strategies, etc. Once the academic year has begun, we start with what we can call "on-going university tutorials", aimed at galvanizing the student's impressions regarding the school, the teachers, the subjects, the didactic methodology used, the timetables, the activities and/or his/her personal concerns. This kind of tutorial also seeks to know the student's academic situation and assess his/her learning outcomes, study routines, and support needs. Finally, it answers any specific needs related to counselling and guidance. On a second level, we also have another kind of "on-going university tutorial", aimed at following and assessing the student's academic performance and personal learning. It seeks to develop general and/or crossover learning skills. Moreover, it looks to provide the student with specific information regarding curricula and available scholarships, as well as aids and resources. Lastly, we have the job market insertion tutorials, whose goals are to provide continued educational counselling (master's degree, etc.) and provide information concerning job offers, public examinations, companies looking to hire new employees, etc. These tutorials also help the student write and prepare the necessary material in order to apply within the job market (forms, CVs, etc.). Ultimately, the job market insertion tutorials deal with holding informative sessions with graduates, professional bodies, associations and other related entities.

Concerning the group tutorial method, it can be defined as an attractive set of learning and group problem-solving experiences, which involves all the group members. Its main features are as follows:

- Cooperation: both the students and the teacher support each other mutually in order to attain a double goal: to master the content knowledge and develop team work skills. The students share goals, resources, achievements and an understanding of each other's roles and problems.
- Responsibility: the students take individual responsibility for their own tasks, as well as issues that are strictly personal, and which must be managed accordingly.
- Communication: the team members exchange important information and contents, efficiently and effectively support themselves, provide feedback so that they can improve their future performance, and analyse their personal conditions and reflections in order to attain better results.
- Collaborative work: together, the students learn how to solve problems, developing leadership, communication, trust, decision-making and problem-solving skills.

In sum, the group tutorial generates support systems that foster academic development, facilitate the acquisition and development of working skills, and promote improvement in peer relationships while also having an impact on the educational process. These systems also ease the transition into the job market (after having created a professional project within the university), and allow for an efficient use of time.

4 Some examples of group mentoring

We present some examples developed by our group which have afforded quite good results: Fundamental Concepts, Support, Remedial, Mainstreaming, Application, Reading-Debating Workshop, Puzzle Solving Technique or Problem Based Learning (PBL) [5] and [6].

4.1 Fundamental Concepts of Mathematics GM

Goals:

General: Increase academic performance in Mathematics subjects; Engender a positive attitude aimed at avoid frustration and students dropping out of the course; Develop capabilities: study, teamwork, creativity and decision-making

Specific: Establish basic concepts and algorithms; Standardize mathematical skills that facilitate adaptation to the university environment; Work on handling mathematical language

Procedure:

Diagnostic assessment aimed at identifying student needs. Selection of group members. Application of mentoring activities aimed at providing students with support in identified gaps in learning. Follow-up assessment, supplemented with a final exam.

Guidance regarding how to proceed: Progressively cover topics in an orderly way. Read the topic guides carefully. Be sure to understand and know how to solve all the examples. Attend self-assessment sessions. Once you know how to do the examples, move on to the next topic.

Methodology: Working groups of 7 students in classroom sessions; 1st session: The tutor presents the topics in a highly practical way and hands out notes on the topic and the tasks to be carried out by the group; 2nd session: public defence of the completed group assignment; the same format is repeated for each block of topics.

Contents: Algebra: Polynomials, factoring, algebraic fractions; Trigonometry; Vectors in the plane and in space; Equations and systems of equations; Matrix Calculus and Analytic Geometry. Calculus: Real and complex numbers; Inequalities and inequations; Sequences and functions; Limit and continuity; Derivatives, derivative applications; Immediate integrals, methods of integration and calculus of areas

Assessment: Spoken answers to questions to demonstrate understanding and the capacity to use the basic concepts of the subject successfully. Solving of problems aimed at testing competence in the required skills. Assessment exercises done outside the classroom.

4.2 Support GM

Goals: Improve academic performance; Take action regarding topics of proven difficulty in previous courses; Develop capabilities: study, teamwork, creativity and decision-making.

Procedure: Diagnostic assessment aimed at identifying student needs. The tutor/coach reinforces the concepts, helps discern the goals and their ramifications and encourages active participation. Application of mentoring activities aimed at providing students with support with respect to encountered difficulties.

Methodology: Working groups of 7 students in classroom sessions; 1st session: Employing a highly practical approach, the tutor reinforces the topics in which difficulties are usually encountered; the tasks to be carried out by the group are handed out; 2nd session: public defence of the completed group assignment; the same format is repeated for each topic addressed.

Contents: Improper integrals. Parametric Integrals. Functions of Several Variables: Domain, Image, Contours; Limits and continuity; Derivability and differentiability; Extremals.

Assessment: Spoken answers to questions to demonstrate understanding and the capacity to use the basic concepts of the subject successfully. Solving of problems aimed at testing competence in the required skills. Assessment exercises done outside the classroom.

4.3 Remedial GM

A group that is particularly sensitive to tutorial mentoring support is that of students who have failed the subject in the first semester. In some cases, failure is not a problem of lack of effort or ability, but rather a problem of a mismatch between the demands of the subject and learning outcomes. The aim is to provide effective guidance on how students should study, thus enabling them to learn what is being taught in a particular subject, placing special emphasis on the kind of exercises in which the most mistakes have been detected in previous tests.

Goals: Overcome academic failure; Take action regarding topics of proven difficulty in different assessment tests; Develop: study techniques, teamwork, creativity and decision-making.

Methodology: Weekly sessions covering the theory of the subject, solving of remedial exercises and pubic defence of these solutions.

Assessment: Self-assessment tests to measure the level of understanding and skill in using the algorithms for solving problems.

4.4 Mainstreaming GM

Many students have a vision of the subject as something alien to other parts of the degree. The aim is to work on mainstreaming or interdisciplinary skills such as the ability to analyze and synthesize and the development of interpersonal skills

Goals: Build systems to support academic development; Quality of teaching. Decrease the dropout rate; Develop: study techniques, teamwork, creativity and decision-making.

Methodology: Exercise involving searching for applications of the topics studied in the subject in other course subjects. Pooling of knowledge within the group to prepare a tree diagram, the branches of which represent the links between subjects.

Assessment: Pooling of knowledge and public defence of the completed assignment.

4.5 Application GM

Mathematics and the world: The aim is to work on finding practical applications. Students can choose any topic from the syllabus. In Fig. 3 basic guidelines are established and the group is given free rein to prepare a presentation that will be publicly defended, questioned and assessed.

Fig. 3. Applied learning

4.6 Reading/Discussion Workshop

We tend to separate reading, writing and speaking skills from performance in Mathematics. However, the main obstacle students encounter is problem solving, in which reading comprehension underlies the ability to develop the necessary strategies to solve the problem itself. Students have great difficulty in expressing concepts in words (and even more so in mathematical language). Despite this, they may be capable of solving the exercises they are set. Using texts on Mathematics and the world, reading/discussion workshops can help diminish the perception that the subject is unrelated to the real world.

Reading programme: We have chosen a text that allows the basic concepts of numbers, geometry, trigonometry and functions to be reinforced at the same time as linking them with the world around us in an entertaining way: "*Reflexiones sobre la Matemática y el Mundo que nos rodea*" [Reflections on Mathematics and the World Around Us] by Francisco Rivero Mendoza, lecturer at the University of the Andes. (www.saber.ula.ve , Monografías Facultad de Ciencias).

Reading/discussion: A month before the discussion, all the students receive the text and a Reading, Fig. 4, or Observer Sheet, as appropriate. Students in the subgroups acting as active observers (who also have to read the text) fill out an opinion sheet. The tutors use an assessment table containing ten items to assess oral and written expression on an individual level.

RECORD READING/DISCUSSION Reading/Discussion: "*Reflexiones sobre la Matemática y el Mundo que nos rodea*" Student:
1- Quote six Key-words that you consider highlighting in book reading 2- List ten words you did not know before reading the text, look them up in the dictionary and describe briefly 3- Describe three recount facts in the book that have particularly impacted you (historical, scientific, biographical, imaginative, etc..) 4- Make a summary of the main theme of the text and provides a scheme where its major parts and subsections are indicated (15-20 lines) 5- Make a reasoned overall rating of the text (I liked it before .... I did not like it before ... it has been difficult for me to follow ...) 6- Investigate a brief biography of the author. Do you already know him? Does he have other similar works? Does he have any awards? ...

Fig. 4. Reading Workshop

Discussion: An hour in length. Students in the two subgroups into which the large group is divided express their opinions and answers to questions and suggestions from the tutor/moderator, Fig. 5. The roles of the discussion and observation subgroups are exchanged in subsequent discussions.

Fig. 5 Discussion Workshop

4.7 Puzzle Solving GM

A group of students must autonomously recompose a topic from the syllabus that has been previously split up by the tutor. To do so correctly, they have to: understand, become experts, integrate and apply the concepts they are given as well as related concepts. The learning process is led autonomously by the group of students and is cyclical in character, generating new learning needs.

Goals: Puzzle solving (Aronson) is a cooperative learning technique: It promotes self-directed learning and increases academic performance. It encourages continued study of a subject, thereby enabling the furthering of knowledge. It develops the social skills needed to interact with other members of the group and assertively expound one's own point of view. It promotes learning autonomy.

Methodology: The tutor splits up a lesson into three parts as shown in Fig. 6. Groups of 6 students are formed, assigning one part to each pair of students. First phase: individual reading time (15 minutes). Second phase: those responsible for the same part, but from different groups, come together to clarify any doubts that may have arisen (15 minutes). Third phase: students return to the original group for each of those responsible for each part –now experts in the matter– to explain their part of the topic to the group (30 minutes). Fourth phase: an example proposed by the tutor is solved as a team (30 minutes). Fifth and final phase: each student solves an exercise individually (15 minutes).

Assessment: There are two marks: The mark corresponding to the exercise solved by team (fourth stage) and the mark corresponding to the exercise solved individually (fifth phase). The grade will be the average of the mark obtained in the two tests.

Second order linear differential equations: $y''(x)+a(x)y'(x)+b(x)y(x)=f(x)$

General solution: $y=y_h+y_p$, where y_h is the general solution of associated homogeneous equation and y_p is the particular solution of nonhomogeneous equation.

Case homogeneous: the associated homogeneous equation with constant coefficients, $y''(x)+ay'(x)+by(x)=0$, a,b ctes.

The objective is finding two **linearly independent** solutions y_1, y_2 and the general solution is a linear combination of them: $y_h= C_1 y_1+ C_2 y_2$.

Definition. The algebraic equation $k^2+ak+b=0$ is called the characteristic equation (ch. eq.) of the differential homogeneous equation with constant coefficients $y''(x)+ay'(x)+by(x)=0$.

We distinguish three cases:

1. Two real and distinct roots: k_1, k_2;………………. $y_h = C_1e^{k_1x} + C_2e^{k_2x}$
2. Two real and equal roots: $k_1= k_2$;………………… $y_h = C_1e^{k_1x} + C_2xe^{k_1x} = e^{k_1x}(C_1 + C_2x)$
3. Two Complex roots: $k = \alpha \pm i\beta$…………………….. $y_h = e^{\alpha x}(C_1 \cos(\beta x) + C_2 sen(\beta x))$

Case nonhomogeneous: The objective is finding a particular solution y_p of nonhomogeneous differential equation. We consider two methods: Method of Undetermined Coefficients and method of Variation of Constants.

Method of Undetermined Coefficients

The right side *f*(*x*) of a nonhomogeneous differential equation is often an exponential, polynomial or trigonometric function or a combination of these functions. A choice for the particular solution y_p should match the structure of *f*(*x*).

f(*x*)	y_p	k
$P_m(x)$	$A_m(x)x^k$	k=0 if 0 is not a root of ch. eq. k=s if *s* is the order of the root 0 in the ch. eq.
$e^{\mu x}P_m(x)$	$e^{\mu x}P_m(x)\, x^k$	k=0 if μ is not a root of ch. eq. k=s if *s* is the order of the root μ in the ch. eq.
$P_m(x)\cos(qx)$ $P_m(x)sen(qx)$	$(A_m(x)\cos(qx) + B_m(x)sen(qx))x^k$	k=0 if *qi* is not a root of ch. eq. k=s if *s* is the order of the root *qi* in the ch. eq.
$e^{px}P_m(x)\cos(qx)$ $e^{px}P_m sen(qx)$	$e^{px}(A_m(x)\cos(qx) + B_m(x)sen(qx))x^k$	k=0 if *p+iq* is not a root of ch. eq. k=s if *s* is the order of the root *p+iq* in the ch. eq.

Superposition Principle. If the right side of a nonhomogeneous equation is the sum of several functions of kind exponential, polynomial or trigonometric or a combination of these functions then a particular solution of the differential equation is also the sum of particular solutions constructed separately for each term in the right side.

Method of Variation of Constants

If the general solution y_h of the associated homogeneous equation is known, then the general solution for the nonhomogeneous equation can be found by using the *method of variation of constants*.

Let the general solution of a second order homogeneous differential equation be

$$y_h = C_1 y_1 + C_2 y_2$$

where y_1, y_2 are linearly independent solutions of associated homogeneous equation.

Instead of the constants C_1 and C_2 we will consider arbitrary functions $C_1(x)$ and $C_2(x)$. We will find these functions such that the solution $y_p = C_1(x) y_1 + C_2(x) y_2$ satisfies the nonhomogeneous equation with the right side $f(x)$.

The unknown functions $C_1(x)$ and $C_2(x)$ can be determined from the system of two equations:

$$C_1(x)y_1 + C_2(x)y_2 = 0$$
$$C_1(x)y_1' + C_2(x)y_2' = f(x)$$

Fig. 6. Puzzle Solving Example

4.8 PBL GM

A group of students has to find the answer to a question or solve a problem, both autonomously and guided by the tutor. To do so correctly, they have to: programme, search, understand, integrate and apply basic as well as related concepts. The learning process is led by the students and is cyclical in character, generating new learning needs.

Goals: For students to be able to find out what they need to know to advance in the solving of the set question or problem. As the programme advances, they will be responsible for planning, reading up on and developing those aspects needed to solve the problem. It fosters: interdisciplinary learning and integration of knowledge, teamwork, creativity and decision-making.

Methodology: It consists of 8 phases:

1 - Read and analyze the problem

2 - Brainstorming

3 - Listing the known

4 - Listing the unknown

5 - List of actions needed to solve the problem

6 - Defining the problem

7 - Getting the necessary information

8 - Presenting results

An example: Mosquito Control

Presentation of the problem: As can be seen in the provided newspaper article, we are suffering a hitherto unknown plague of mosquitoes. The usual methods of controlling mosquitoes do not seem to be effective against this plague. Students have a week to determine its causes and recommend the most suitable solutions.

Identify what we know, what we need to know and our ideas about the problem:

We know that: We have to find the causes of the problem. Time available: one week. Mosquitoes can travel large distances ranging between 50 and 60 kilometres. The amount of rainfall was normal this year.

We need to know: The geography of the area, whether the mosquitoes are indigenous, the conditions that make mosquitoes proliferate, budget, whether local drainage systems have recently changed.

Ideas: Perhaps there is a large amount of stagnant water in the region. Some kind of natural event may have led to the water stagnating (logging). Mosquitoes have become resistant to the fungicides employed against them due to mutation or adaptation.

State the problem: How can we reduce the mosquito population to its usual size so as to then consider the environmental impact, reduce health risks and prevent this phenomenon from happening again, all within a feasible budget?

Gather information: Information on varieties of mosquitoes and their control, information on changes in population and land use in the affected area was gathered from the Internet and the nearest public library.

Possible solutions:

Strategies: Education campaigns (announcements in the press, talks with representative community groups, etc.); and application of chemicals

Advantages: Low cost, public funds, etc. Drawbacks: Cost, fear, lack of interest, is it not the responsibility of public bodies?

Consequences: Change the way people think and behave; potential help to reduce the problem of mosquitoes; spread knowledge of the ecosystem.

Determine the best solutions: A combination of: an educational campaign, application of chemicals and further research.

Presentation of the problem: A group of specialists was formed who listened to the proposals and gave their views on these proposals.

Final Report: The entire group gets together to discuss the lessons learned on the topic and their experience as researchers. Students answer two questions in writing: What do you think of the problem and what did you find out? What questions remain unanswered?

Assessment: Monitoring tests. Pooling of knowledge, public defence of the report and a proposed questionnaire.

Other examples: What do the police do when they want to check the speed of a vehicle?
Why is there harmony in nature?

5 Results and conclusions

The following is a list of some of the achievements of Group Mentoring sessions of this kind:

- We have achieved the involvement and participation of a large group of students
- Over 85% of students coming from Vocational Training regularly attended the Fundamental Concepts, Support and Remedial GM sessions.
- Approximately 40% of these students achieved the minimum established grade.
- We have achieved the participation of 8 groups of students in the Mainstreaming GM, who made interesting contributions
- The reading/discussion workshop, which was established as obligatory for one experimental group, was a very enriching experience for tutors and students alike.
- We highlight the surprise expressed by students when achieving learning goals via the Puzzle Solving GM
- Students score mentoring very highly on account of it being specific, involving small groups and the fact that it fosters self-learning
- Participation in GM sessions started off with almost 33% of all students (5 groups of 7), but fell to 24% (5 groups of 5) over the semester
- The joint action of different types of group mentoring sessions favoured results that were made evident in continuous assessment tests, classroom practicals and laboratory practicals. Between 30 and 50% of the students participating in these GM sessions passed the subject in one or other of the exam periods.

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Implementation of Adaptive Degree Courses in Industrial and Aeronautical Engineering.

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Conference Key Areas: Bologna Process & New European Curricula, Education and Research
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Abstract

At the E.T.S.I.D. (Superior Technical School of Design Engineering) of the UPV (Polytechnic University of Valencia), the Adaptive Degree Courses (ADC) have been implemented to adapt the old ETSID's degrees to the new Bologna degrees. The courses have been implemented for the following degrees: Mechanical Engineering, Electronics Engineering, Electrical Engineering, Design Engineering and Aeronautical Engineering. This paper will present the experience of ETSID in the implementation of ADC. The ADC are development since the 2010/11 to the present. This document will present an analysis of the implementation, detailing the contents of the programs for each degree, and the study of some parameters to quantify the quality of the experience, such as: number of applications, acceptance rate, success rate, etc.

1 Introduction.

The Bologna Declaration [1] was signed in 1999 by the Education Ministers from different European countries in the Italian city of Bologna. With the Declaration, it was initiated a process of convergence, to facilitate the exchange of graduates and adapt the content of degrees to the demands of society. This process seeks to improve the quality of graduates and their competitiveness through greater transparency and focused to the student learning and quantified with ECTS (European Credit Transfer and Accumulation System) [2].

The Bologna process led to the creation of the EHEA (European Higher Education Area), which serves as a framework for the reforms that have taken place in the adaptation process [4].

In Spain the Bachelor and Master's degrees, established by spanish law have the following structure:

- Title of degree 240 ECTS (4 academic years). With some exceptions: Architecture, Pharmacy, Dentistry, Veterinary Science 300 ECTS (5 academic years) and Medicine 360 ECTS (6 academic years).
- Master's Degree from 60 to 120 ECTS (1 to 2 academic years).
- PhD, defined by each university.

This new situation has led to former graduates could adapt their old degrees to the new programs by performing the Adaptive Degree Course (ADC) [3]. ADC will permit student take subjects to get the knowledge and the number of credits to adapt to the new degrees.

The following sections show a detailed ADC content analysis, implementation, monitoring and the study of the different parameters that measured the results.

2 Degrees in engineering and aeronautical engineering.

2.1 Requirements.

To satisfy the high demand of students who want to continue the process of recognition of old degrees, adapting them to the new degrees, the ETSID performs the courses called ADC (Adaptive Degree Courses).

These courses have the objective to adapt the largest number of graduates of the old degrees, to the new education system and new degrees created from the Bologna process.

In the 2013-14 academic year, has launched the third edition of the ADC. The number of vacancies are listed in Table 1 [5].

Table 1. Adaptive Degree Courses and number of vacancies.

Adaptive Degree Courses	Vacancies' num.
Degree in Aerospace Engineering	30
Degree in Electrical Engineering	85
Degree in Engineering in Industrial Design and Product Development	120
Degree in Mechanical Engineering	120
Degree in Industrial Electronics and Automation	120

The access to ADC requires to have an old official academic degree as shown in Table 2, obtained in this or another university.

Table 2. Qualification required to ADC and that you can access.

Degree in possession	ADC that you access
Aeronautical Engineer	Degree in Aerospace Engineering
Electrical Engineer	Degree in Electrical Engineering
Industrial Design Engineer	Degree in Engineering in Industrial Design and Product Development
Mechanical Engineer	Degree in Mechanical Engineering
Electronical Engineer	Degree in Industrial Electronics and Automation

2.2. Adaptive Degree Courses program.

The program of subjects to be taken in each of the courses varies by speciality degrees. The program of the subjects are shown in the following subsections.

2.2.1. Adaptive Degree Course of Aerospace Engineering.

2.2.1.1. Aeromotors' Speciality: The course [6] consists of 63 ECTS (subjects: 51 ECTS and ADC Final Thesis: 12 ECTS).

- Mathematics III
- Automatic Control
- Airport Engineering
- Aerospace Manufacturing
- Vibrations
- Structural Calculate of Propulsives Systems
- Rocket Engines
- Transport of Mass and Energy Phenomenon
- Flight Mechanical
- Combustion
- ADC Final Thesis

2.2.1.2. Aircrafts' Speciality: The course [6] consists of 63 ECTS (subjects: 51 ECTS and ADC Final Thesis: 12 ECTS).

- Automatic Control
- Airport Engineering
- Propulsion
- Aerospace Manufacturing
- Mathematics III
- Vibrations
- Aeroelasticity
- Aerodynamics II
- Transport of Mass and Energy Phenomenon
- Large Flight Mechanical
- ADC Final Thesis

2.2.1.3. Airports' Speciality: The course [6] consists of 61,5 ECTS (subjects: 49,5 ECTS and ADC Final Thesis: 12 ECTS).

- Automatic Control
- Aerospace Manufacturing
- Flight Mechanical
- Propulsion
- Construction methods
- Construction Organization and management
- Mathematics III
- Fluid Mechanics
- Aerodynamics
- ADC Final Thesis

2.2.2. Adaptive Degree Course of Electrical Engineering.

The course [7] consists of 73,5 ECTS (subjects: 61,5 ECTS and ADC Final Thesis: 12 ECTS)

- Mathematics II
- Electricity
- Chemistry
- Thermodynamics and heat transfer

- Fluid Mechanics
- Business Organization
- Industrial Production Systems
- Environmental Technology
- Control of Machines and A. E.
- Renewable Energy
- Regulation and Industrial Automation
- Power Electronics
- ADC Final Thesis

2.2.3. Adaptive Degree Course of Industrial Design and Product Development Engineering.

The course [8] consists of 79,5 ECTS (subjects: 67,5 ECTS and ADC Final Thesis: 12 ECTS).

- Mathematics II
- Computer
- Electrical Technology / Electronics
- Technical Office
- Figureic Design and Communication
- Basic Design and Creativity
- Workshop Models and Prototypes
- Conceptual Design
- Optional mentions
    - Mention IV: New Product Design
        - Advanced Product Development for Leisure and Habitat
        - Design for Leisure and Habitat
        - Communication of New Products for Leisure and Habitat
- ADC Final Thesis

2.2.4. Adaptive Degree Course of Mechanical Engineering.

The course [9] consists of 78 ECTS (subjects: 66 ECTS and ADC Final Thesis: 12 ECTS).

- Mathematics II
- Physics for Speciality
- Chemistry
- Business Economics
- Environmental Technology
- Electronics and Automation
- Machine Design II
- Materials Science II
- Manufacturing Process Systems
- Mechanical Vibrations
- Heat Engines
- Fluid Engineering
- Combustion
- ADC Final Thesis

2.2.5. Adaptive Degree Course of Industrial Electronics and Automation Engineering.

The course [10] consists of 63 ECTS (subjects: 51 ECTS and ADC Final Thesis: 12 ECTS).

- Mathematics II
- Electricity
- Chemistry
- Thermodynamics and Fluid Mechanics
- Industrial Production Systems
- Business II
- Environmental Technology
- Control Techniques
- Robotic Systems
- ADC Final Thesis

3 Admission criteria and curriculum evaluation.

The admission criteria for the access of graduates will be made according to merit rating established by the UPV and detailed in Table 3, together with the corresponding weight:

Table 3. Curriculum assessment for access and their weighting.

Merit	Weighing
Merit 1: Academic transcript. Average rating of Academic transcript in a scale of 0 to 10 points..	60%
Merit 2: Professional experience. Years, or fraction thereof, or equivalent professional practice of Engineer, at the appropriate speciality duly accredited.	25%
Merit 3: Additional merits associated with continuing training. Other qualifications, courses, masters and / or official studies.	15%

The graduate must complete the following information for the evaluation of the curriculum, at the moment of registration.

- Personal data

- Studies requirement: Students must select the studies that has performed and indicate where was obtained, when was finished and the average rating of the transcript with records. (Merit 1)

- Other official studies: students can register other official university studies that have performed and want to present like added merits. (Merit 3)

- Course of continuous training and specialization: the student can register other non - official studies that wish present as a merit.

  - Performed at university:

- Master's Degree unofficial
- Specialist university course
- Another unofficial university course
- Performed in Profesional Association
- Performed in Accredited Lenguages Centre:
- German (ZMP)
- German (ZOP)
- French (DALF C1 y C2, CFST y DFTH)
- English (First Certificate, TOELF or equivalent)
- English (Proficiency, ESOL Advanced English or recognized equivalent degree)
- English/French/German/Non indo-european lenguages (EOI médium degree, upper degree)
- Valencian (médium degree, upper degree)
- Other lenguages courses
- Performed in another oficial institutions

➢ Additional information: At this section the student can register different useful additional information for their pre-register (professional association membership, PhD information…).

➢ Professional Experience: In this section the student shall register their professional experience, and should bring in "Attach documentation" Working Life Certificate issued by Labour's Ministry that shows all accredited labor merits entered in the application by the applicant and Certificate issued by the company authority stating in detail the description of the work performed. It only will be evaluated experience that is related to the ADC. (Merit 2)

The student must attach the supporting merits documents indicated at the pre-register through the application intended for that purpose and before the deadline.

4 Credit's transfer and recognition

Students present the Recognition Application to the Academic Committee of the Title (ACT) which is responsible for the provisional resolution at the Centre and in charge of raising the proposed recognition to the Credits' Subcommittee Recognition at UPV final decision .

The transfer and credit recognition will be based on the skills acquired in official university teachings, accredited professional or work experience and other senior officers' teachings.

The ACT will provide the recognition until 30 credits per work experience for students admitted on request by the student. A maximum of 10 ECTS per worked year. He must prove, beyond any doubt and enough, having had experience in his job for a minimum of 1 year performing functions equivalent or superior to the degree that qualify them. That documentation shall be submitted together with the pre-register to the ADC.

The credits' recognition for studies will be performed by comparing the skills acquired by the candidate and the skills acquired at the Degree. It´s possible also apply for subjects' recognition taken at other recognized degrees, submitting an official transcript and sealed subjects' programs that want to recognize.

In both cases, studies or professional experience, the ACT will study only those application expressly specified by the student. the applicant must state what subject he intends to be recognize and accredited for this merit.

5 Adaptive process analysis

The adaptive degree process is at the third edition and in this section show the results obtained in this process in each of the different ADC.

The following sections analyze the results from the data which is shown in the corresponding table. In the first figure, you can see the evolution in the three editions of the courses is shown. In the second figure the success rate can be seen, the rate of failures and dropouts for each of the different ADC.

5.1 Adaptive Degree Course of Aerospace Engineering outcomes.

Table 4. ADC of Aerospace Engineering data.

Aerospace Engineering Degree						
Course	**Num. Vacancies**	**Num. Applications**	**Num. Aceppted**	**Succes**	**Failure**	**Left**
2011-12	20	30	19	15	3	1
2012-13	25	35	24	19	3	2
2013-14	30	40	29	24	3	2

Figure 1. ADC of Aerospace Engineering data evolution.

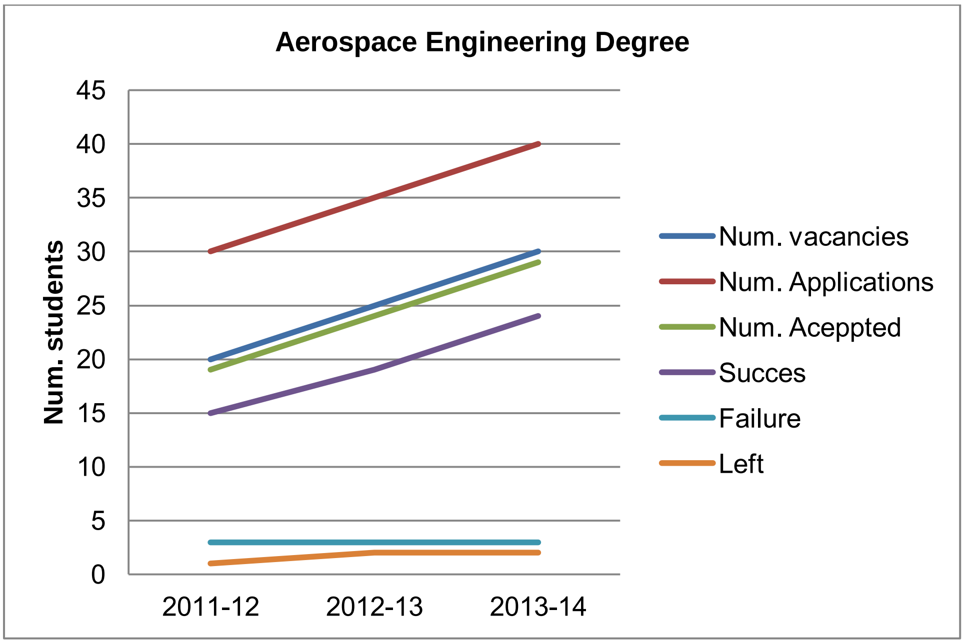
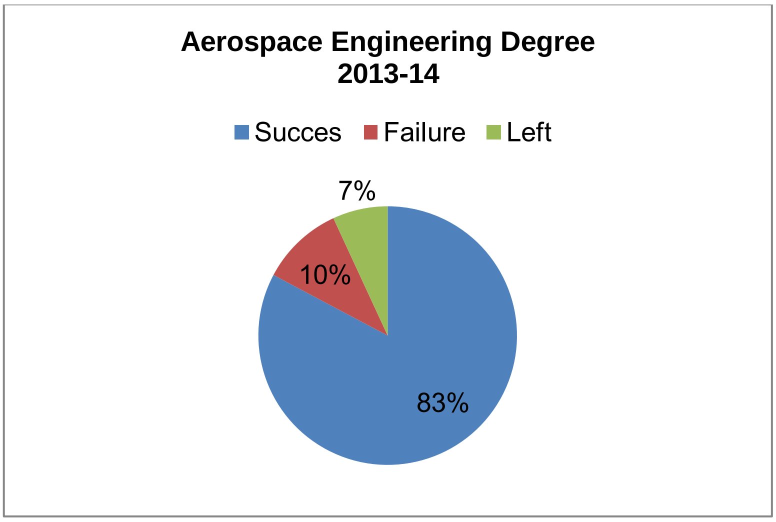


Figure 2. ADC of Aerospace Engineering success rate.



5.2 Adaptive Degree Course of Electrical Engineering outcomes.

Table 5. ADC of Electrical Engineering data.

Electrical Engineering Degree						
Course	**Num. Vacancies**	**Num. Applications**	**Num. Aceppted**	**Succes**	**Failure**	**Left**
2011-12	70	80	69	55	10	4
2012-13	80	90	78	65	8	5
2013-14	85	100	83	77	4	2

Figure 3. ADC of Electrical Engineering data evolution.

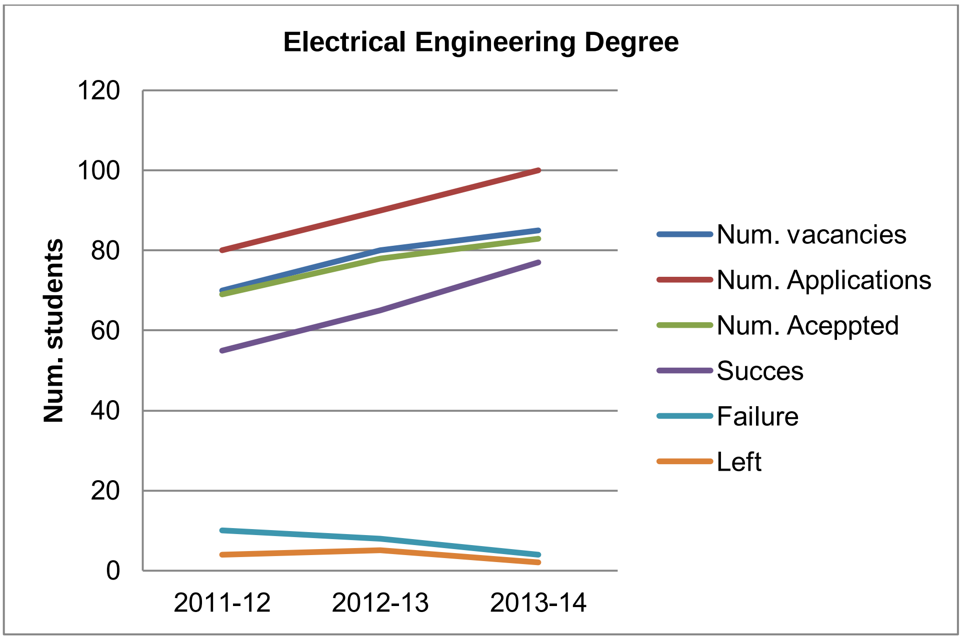
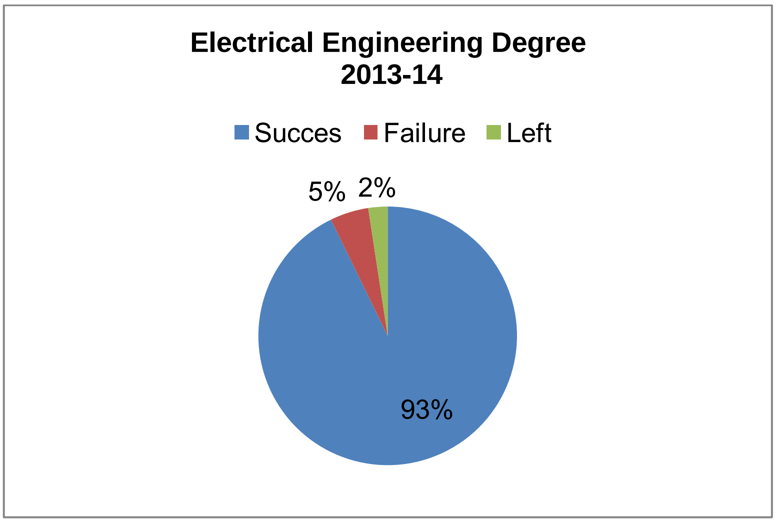


Figure 4. ADC of Electrical Engineering success rate.



5.3 Adaptive Degree Course of Industrial Design and Product Development Engineering outcomes.

Table 6. ADC of Industrial Design and Product Development Engineering data.

Industrial Design and Product Development Engineering Degree						
Course	**Num. Vacancies**	**Num. Applications**	**Num. Aceppted**	**Succes**	**Failure**	**Left**
2011-12	90	100	88	77	7	4
2012-13	100	110	97	86	8	3
2013-14	120	130	116	103	9	4

Figure 5. ADC of Industrial Design and Product Development Engineering data evolution.

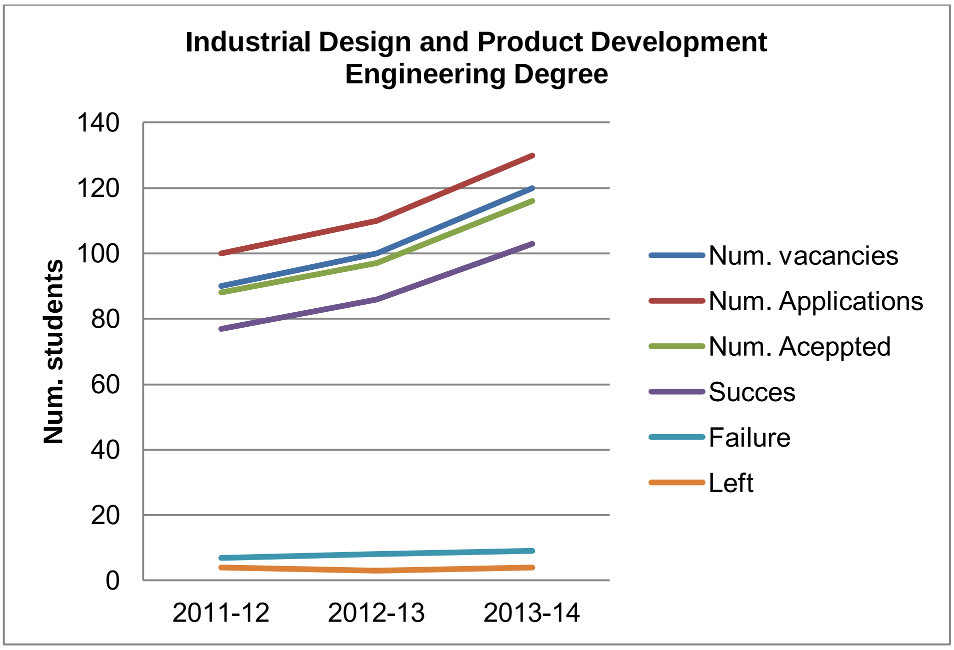
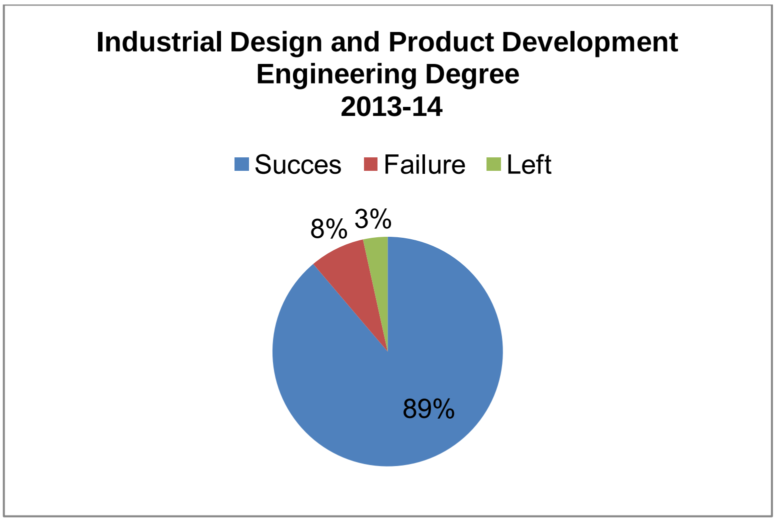


Figure 6. ADC of Industrial Design and Product Development Engineering success rate.



5.4 Adaptive Degree Course of Mechanical Engineering outcomes.

Table 7. ADC of Mechanical Engineering data.

Mechanical Engineering Degree						
Course	**Num. Vacancies**	**Num. Applications**	**Num. Aceppted**	**Succes**	**Failure**	**Left**
2011-12	90	100	88	73	11	4
2012-13	100	110	96	82	13	1
2013-14	120	130	117	104	11	2

Figure 7. ADC of Mechanical Engineering data evolution.

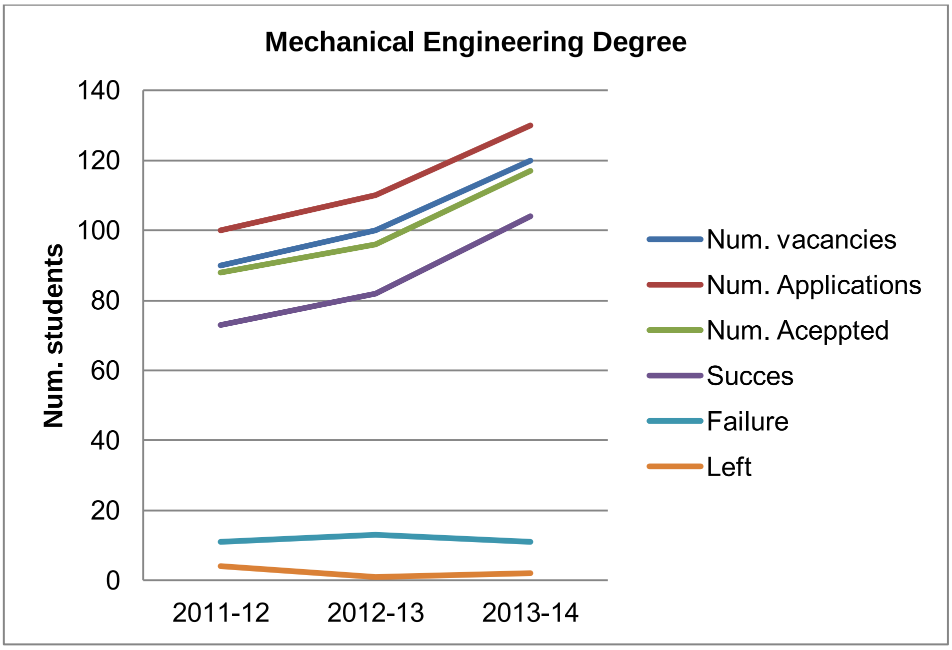
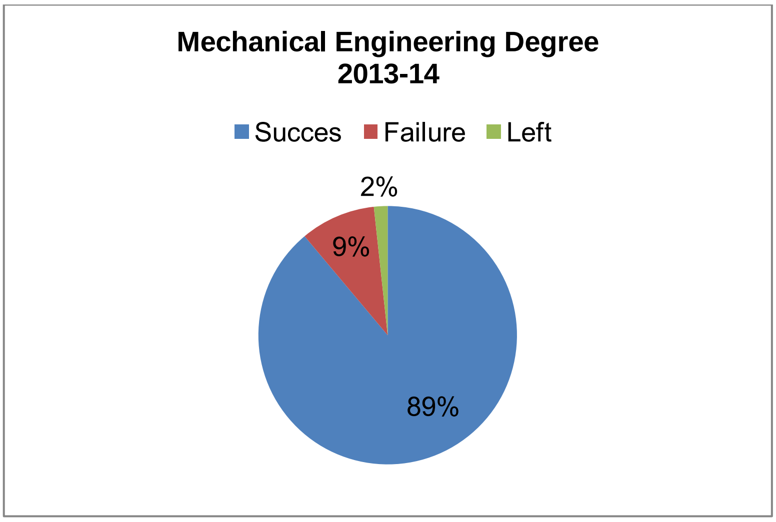


Figure 8. ADC of Mechanical Engineering success rate.



5.5 Adaptive Degree Course of Industrial Electronics and Automation Engineering outcomes.

Table 8. ADC of Industrial Electronics and Automation Engineering data.

Industrial Electronics and Automation Engineering Degree						
Course	**Num. Vacancies**	**Num. Applications**	**Num. Aceppted**	**Succes**	**Failure**	**Left**
2011-12	90	100	86	68	14	4
2012-13	100	110	95	79	13	3
2013-14	120	130	118	101	16	1

Figure 9. ADC of Industrial Electronics and Automation Engineering data evolution.

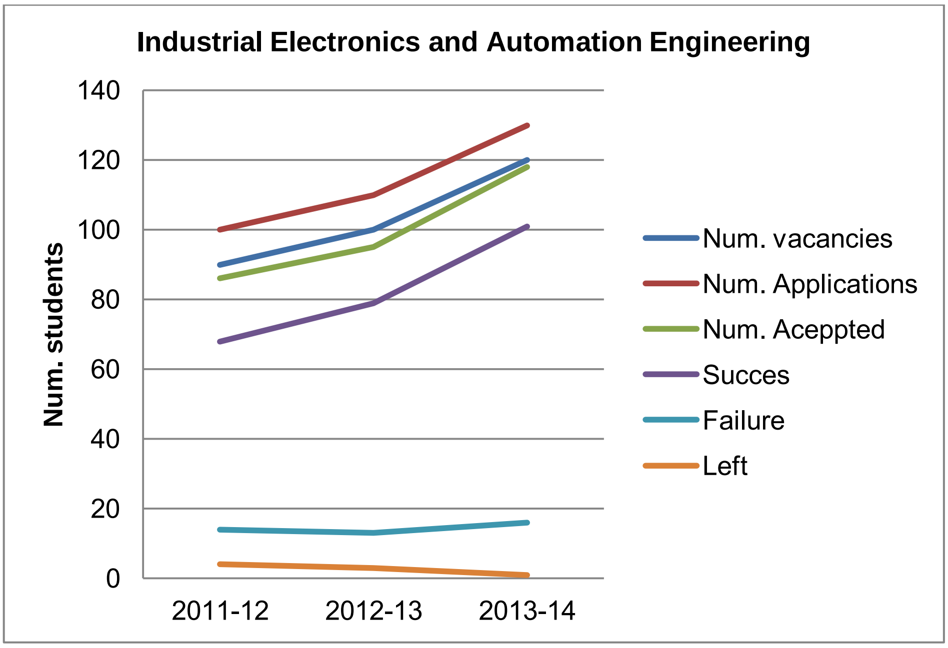
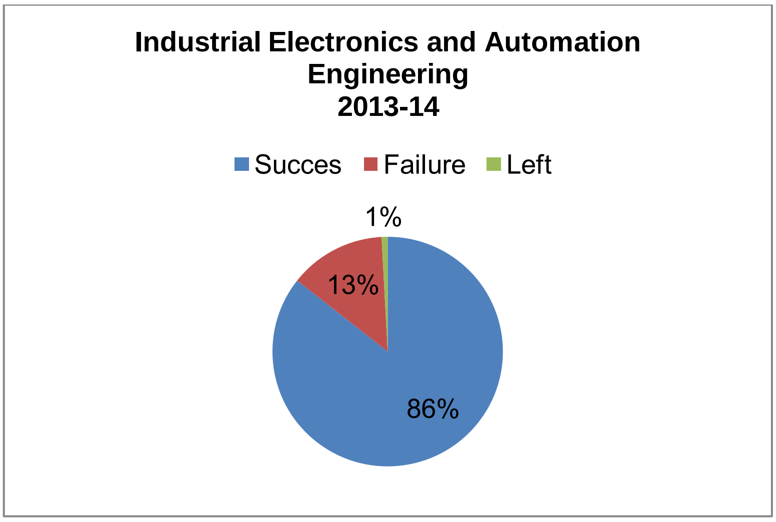


Figure 10. ADC of Industrial Electronics and Automation Engineering success rate.



6 Conclusions.

Adaptive Degree Course are useful for students graduated before the Bologna process which has reformed all degress. These courses allow obtaining new degrees, under certain conditions.

This paper shows the successful mission of these courses taught at ETSID. The results show the high demand of graduates to adapt to the new degrees. Moreover, the high rate of success, in all degrees is above 85 % and some as high as 90 %. The dropout rate is very low, due to the interest of graduates to get adapted. It is around 2 %, except for the degree of Aerospace, which increases the rate because have higher difficulty .

Failure rate, many often is due to the situation of graduates. Many cases these courses must be made sharing their job obligations. This rate is around 10% varying smoothly depending on specialities.

These rates are very satisfactory. Results are above expectations and enabling rapid integration of former graduates to the new EHEA scheme.

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Critical Evaluation

Overcoming the Barriers

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Abstract: *A major criticism of students' work is a limited ability at critical evaluation. This paper defines critical evaluation, show how it may be adequately demonstrated and explain why it is important. This is discussed in the context of a classification of learning outcomes in the cognitive domain. It questions how critical evaluation is best taught.*

INTRODUCTION

A recurring criticism of the work of engineering students is their limited ability at critical evaluation. Written work is often too descriptive lacking analytical ability and critical evaluation with inadequate evaluation of evidence. This is apparent at all levels up to and including postgraduate level. Examiners' repeatedly highlight these deficiencies but rarely suggest how they may be overcome.

Learning outcomes are usually written expecting students to demonstrate critical evaluation skills. However students mostly fail to properly demonstrate these skills either through imperfect understanding or inadequate training. If asked to 'critically evaluate…' too often the response is without discrimination or evaluation and demonstrate a skill level that is little in excess of basic knowledge.

It is for educators to more clearly ***explain*** the meaning and importance of critical evaluation and how it may be adequately demonstrated and not continue to use expressions such as 'critically evaluate' and ***expect*** students understand and respond appropriately.

SO WHAT IS MEANT BY CRITICAL EVALUATION?

The word 'critical' derives from the Greek 'kriticos' meaning discerning, *discriminating, and judgmental*. Thus 'critical' is used in the questioning, investigative, analytical sense, rather than the disapproving, fault-finding sense. To 'evaluate' is to assess and judge issues in order to solve problems. 'Critical evaluation' may be defined, therefore, as 'the ability to compare, discriminate, analyse, draw inferences, judge, defend, and solve problems' [1].

BLOOM'S TAXONOMY OF LEARNING OUTCOMES

Over 50 years ago the American educational psychologist BS Bloom led a group that classified learning outcomes, with the intention of developing a classification system for the three domains of learning - the cognitive, the affective and the psycho-motor domains (*see foot note*).

The cognitive domain involves the knowledge and the development of intellectual attitudes and skills. Bloom's group identified six major levels of learning outcomes starting from the simplest to the most complex, namely ***knowledge, comprehension, application, analysis, synthesis and evaluation.*** These divisions are not mutually exclusive and, arguably, synthesis and evaluation should be reversed [2] and that it should include ***creation*** as a separate domain.

It is possible, of course, to '*know*' a topic at different levels and it has been shown that the higher that level the more we remember [3]. This hierarchy is generally referred to as Bloom's Taxonomy of the Cognitive Domain [4]. There are other systems or hierarchies but Bloom's is probably the most widely applied.

HOW CAN CRITICAL EVALUATION BE DEMONSTRATED?

Using Bloom's taxonomy, the teacher can ask a group of students *the same question and expect different levels of response*. The following is a simple adaptation of the taxonomy - with sample verbs - to indicate output levels from Level 1 to Level 6. Typically, Levels 1 to 3 correspond to difficulties associated with the first years of a university engineering programmer. Final year and graduate level students should be expected to achieve outcome Levels 4, 5 and 6.

Foot note: Cognitive = intellectual, rational skills; Affective = emotional, sentimental; Psycho-motive = though process, consciousness.

1. Knowledge: Remembering Information.

Knowledge is defined as the remembering of previously learned information. This may involve the recall of a wide range of material, from specific facts to complete theories requiring only the recall of the appropriate information.
Knowledge demonstrates memory by recalling facts, terms, basic concepts and answers through knowledge of specifics (terminology, scientific facts), understanding ways and means of dealing with specifics (conventions, trends and sequences, classifications and categories, criteria, methodology) and knowledge of universals and abstractions in a field (principles and generalisations, theories and structures). Knowledge represents the lowest level of learning in the cognitive domain.
Sample verbs: List, define, label, state, name, quote, outline.

2. Comprehension: Understanding Information.

Comprehension is defined as understand the meaning of information. This demonstrates understanding of facts and ideas by organising, comparing, translating, interpreting, describing and stating the main ideas, by translating words to numbers, explaining or summarising, and by predicting consequences of events. This learning outcome goes one step beyond the simple remembering of material and represents the lowest level of understanding. .
Sample verbs: demonstrate, explain, summerise, illustrate, identify, give examples.

3. Application: Using Information.

Application refers to the ability to use learned material in new and specific situations. This may include the application of such things as rules, methods, concepts, principles, laws and theories, typically, using new knowledge in a different way as in solving problems in new situations by applying acquired knowledge or by present facts, techniques and rules differently or unconventionally. Learning outcomes at this level require a higher level of understanding than those under comprehension.
Sample verbs: apply, demonstrate, solve, compute, show, examine, relate, assess.

4. Analysis: Exploring Information

Analysis refers to the ability to disseminate information into its component parts so that its organisational structure may be understood. This may include the identification of parts, analysis of relationship between parts by identifying motives or causes, recognition of the organisational principles involved and by making inferences and finding evidence to support generalisations. Learning outcomes at this level are of a higher intellectual level than comprehension and application because they require an understanding of both the content and the structural form of the material. Sample verbs: analyse, categorise, compare, contrast, discuss.

5. Synthesis.

Synthesis refers to the ability to put parts together to form a new whole. This may involve the production of a unique communication, a plan of operations (research proposal), or a set of abstract relations (scheme for classifying information) or presenting information way by combining elements in a new pattern or proposing alternative solutions. Learning outcomes at this level stress creative ability, with emphasis on the formulation of new patterns or structure. Sample verbs: create, design, invent, develop, integrate, adapt, compose.

6. Evaluation

Evaluation is concerned with the ability to judge the value of information for a given purpose, based on definite criteria. These may be internal criteria (organisation) or external criteria (relevant to the purpose); the student may determine the criteria or be given them. Presenting and defending opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria. Learning outcomes in this area are the highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgments based defined criteria. Sample verbs: assess, judge, recommend, critique, defend, justify, interpret, evaluate, support.

WHY IS CRITICAL EVALUATION AN IMPORTANT SKILL?

Intellectual skills at any level are important, because non-critical evaluation skills give rise to:

- rigid and narrow thinking - thinking based on past practices without considering current data.
- prejudicial thinking - gathering evidence to support a particular position without questioning the position.
- emotive thinking - responding to the emotion of the message rather than the content.

However, critical evaluation skills are necessary to understand the validity of arguments that inform beliefs and actions. Written learning outcomes enable best judgments as to the logic of written material, the adequacy with which conclusions are supported by the data, and the value of the work based on personal values and opinions.

DEVELOPING CRITICAL EVALUATION SKILLS.

Too often students are required to demonstrate learning outcomes that are appropriate to assessment and to judge the value of knowledge and information. Whilst lower level cognitive skills are important, it is higher-level cognitive skills are increasingly valued.

The notion of critical evaluation is important. However, research suggests that many teachers have only a vague understanding of ‘critical evaluation’ and how it can be taught [5]. It is assumed that this is best taught in the classroom embedded in the curricula; there is little evidence to support the validity this assumption [8]. Evidence strongly suggests that ‘critical evaluation’ should be taught as a ***separate set of skills*** [6, 7].

Appendix 1 comprises teaching / learning examples to develop the skills of critical evaluation.

CONCLUSION

- An understanding of its hierarchy of learning outcomes will inform, encourage and enhance the development of critical evaluation skills of engineering students. It is best taught as a separate set of skills.
- Higher level skills based on evidence and personal judgments depend on relevant experience and insight and best demonstrated at postgraduate level.

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Appendix 1

Example 1. Apples and Healthy Eating

1. What are the health benefits of eating apples?
2. Compare the health benefits of eating apples v oranges
3. Which types of apples are best for baking apple pie, and why?
4. List four ways of serving foods made with apples. Explain which have the greatest health benefits. Support your statements with references.
5. Convert an 'unhealthy' recipe by replacing ingredients and explain the health benefits of using the new ingredients the original ingredients
6. Do you feel that serving apple pie for an afternoon snack is healthy? Defend & justify.

Example 2: A Student Experimental Project

1. For a given project, assemble known relevant data, assess the resources (experimental, computing, technical, financial) available and other support...
2. Understand the data and their relevance to the project... Agree principal objectives, Understand resource constraints. Understand importance of accurate documentation and data recording.
3. Devise an action plan: timetable (stage objectives), direction and type of experimentation, accuracy and limitations. Conduct experiment, assemble results.
4. Analyse results, draw inferences, show relationships, report conclusions. Report experimental accuracy and limitations, suggest type and direction for further investigation. Completion on time and budget? If not, why not?
5. Discuss limitations, propose improved techniques. Consider industrial implications, wider relevance Lateral / 'out of the box' thinking.
6. Technology transfer opportunities, likely beneficiaries / collaborators, financial implications. Appropriate dissemination (journals, conferences). Cost/benefit analysis.

Undergraduate students at least achieve the above three outcomes and graduate students all six.

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Two years of experience in virtual mobility in renewable energies.

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Conference Key Areas: Lifelong learning in EE; Green Engineering; Internationalizing the engineering curriculum.
Keywords: Photovoltaic energy; Wind energy; e-learning; international collaboration

Abstract

Renewable energies had experienced a fast rise in recent years all around the world, providing new employment opportunities. Green electricity generation is becoming a fundamental part of the energy mix in which will build sustainable energy society. It makes necessary a permanent and qualified training that meets the demand in this new professional activity. An international experience between universities in Spain and South-America is described in the paper. The e-learning courses in photovoltaic and wind energy developed from 2000 to 2010 as lifelong learning have been offered the last two years in other universities as elective subjects in different curricula using an on-line methodology. The course in photovoltaic systems will be available at the end of this year as virtual mobility in some of the European Erasmus programs.

1 Introduction

Photovoltaic and wind energy are some of the renewable energies that had experienced a fast rise in recent years and also had provided employment opportunities: groups of R&D, engineering companies, electricity installers, technicians, maintenance, etc. Renewable energy generation is becoming a fundamental part of the energy mix in which will build sustainable energy society. It makes necessary a permanent and qualified training that meets the demand in this new professional activity. The possibilities of combining this technology with other renewable resources (hydro, biomass, fuel cells, etc.) will allow the rural electrification of many areas of emerging countries, promoting rural development, increasing the quality of life in these areas, and the settlement of the population.

Teachers of the Universitat Politècnica de València (UPV or Polytechnic University of Valencia) have been developing R&D activities in the field of photovoltaic and wind energy with Spanish companies during the last 25 years. As a result of this collaboration, the UPV has three photovoltaic plants connected to the grid. The first one was built in 1999 in the north roof of the Escuela Técnica Superior de Ingenieria del Diseño (ETSID). It has 234 crystalline modules with a total power of 17.5 kWpk and 6 single-phase inverters. It has been used for R&D projects, student's final degree projects and in the face-to-face lifelong learning courses developed in the UPV since 2000. In summer of 2010 was built a second PV plant in the same roof. The 64 amorphous silicon modules were done in the new German factory of the American manufactures EPV. The 3.3 kWpk plant includes a Danfoss inverter, a Danfoss web monitor system and an Eos Web monitor system for the data acquisition of strings parameters.

The last PV plant is built in the highest roof of the Nexus building. It includes crystalline (c-Si) and amorphous silicon (a-Si) modules from different manufacturers. Two inverters were provided by SMA, a SB1200 with a low frequency transformer for the amorphous silicon modules and a SB4000TL transformer-less inverter for the crystalline modules. The plant includes the monitor system of SMA and an Eos Web server. The Eos Web monitor system included in this plant is used by its manufacturer (Carlo Gavazzi) for the test of the product and for the introduction of new elements in this system. Eos Web receives signals from different devices: strings parameters, ambient and module temperatures, irradiance, Ac energy, etc. Part of the information is public (http://158.42.231.186/ and http://158.42.230.62/index.php) and other is only available for the managers of the plants.

Fig. 1. Mosaic with the photovoltaic plants available in the UPV.

The experience acquired in the construction of these PV plants had enhanced the quality of the given courses. The grown of photovoltaic systems in Spain from 2000 and 2005 was small. The courses developed during these years, with a typical length of 20 hours, were intended for students of degrees in electronics and electrical engineering. The program was developed around the power converters used in PV installations and the modulation techniques used for the control of DC/AC converters. After 2005 the number of grid-connected photovoltaic installations in Spain rises very fast and there was an increasing demand of engineers with training in this new way of electricity generation. The face-to-face courses were modified, extending duration to 30 hours and including more examples of grid-connected photovoltaic systems. During the period 20005-2008 around 1000 students followed our face-to-face courses.

Wind energy generation systems share some parts with photovoltaic systems: DC/AC converter, PWM modulations techniques, grid regulations, etc. In 2007 was developed the first course in wind energy with a structure copied from the experience in photovoltaic courses: participation of companies, oriented to the application, 25 hours length, etc.

2 From face-to-face to on-line format

The fast development of photovoltaic technology along the entire world produced an increase in the information available about this modern mode of energy generation. It motivated the introduction of an on-line postgraduate course in photovoltaic systems in 2010, with 20 ECTS. In 2012 it was converted to 30 ECTS due to the large amount of contents included in the course. Technology development permits nowadays the access to internet in the entire world. Advantages [1] of e-learning can be summarized in the following points:

- Allows eliminating the inequalities of society, giving people access to a quality and updated education.
- Adapts to the pace of each student, being compatible with other studies, work and family.
- Sustainable and zero carbon footprint: digital resources (no prints) and without displacement.

During the six first editions of the 20 ECTS course the attendees had 6 months to complete the studies. We started the collaborations with some South American universities that offered our on-line postgraduate course in photovoltaic to their alumni [2]. Some problems arise in the first collaborations, mainly related with holiday periods and course calendar. Due to the impossibility of finding an adequate calendar for the different South American countries, we modified the course structure to open the registration along all the year.

At the same time, some of the universities were interested in include in their degrees an elective subject by means international collaborations. This need, combined with a large reduction of attendees in the face-to-face courses motivated the transformation of all the lifelong courses to the on-line format after 2011. The 30 hours face-to-face course was converted firstly in a 4.5 ECTS on-line course that is offered as a 6 ECTS on-line course since 2012.

The first international experience was in spring/summer of 2012 with two universities, one from Mexico and another one from Colombia. At the time of presentation of the paper we are finishing the second year of virtual mobility with these universities. The increase of interest in photovoltaic systems in these countries is producing an increase in the number of attendees in the course. The most important characteristics of these asynchronous on-line courses can be summarized in the following points:

- Enrollment is open all year (except in August).
- The entire course can be done at distance, with asynchronous tutoring and exams (continuous assessment) carried out through the online training platform of UPV (PoliformaT).
- Teaching collaboration with the main national and international companies of the sector, including in the program the recent technical developments in the field.
- On line evaluation combined with face-to-face evaluation with teachers from local universities.

3 Characteristics of the studies.

The online course "Introduction to Photovoltaic Power Systems" is organized into three modules with a total duration of 6 ECTS. The course reviews the fundamentals necessary to understand photovoltaic systems and carry out the design and maintenance of these energy generating installations. The course has a practical approach to the application and includes the latest photovoltaic technology available on the market today. The described contents are reinforced with examples and practical exercises that allow you to apply the theoretical concepts developed in the different units.

The online course "Introduction to Wind Power Systems" is organized into three modules with a total duration of 6 ECTS. The course reviews the fundamentals necessary to understand large and small wind systems and carry out the design and maintenance of these installations. The course has a practical approach to the application and includes the latest developments available on the market today. Examples and practical exercises obtained from the collaborations with companies are used in the course to reinforce the theoretical concepts developed in the different units.

The online postgraduate course "Diploma in Photovoltaic Power Systems" is organized into four modules with a total duration of 30 ECTS. The course covers all type of photovoltaic systems, including the analysis, design, and maintenance of these installations. The described contents are reinforced with examples, practical exercises, information obtained from the photovoltaic plants available at the UPV, collaboration with companies and R&D works. This course correspond to the highest specialization level in this field, being of interest for students that want to find a job in this new technology or professionals that want to extend their knowledge in the field.

The three courses are divided in different sections that cover a defined part of the course. As an example, the course "Introduction to Photovoltaic Power Systems" is structured in three large blocks of 2 ECTS credits each of them:

- Module 1: introduction to photovoltaic systems (2 ECTS).
- Module 2: grid connected photovoltaic systems (2 ECTS).
- Module 3: off-grid photovoltaic systems (2 ECTS).

The same sections appear in the "Diploma in Photovoltaic Power Systems" but with 9 ECTS credits each of them and an extra section titled “Module 4: Photovoltaic project”. All these courses use the same on-line tools, which are described in next subsections. Every module appears to the student as a different website in the on-line platform of the UPV, called PoliformaT (based in Sakai). The student promotion from one module to the following one is conditioned to pass the corresponding module exam with a minimum scoring of 5 (respect to 10).

It is estimated that each of the modules in the 6 ECTS course can be overcome in 4-5 weeks, which fits well in a typical university semester in which the student is following other subjects at the same time. It is estimated that each of the modules of the "Diploma in Photovoltaic Power Systems" can be overcome in 7 weeks, except module 4 that can be done in 3 weeks. Students enrolled in the Diploma have one year to conclude their studies.

3.1 Student Guide

In the Student Guide is included all the information needed to follow satisfactorily the training program that we have developed. It includes explanations about different topics: objectives, structure of the course, access to the online training platform (PoliformaT), website structure, the training material, access to queries and online tutoring, the scoring, and the certification of the studies. Furthermore, it also includes the e-mail of the director of the course for sending an e-mail if the web site is not available.

The Student Guide is included in a website (called Module 0) that only contains basic information about the on-line platform use, an internal e-mail for the contact between students or the teacher, an announcements menu and all the exams of the course. The training material is in their corresponding website, one per module.

3.2 Training material

The modules are structured in different chapters or units, which are accessed via the 'Resources' and 'Modules' menus in PoliformaT. The units include solved examples and references to technical annexes that permit the approach of the student to existing market.

The "Resources" menu gives access to the documents that make up the courses. The student can access and download the following documents:

- Acrobat files where the contents of the chapters are developed.
- Excel files with proposed and solved problems.
- Acrobat files with the slides used in the audiovisual presentations (webinar sessions, Polimedia videos [3], etc.) which can be viewed in the "Modules" menu.
- Complementary files which provide technical information of products, application notes, technical reports, and other materials related to training. Their reading is not mandatory, but some of them will be used in the examples and exercises proposed in the course.

The "Contents" menu includes audiovisual material where are described the contents of the units that make up the courses. The approach used is the most approximate to what is done in a face-to-face. Also it includes audiovisual material provided by companies of the photovoltaic sector and videos recorded during the webinars organized in the UPV. The topics covered in the webinar cover the different parts of the course: supporting structures, stand-alone inverters, photovoltaic modules, etc.

3.3 Doubts and questions

Students will have access to queries and online tutoring with the teachers through the PoliformaT tools called "Forum" and "Messages". During the webinars students can use the chat window for their questions.

By using the tool "Forum" the student can make questions about the contents developed in each unit. The questions will be answered by the teachers in the forum in the shortest time, usually no more than two days. The Forum is the common way to answer the doubts about course contents. The information included in the Forum is visible to all participants of the course. All registered students may participate in each of the themes developed in the 'Forum' bringing their comments and point of view.

PoliformaT has an internal mail system to allow communication between the participants in the course: teachers and students. By using the menu "Messages" students may contact with professors and other students to address non-technical questions or share information. Internal mail allows you to choose the receiver of the mail, not being visible to the other participants. There is the possibility of sending collective mail to all participants of the course, only to professors, only to students or to individual receiver of your choice. Internal mail can be used for all types of consultations, being preferred that questions about the course contents will done using the 'Forum' tool.

3.4 Scoring and certification of studies

To improve the study of the training material the student can carry out the self-exams available in the “Tests&Quizzes" section in PoliformaT. These self-exams revise the main contents developed in the units. Self-exams are not used for the course scoring. Also the student had to solve practical problems related to the contents described in the videos and slides of the course.

There is scheduled an exam to score each module of the course, which will be valued between 0 and 10. The exam will consist of a test with multiple choice questions covering the different parts of the course and you can do the exam as you study each unit. The exam in some modules is related with a project that the student have to develop and solve before acceding to the on-line exam.

All the examinations are carried out via Internet and is not necessary the realization of any kind of test at a time and location. The tests can be carried out at any place with and Internet connection, using hand notes and in several days. Students may do questions about the contents of the exam through the "Forum" tool.

Grades obtained may be seen by the student in the "Gradebook" menu and all the markings of the final exams of each module will be used for the final grade of each student. This final grade must be equal to or greater than 5 and will be included in the certificate of "Achievement" to be issued by the Lifelong Learning Center of the Polytechnic University of Valencia. Those which do not reach the minimum average note of 5 will not obtain a certificate.

When the on-line course is used as an elective subject it is recommended to organize one exam per module with the students in a fixed day in a class-room. The final grade in the elective subject is usually a combination of the face-to-face and the virtual scoring. Percentage for each part can vary but a 50%+50% had been used until now in the first years of this experience. By means the face-to-face exams the students:

- Have an extra motivation to conclude the modules on time.
- Study the on-line subject just like the other, promoting good study habits with routine structures similar to the used in traditional classes.
- Understand that copying works and exercises is not an option, because at the end of each module there is a test to assess their knowledge on the subject.

4 Extending the experience.

After the knowledge gained with the collaboration with universities from Colombia and Mexico in the last two years, the UPV is looking for new partners in other countries [2]. In some countries universities and professionals are reticence to e-learning courses, perceiving them as something distant and with bad quality. To overcome this perception, we are now preparing a sponsored course in photovoltaic systems that will be available in July/2014. In collaboration with companies we are developing a short introductory course following the approach of the massive open online courses [4]. The units that are under development are:

- Photovoltaic modules and arrays, in collaboration with Trina Solar (http://www.trinasolar.com/sp/index.html).
- Grid-connected photovoltaic inverters, in collaboration with SMA Iberica (www.sma-iberica.com).
- Monitor system for photovoltaic installations, in collaboration with Carlo Gavazzi (http://www.gavazzi-renovables.com).

Contacts with other companies are being maintained to expand the contents offered in other areas such as: supporting structures, batteries, stand-alone converters, etc. All the units prepared for this course will be used in the rest of courses, being available for the students that follow our courses as elective subjects in their universities.

Also the course “Introduction to Photovoltaic Power Systems" had been given in English the last three years using the face-to-face mode. During 2014 we are transforming it to a fully on-line version that will be available at the end of the year, using the same approach used in the Spanish version of the course: 6 ECTS, three modules, asynchronous tutoring, etc. This course could be used for virtual mobility en the field of renewable energies under Erasmus program. Other universities could be interested in offer complementary studies in fields as: wind energy, biomass, geothermal energy, etc., so in the future it could be established an international program in this field.

Complementing the on-line courses in photovoltaic power systems, the UPV offers every year a practical course in photovoltaic systems. The course "Practical Photovoltaic Systems" has 6 ECTS and includes face-to-face practical works and online parts. The face-to-face parts are developed in the Nexus photovoltaic plant in the UPV during 1 week, with 25 hours of work with a teacher. For students who can travel and stay in Valencia during the scheduled dates for the class activities, are available:

- A photovoltaic plant of 4 kWpk of crystalline silicon modules and 1 kWpk of amorphous silicon modules located on the roof of the Nexus building (building 6G) where to undertake activities related to the installation, starting up and monitoring of a grid connected system.

Fig. 2. Photovoltaic plants available for the practical course.

- A computer classroom of the Lifelong Learning Center (www.cfp.upv.es) where the students will process and analyze data acquired in the photovoltaic plants of the Polytechnic University of Valencia (stand-alone and grid-connected).

Also some visits to photovoltaic installations are done during the face-to-face parts of the course. For students who cannot attend to the practice week developed at the Polytechnic University of Valencia, we have prepared material to perform an equivalent work:

- Visits to facilities will be replaced by virtual tours (Polimedia video) which will be available in "Modules" of PoliformaT.
- Exercises developed in the computer classroom can be performed on their own computers due to there is no need of any special software.

The course "Practical Photovoltaic Systems" has been developed during the last 4 years in Spanish but could be translated to English to complement the contents given in the on-line course "Introduction to Photovoltaic Power Systems". With these two courses students under Erasmus programs will acquire a high level of knowledge in photovoltaic systems.

5 Business model used for the program internationalization.

Considering what kind of lifelong learning materials the Universities are offering, sharing materials in a win/win relation must be defined and described. To describe the win/win relation, we have opted by the Canvas business model. The Canvas business model, created by Alexander Osterwalder describes in a logical manner the way in which organizations create, deliver, and capture value. The process of designing the business model is part of the institutional business strategy [5]-[7]. Therefore, it is of vital importance to structure this type of resources to know how a lifelong learning centre operates and the strengths and weaknesses of the same.

The model try to carry out a diagram, called "canvas", made up of 9 building blocks. The model is applied to an organization to review the different ways of being profitable in its sector. It is worth mentioning that all business model will provide an added value to any company who makes use of them, because from the same, there will be a greater concept and vision of the organization through a systemic approach that encompasses all aspects of the institution.

Formal descriptions of the business become the building blocks for its activities. Osterwalder proposes a single reference model based on the similarities of a wide range of business model conceptualizations. With his business model design template, an enterprise can easily describe their business model. Categories used are included in Fig. 3 and described below.

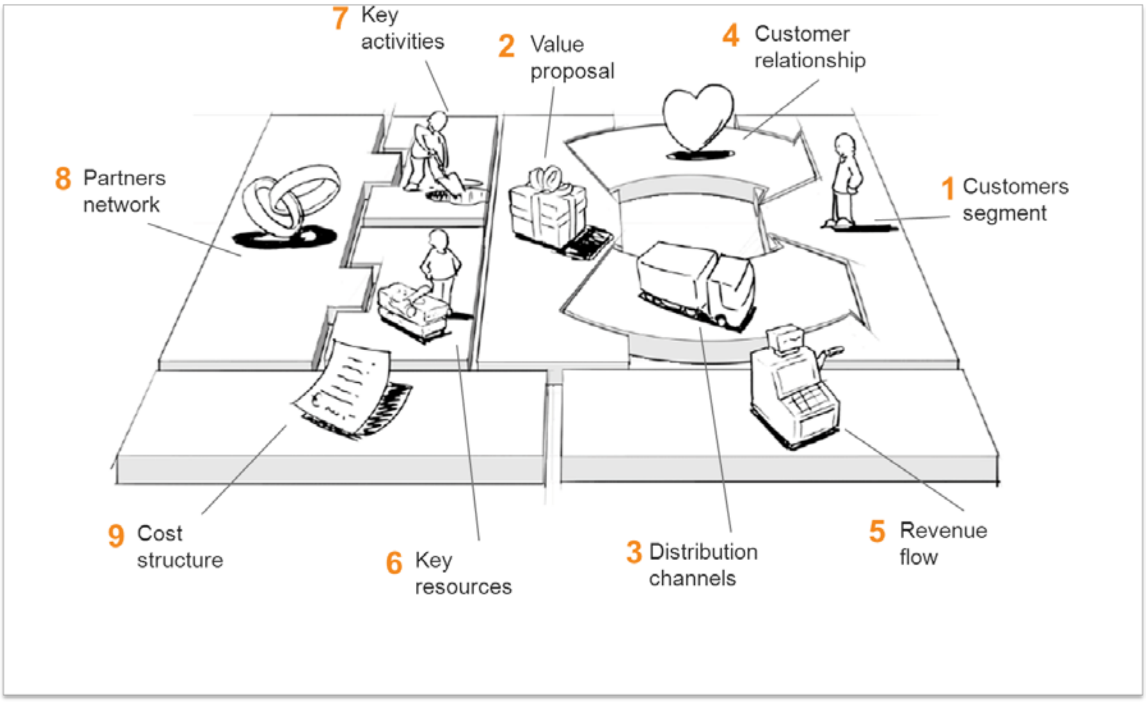

Fig. 3. Canvas business model

Value Proposal:

The collection of products and services a business offers to meet the needs of its customers. According to Osterwalder, a company's value proposition is what distinguishes itself from its competitors. The value proposition provides value through various elements such as newness, performance, customization, "getting the job done", design, brand/status, price, cost reduction, risk reduction, accessibility, and convenience/usability. The value propositions may be quantitative- price and efficiency or qualitative- overall customer experience and outcome.

Key Activities:

The most important activities in executing a company's value proposition. An example for Bic would be creating an efficient supply chain to drive down costs.

Key Resources:

The resources those are necessary to create value for the customer. They are considered an asset to a company, which are needed in order to sustain and support the business. These resources could be human, financial, physical and intellectual.

Partner Network:

In order to optimize operations and reduce risks of a business model, organization usually cultivate buyer-supplier relationships so they can focus on their core activity. Complementary business alliances also can be considered through joint ventures, strategic alliances between competitors or non-competitors.

Customers segments:

To build an effective business model, a company must identify which customers it tries to serve. Various set of customers can be segmented base on the different needs and attributes to ensure appropriate implementation of corporate strategy meets the characteristics of selected group of clients.

Distribution Channels:

A company can deliver its value proposition to its targeted customers through different channels. Effective channels will distribute a company’s value proposition in ways that are fast, efficient and cost effective. An organization can reach its clients either through its own channels (storefront), partner channels (major distributors), or a combination of both.

Customer Relationship:

To ensure the survival and success of any businesses, companies must identify the type of relationship they want to create with their customer segments. Various forms of customer relationships include:

- Personal Assistance: Assistance in a form of employee-customer interaction. Such assistance performed during either sales, after sales, and/or both.
- Dedicated Personal Assistance: The most intimate and hands on personal assistance where a sales representative is assigned to handle all the needs and questions of a special set of clients.
- Self Service: The type of relationship that translates from the indirect interaction between the company and the clients. Here, an organization provides the tools needed for the customers to serve themselves easily and effectively.
- Automated Services: A system similar to self-service but more personalized as it has the ability to identify individual customers and his/her preferences. An example of this would be Amazon.com making book suggestion based on the characteristics of the previous book purchased.

- Communities: Creating a community allows for a direct interaction among different clients and the company. The community platform produces a scenario where knowledge can be shared and problems are solved between different clients.
- Co-creation: A personal relationship is created through the customer's direct input in the final outcome of the company's products/services.

Cost Structure:

This describes the most important monetary consequences while operating under different business models.

Classes of Business Structures:

- Cost-Driven - This business model focuses on minimizing all costs and having no frills.
- Value-Driven - Less concerned with cost, this business model focuses on creating value for their products and services. i.e. Louis Vuitton, Rolex

Characteristics of Cost Structures:

- Fixed Costs - Costs are unchanged across different applications. i.e. salary, rent
- Variable Costs - These costs vary depending on the amount of production of goods or services. i.e. music festivals
- Economies of Scale - Costs go down as the amount of good are ordered or produced.

Revenues:

The way a company makes income from each customer segment. Several ways to generate a revenue stream:

- Asset Sale - (the most common type) Selling ownership rights to a physical good.
- Usage Fee - Money generated from the use of a particular service
- Lending/Leasing/Renting - Giving exclusive right to an asset for a particular period of time.
- Licensing - Revenue generated from charging for the use of a protected intellectual property.
- Brokerage Fees - Revenue generated from an intermediate service between 2 parties.
- Advertising - Revenue generated from charging fees for product advertising.

6 Blended Lifelong Learning Business Model: REUNITIC project

In the last 4 years (2009-2013), the UPV has developed a new business model for sharing distance training materials with other educational institutions [8]. The initial restriction was seen as the way through which one could relate to other universities with a model win/win. This pilot experience was named REUNITIC. The creation of e-learning training materials is an expensive experience with a certain level of risk. Also the cost of e-learning materials production represents a fundamental barrier to entry in this business. If uncertainty of demand is added to previous issues, we obtain that it is complicated to make production of blended learning. It explains why not many universities have classroom e-learning training materials developed at the moment. The clients of this proposal are therefore the universities (public or private) who want to supplement their offer of lifelong learning.

The value proposition that is formula is simple: to make available material for e-learning education in the latest technology trends contrasted its demand among professionals of globalized sectors. Local Materials, obviously, do not respond to these diagrams. However, training for professionals in technology industries allows for the transfer and adaptability. What customers are suggested for this type of training? The alumni of each institution is the answer.

The distribution channel of these courses is internet. There are 3 possibilities: access to synchronous session in supplementary schedules, access to these same recorded sessions, and/or access to materials produced ex profeso belonging to the first quadrant of the instructional training. The platform used in REUNITIC project is the platform of the UPV. Also the certification is the own of the UPV.

The relationship with the client "student" is strictly emotional. The alma mater of each professional receives an offer of training from the UPV, which belongs the training material and certifies the studies. This professional becomes one more in the group of participants and as such he is treated. The University that participates in REUNITIC project receive the course registration fees and pay a base price to the UPV per attendee that is participating in the course (typically 80% of the price of the course). The Partner University income compensates for the electronic promotion through their distribution lists. If the number of professional interested in the course is high enough, it is recommended to propose a day for a "blended" presentation of the course, with experts from both institutions but without incurring in travel expenses.

UPV partners for this project are universities that have continuous training activity and alumni that have already been inserted in the labour market. Also universities that are starting new subjects in new degrees are also interested in the project due to there is not a minimum number of students for starting the course. Resources are critical of both the materials produced and the platform that houses the materials. The critical activities are the presentation of the project, the electronic promotion, and the possibility of developing blended days of presentation of the different courses. What costs? The electronic promotion and the usual payments related to Lifelong Learning. The UPV is who bears the costs of teachers but the local promotion is in the hands of the partner.

And … revenues? The partner University charges the participant the final price in local currency. The final local price is equal to the base price plus a margin. The final local price should never be higher than the one that UPV can bid directly in their own Lifelong Learning offer. In these moments, the UPV is developing this model in Colombia with 4 institutions (the Javeriana Pontifical University in Bogotá was the pioneer in this project) and with 2 more in Mexico. Chile, Brazil, Peru, Honduras and Costa Rica are the next steps.

The development of this entire course requires tools that allow for recording sessions and sharing session in synchronous. Adobe Connect is the SW option chosen by the UPV. It is necessary to adapt the classroom to allow not only face-to-face classroom but also synchrony in distance or asynchrony. These classrooms must have cameras (at least 2), projector and with a sound system with multiple inputs, covering the entire classroom and the teacher microphone at least.

7 Summary

Collaboration between universities is changing with new technological developments. E-learning offers to students the option of following very specialized courses with trainer experts in a specific field. Experience in the topic, practice in on-line training and expertise gained with the collaborations with international companies will benefit the students with a high quality training available at any place and date. New universities with interest in the collaboration in on-line specialized trainings are welcome. The collaboration born with the aim of being bidirectional, so UPV can offer in the future on-line courses from other universities that are not offered by UPV professors, giving new opportunities to the alumni in a global market. The economic model below the collaboration follows a win/win approach that is now looking for new partners after the first experiences performed in the last year with universities from different countries.

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Development of work placements in the School of Building Engineering at the Universitat Politècnica de València: Financial crisis and compulsory work placements.

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Conference Key Areas: Bologna Process & New European Curricula, World financial crisis and EE, Employability across borders: placements, companies, economic crisis, curriculum.

Abstract

The first work placement agreement signed at the Universitat Politècnica de València (UPV) took place in the School of Building Engineering (ETSIE) during the academic year 1982/1983. In this communication we analyze the development of work placements in ETSIE available since the computerized agreements until today, with particular emphasis on the peak of the construction area, the implementation of the Bologna Treaty and the impact of the financial crisis. Last but not least, we will address the work placements both in the context of the Bachelor's Degree in Technical Architecture and in that of the Master's Degree in Building Constructions. Furthermore, we will focus on the wide range of curricular and extra-curricular choice of placements available to the students.

1 Introduction

ETSIE remains the indisputable leading force in work placements in within the context of the UPV. It was the first school in the UPV that identified the need to set in place a cooperation agreement between university and enterprise. In ETSIE we always acknowledged work placements as one of the key elements in the whole of the students' education, being the best way to get a feeling of the actual job and implement the knowledge they have acquired during their years of schooling.

The result of these placements was such, that the upcoming curriculum of Bachelor's Degree In Technical Architecture would foresee to include work placements as a major, following the rules of the Spanish legislation *Real Decreto 29th October 1393/2007* on the organization of official university studies, corresponding the Framework of the European Higher Education.

However the impact of the financial crisis on the construction boom throughout these last years has forced the school to reconsider this decision.

2 Work placements in the new curricula

The implementation of the Framework of the European Higher Education has brought major changes in the context of all European Universities. UPV, and more specifically, ETSIE was one of the schools who first applied the agreement throughout the creation on 2009/2010 of the Bachelor's Degree in Technical Architecture and the Master's Degree in Building Constructions.

Let us go now through the specifics of work placements in these two degrees, product of the Bologna declaration.

2.1 Classification of work placements

The diagram below shows the two sorts of work placements:

- **Curricular**
  - Required: 6 ECTS
  - Elective: 12 ECTS (Concentration block or Minor)
- **Extra-curricular**
  - Final Project
  - Voluntary

Curricular work placements are considered academic activities, and are reflected as such in the transcript of records.

Extra-curricular work placements are those carried on voluntarily and despite they serve the same purpose they are not considered a forming part of the studies program. However, they can be taken into account in the European Transcript of Records.

It is stated that in the Bachelor's Degree in Technical Architecture students must pass compulsorily 6 ECTS of the work placement subject area. Given the current value 1 ECTS = 25 business hours, every student is required to compulsorily complete an external curricular placement of 150 hours.

Students can also opt to complete the concentration block throughout the realization of a work placement. These optional curricular work placements are worth 12 ECTS, i.e. 300 business hours.

Last, students can choose to go for extra-curricular work placements, either to acquire some working experience, either as valid working hours that will be accounted when completing their Final project (FP).

There are no curricular work placements in the context of the Master's Degree in Building Constructions.

2.2. Restrictions

Some restrictions are to be applied in within the new legal framework of work placements.

Given the case of maximum dedication of students in work placements, when the Bachelor's Degree in Technical Architecture covers 240 ECTS and the Master's Degree in Building Constructions 72 ECTS:

Highest nr. of hours in work placements	Type of placement	
	CURRICULAR	EXTRA-CURRICULAR
Weekly	40	40
Per academic year	Upon studies program [1]	750
During the studies	Upon studies program [1]	30% of Degree [2]

Table 1: Maximum dedication of students in placements

1 The Bachelor's Degree in Technical Architecture studies program stands for a maximum of 18 ECTS (450 hours) for curricular placements (6 compulsory and 12 optional). There are no curricular placements in the program of Master's Degree in Building Constructions.

2 Bachelor's Degree in Technical Architecture ____ 1800 hours
Master's Degree in Building Constructions ____ 540 hours

(1 ECTS = 25 business hours)

Therefore, a Bachelor's Degree student could complete in total and per academic year 450 curricular and 750 extra-curricular hours, and during all the studies, 450 curricular and 1800 extra-curricular hours. The total number of hours facilitates a stronger understanding between the future graduates and adds value to the hands-off education of these students in a working environment.

In the case of Master's Degree, extra-curricular work placements are however limited to 540 hours, therefore practical training is more limited.

3 Development of Work Placement

In order to explain the development of work placements, we should first consider the development of the student population in ETSIE.

3.1 Student population in ETSIE

The School of Building Engineering was created in the academic year 1971-1972. This was the first time the discipline of Technical Architecture was taught upon the 1969 studies program.

Nowadays it is known by the acronym ETSIE (in Spanish, *Escuela Técnica Superior de Ingeniería de Edificación*) and among its disciplines we can find the Bachelor's Degree in Technical Architecture and the Master's Degree in Building Constructions. The studies on Technical Architecture are about to disappear as they belong to the old program.

Let us first take a look at the number of new students enrolled in ETSIE from its beginnings:

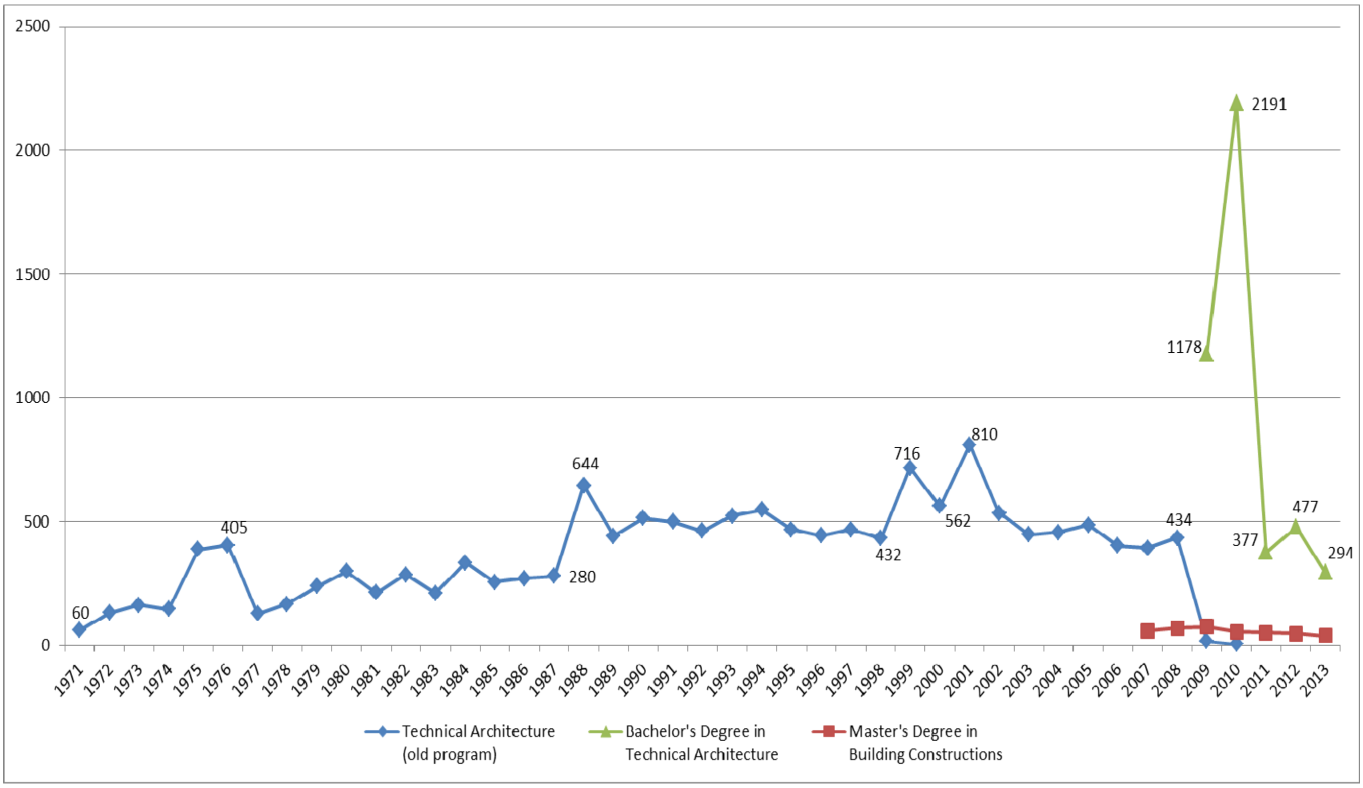

Diagram 1: New students

As shown, during the first year 60 new students enrolled in the studies of Technical Architecture. In this diagram we observe several peaks up to the year 2001, where the number of new students rose up to 810 in Technical Architecture. In the Bachelor's Degree, we notice the first two values are very high. This is due to the fact that quite a few students from the old plan moved into the new one and also there were many people who already had the old Degree that enrolled in the new Bachelor's Degree.

Regarding the Master's Degree values, a decrease in the number of new inscriptions has been noticed.

Let us now take a look at the total number of students enrolled in ETSIE from its beginnings.

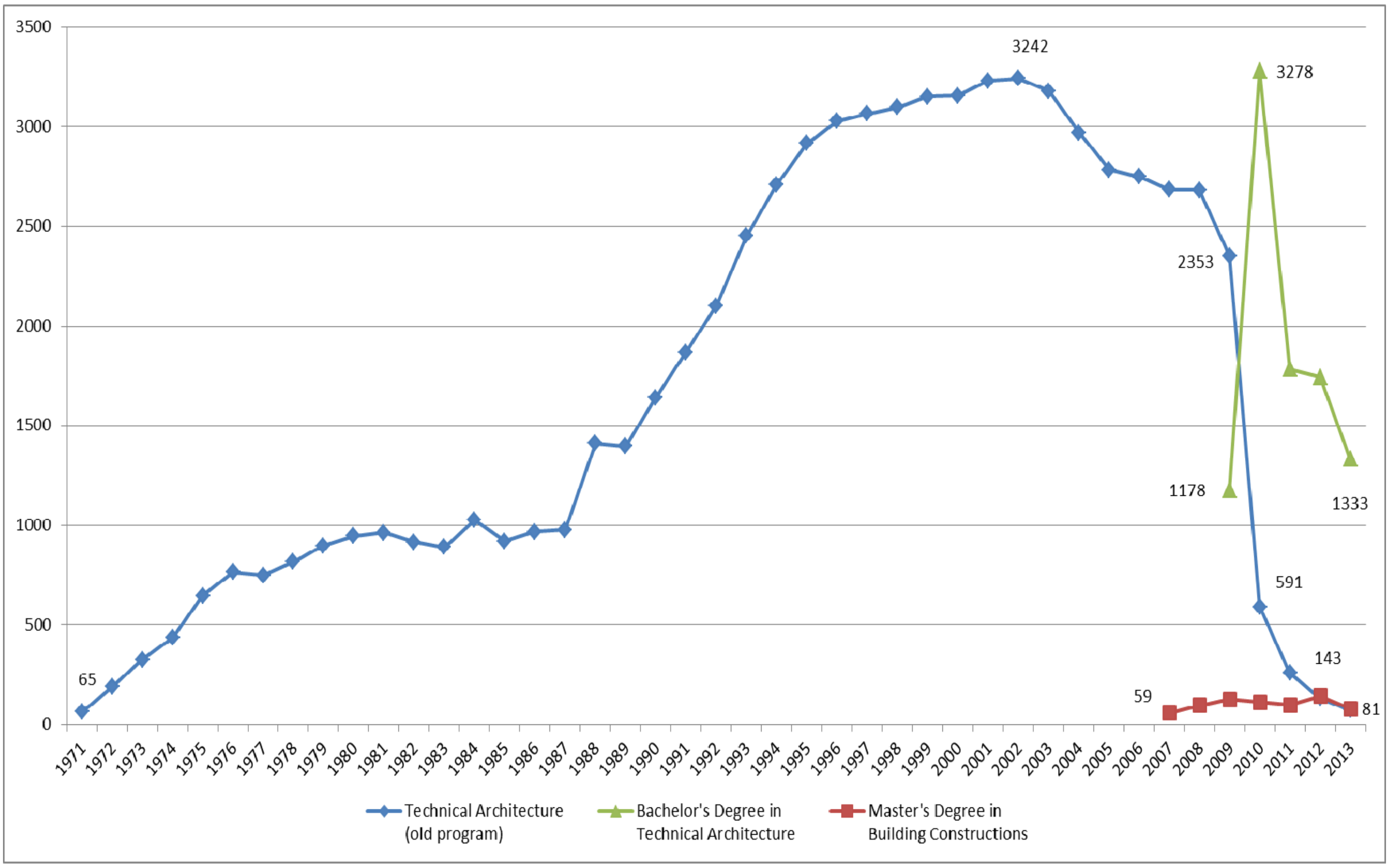

Diagram 2: Number of students enrolled in ETSIE

As shown in this diagram, during the first year there were 65 students enrolled in the studies of Technical Architecture. This number was growing steadily until the highest peak, during the years 1996-2003, counting over 3000 students. From this moment on, the amount of students decreased, but bear in mind that the Bachelor's Degree was from the academic year 2009 open for enrolment. In 2009, counting both the students enrolled in the old plan and those from the new plan, we obtain a total of 3531 enrolled students. This number goes up during 2010, with a total of 3869 students between both degrees.

However, at that time the crisis in the building sector hit hard and drove to a decrease in the number of new students enrolled, while the number of old students remained high, as shown in diagram 1. In consequence, we observe than the number of students in ETSIE dropped by 50% in the year 2013.

We observe a moderate evolution in the numbers around the Master's Degree, but also a slight decrease.

Let us finally have an overview the number of graduates throughout time.

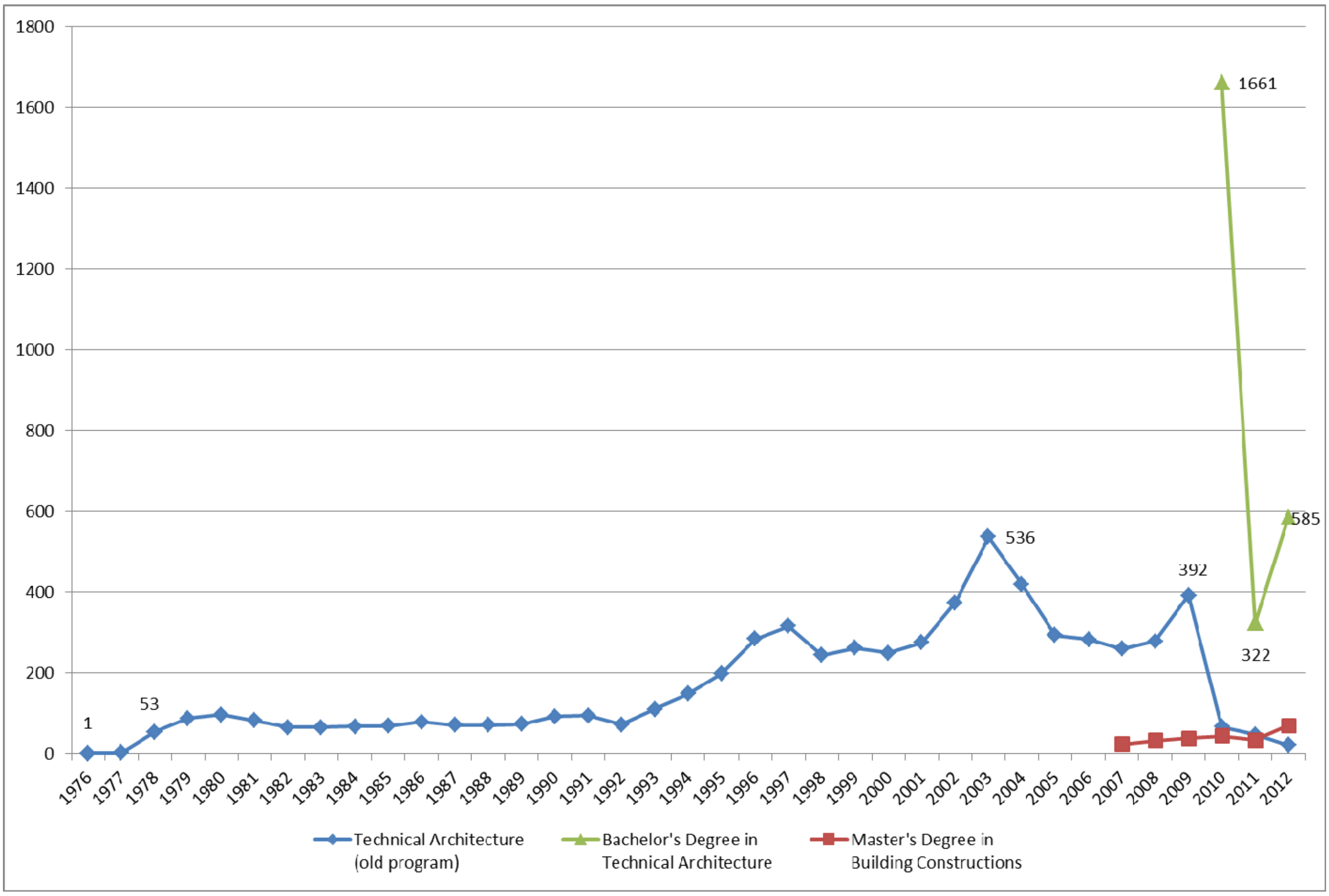

Diagram 3: Graduate students

Firstly, and related to Technical Architecture, let us comment on two main peaks; the first one in 2003 showing 536 graduates; the second one, 2009 with 392. The first peak is caused directly for a high rate of new inscriptions between the years 1996 – 2003, giving a rate of over 3000 a year as shown in diagram 2. The 392 new graduates from 2009 are resulted from the implementation of the new Bachelor's Degree: it is understood students streamlined when the old plan was about to be revoked.

Secondly, and related to the Bachelor's Degree, we observe a high number of graduates in 2010, product of the migration of most of students from the old plan into the new Bachelor's Degree in Technical Architecture. Last year 585 students were graduated.

3.2 Work placements in ETSIE

Despite the fact that the first agreement was signed during the academic year 1982/1983, we only have computerized data from a decade later. Let us then proceed to analyze the stats from that point on.

Let us take a look at the stats on work placements completed by ETSIE students year by year.

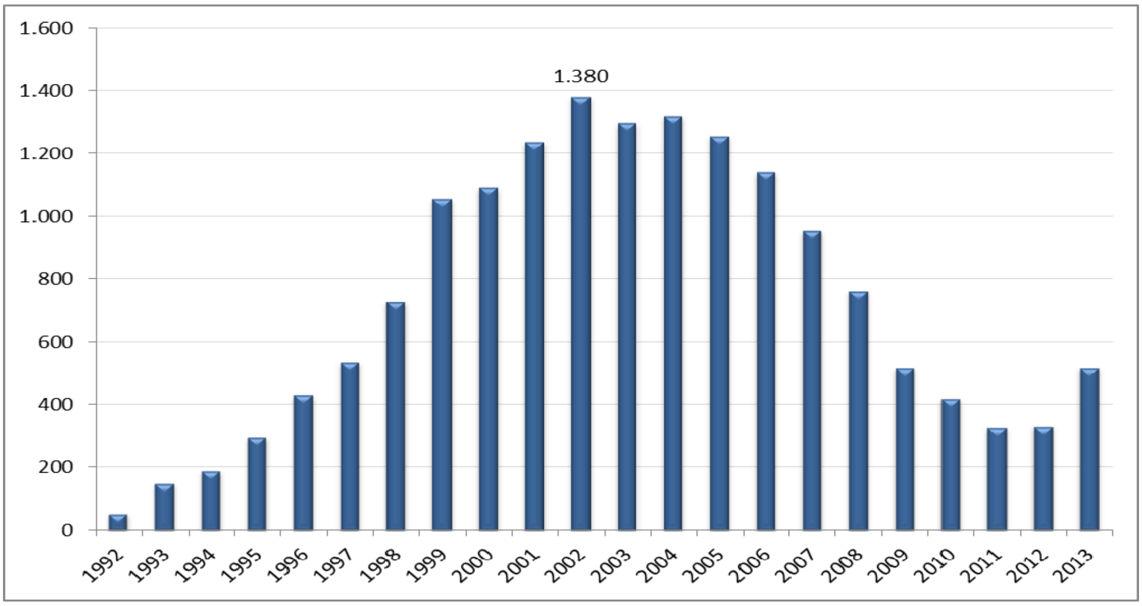

Diagram 4: Number of work placements

We notice the highest peak in 2002, with the highest number of processed work placements both in ETSIE as in UPV.

From 2007 on, there is a noticeable decrease in the number of placements, finding the lowest number of processed placements in 2011. We find a tiny increase from 2013 on, but this is to be analyzed separately.

As shown in the following table, most placements in ETSIE have received financial remuneration, i.e. economic compensation.

Year	% Remunerated Placements	% Non-remunerated Placements
1992	96,15%	3,85%
1993	94,59%	5,41%
1994	94,70%	5,30%
1995	96,40%	3,60%
1996	93,67%	6,33%
1997	89,33%	10,67%
1998	86,16%	13,84%
1999	96,46%	3,54%
2000	97,32%	2,68%
2001	99,90%	0,10%
2002	100,00%	0,00%
2003	100,00%	0,00%
2004	97,91%	2,09%
2005	99,41%	0,59%
2006	100,00%	0,00%
2007	100,00%	0,00%
2008	100,00%	0,00%
2009	99,76%	0,24%

2010	100,00%	0,00%
2011	100,00%	0,00%
2012	100,00%	0,00%
2013	44,91%	55,09%

Table 2: Average of remunerate / non-remunerate placements

Except, during the academic year 2012/2013, with a high number of students enrolled in compulsory work placements needed to be placed, the board of ETSIE was forced to make a vital decision.

Thus, although the regulation establishing the rules on practices in companies and institutions of UPV students indicates that all work placements that students carry out, will generally receive an economic compensation, the School Board agreed unanimously and exceptionally, to allow students enrolled in compulsory work placements, to carry out them without any economic compensation. And this is mainly the reason why the number of work placements in 2013 shows an increase over the previous year, yet the percentage of remunerated work placements in the same year is less than 50%.

It should be stated that the School Board has extended this decision during the academic year 2013/2014 but it is foreseen it will be revoked as soon as the financial and social situation in Spain improves.

Regarding the financial side of these placements, we may point out the funding per working hour has decreased, although not significantly.

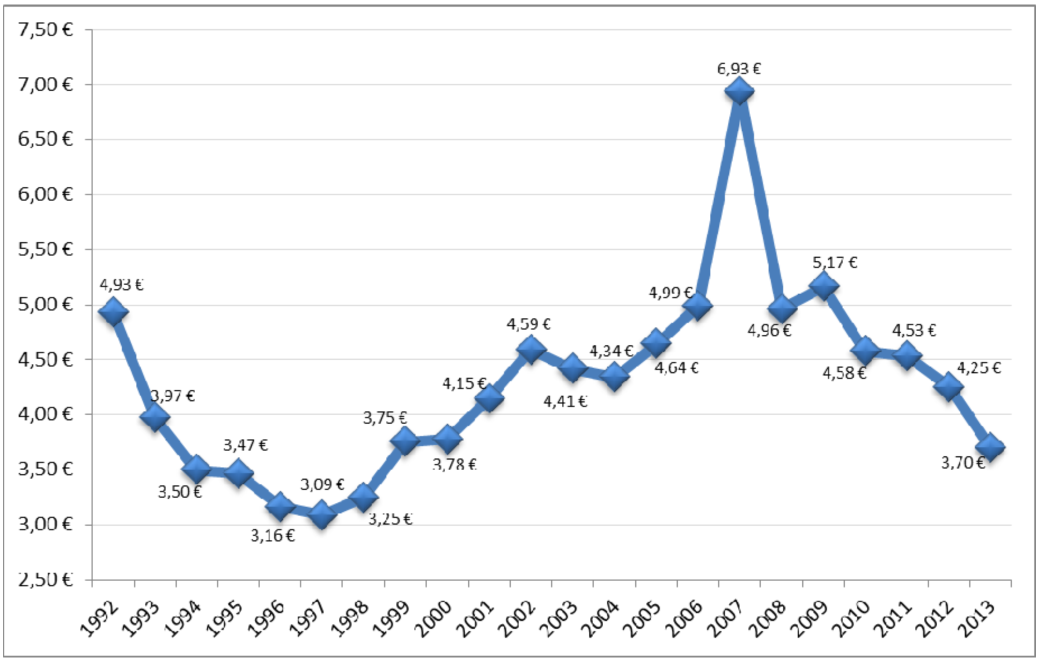

Diagram 5: Rate €/h

Comparing the stats we notice the rate €/h is 3, 70€/h in 2013, and it would be more or less the same in 2000. While back in 1997 the rate was stated as 3, 09 €/h. It is noticeable that the cost of living is totally different.

On the following diagram we are to compare the ratio students/placements completed, given the fact that the very same student can complete a diverse amount of placements in one or more companies.

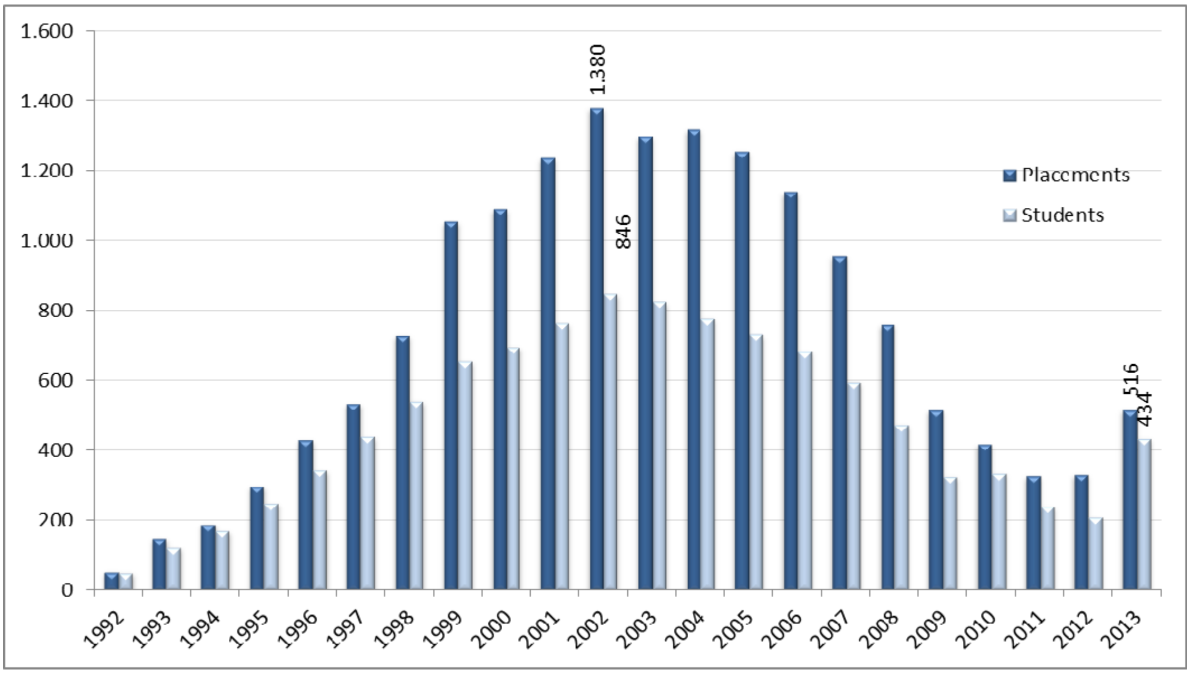

Diagram 6: Number of work placements v students

As shown, the year most work placements were performed, was also the year that most students carried them out. However, even though the number of placement decrease is more noticeable, the decrease in number of students is less so. Therefore, work placements decrease, but the number of students completing these placements increases.

Another important factor we should go through is the number of companies involved.

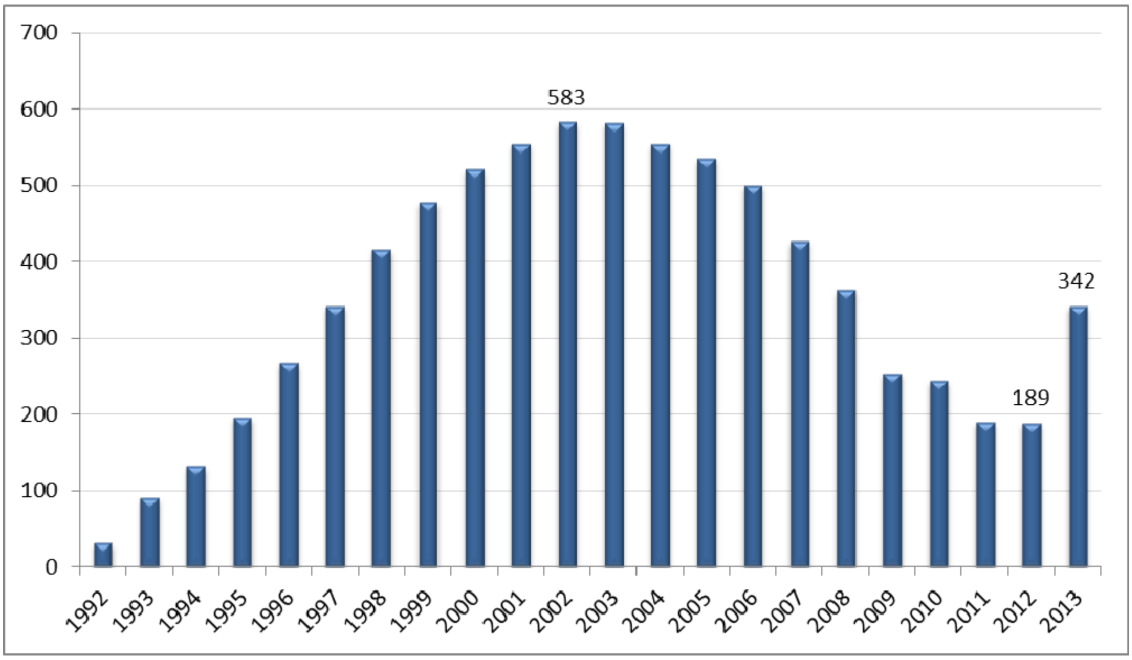

Diagram 7: Number of companies

We notice in these stats that the years with more placements coincide with the years with more collaborators. And similar to the number of work placements and the number of students carrying them out, we see a rise in 2013, a product from compulsory work placements.

Last in this point, we are about to go through the number of vacancies that have been processed in the school, pointing that we only have computerized data since the year 2003.

Let us then observe the following stats:

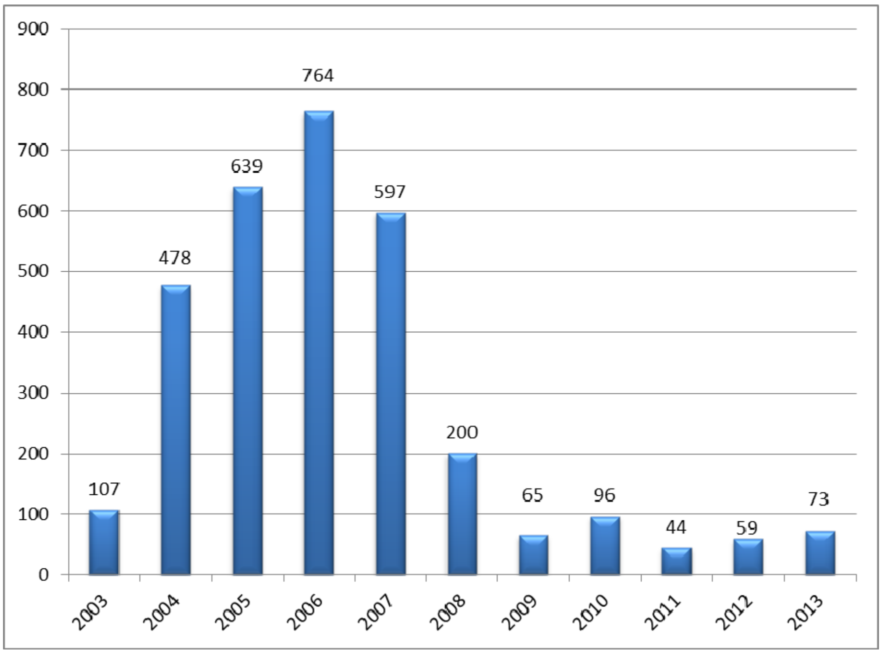

Diagram 8: Number of vacancies offered

As you can see, 2006 was the year that most vacancies were offered in ETSIE. And considering the ratio of number of students enrolled by position offered, we notice the following:

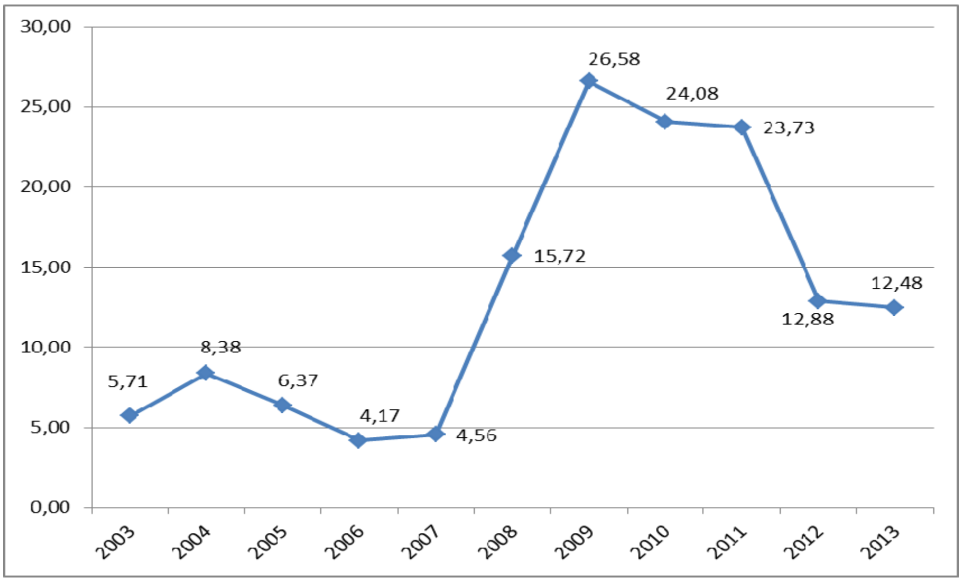

Diagram 9: Ratio enrolled students / vacancies offered

Therefore, while in the year 2006 there was a work placement vacancy for every 4 candidates, since the construction dropped so massively, in 2009 there were 26 candidates for every single vacancy.

Finally, let us check out the different work placements that have been registered since the Bachelor's Degree in Technical Architecture was implemented.

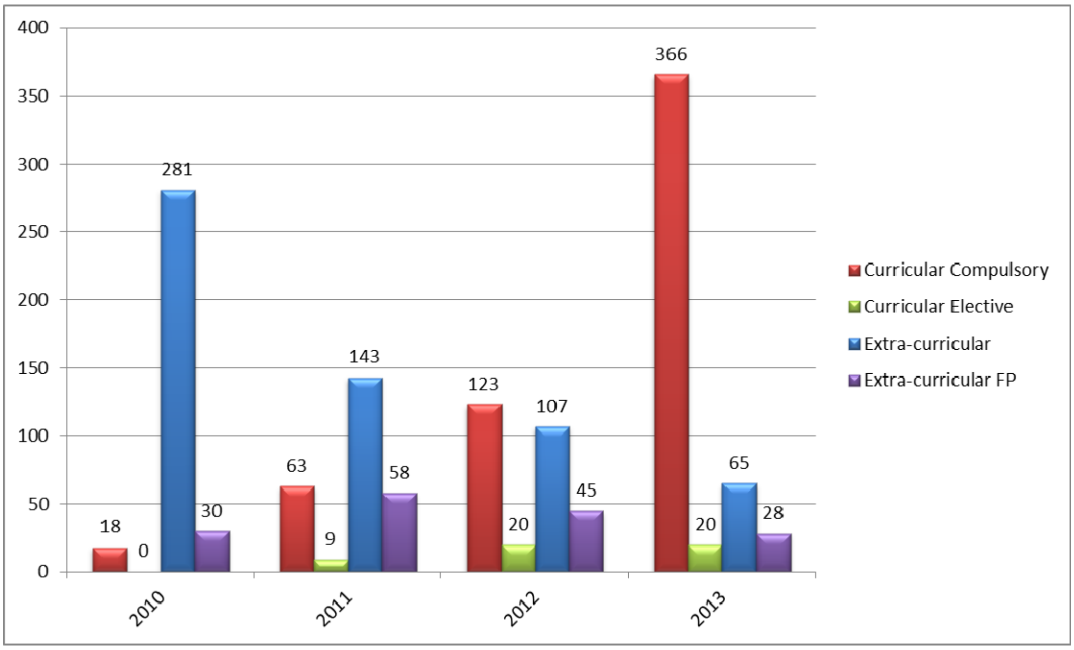

Diagram 10: Work placement types

As shown in the diagram, the number of compulsory work placements has been rising with time. This is due to the fact that compulsory work placements are fixed in the last semester of the last year. Being so, most of students who started their schooling in 2009 were in the last semester of their studies in 2013, and therefore completed their compulsory placement around that time.

Extra-curricular or voluntary placements prove against that trend, having decreased through the years. This is the clear consequence of both, the financial crisis of the building sector and of the new rule present in the Bachelor's Degree studies stating compulsory attendance to lectures. For these reasons, although students are interested in carrying on voluntary work placements, it is hard for them to either the balance lecture attendance with placements, or finding companies where they can complete their placements in.

Regarding work placements aimed in order to complete the Final Project, we observe as well a slight decrease, while elective work placements stay at similar levels.

4 Summary

The main conclusion after having analyzed all data is that the evolution of work placements is closely related with the precarious situation of the building sector in Spain. The greatest decrease in the number of work placements and the most important increase of unemployment are both directly related with the precarious momentum of the building sector. A great number of the companies that used to be collaborate with ETSIE found themselves in Redundancy Dismissal Procedures, so some of them would stop offering work placements and many others have to close their business.

On the other hand we can also conclude that in a sector where the financial crisis is so charged with a curriculum where there are compulsory work placements, the school has been forced to reconsider the economic compensation associated to work placements. And for this reason compulsory work placements can be carried out without financial remuneration.

Though we must high-light that these are the only work placements allowed without economic compensation (total 150 hours). If the company wants the same student to continue with more work placements, these have to be compulsorily paid.

Therefore the adopted solution may not be the optimal one, but these compulsory work placements may serve to get in touch with the company, and if the relationship is really successful and the company wants the student to continue, a minimum economic compensation should be given.

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SUSCOMTEC: a successful case of Intensive Program

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Abstract

A review of the SUSCOMTEC Intensive Program is made in this paper, from the beginning of the proposal to the end and with the start of the new proposal.

The objective of this paper is to summarize the experience of 3 years of an Intensive Program (IP) coordinate by the Telecommunication School (ETSIT) at Universidad Politécnica de Valencia (UPV).

The paper will describe how SUSCOMTEC was created and how the three editions were developed, including some tips for the preparation of an event of these characteristics that includes about 60 students and 20 lecturers.

1 Introduction

One of the main points in the last ERASMUS Program (previous to the ERASMUS+ that started in 2014) were the Intensive Programs, in order to enforce the relationships between the EU universities and their lecturers and students, but not in a long time course but in short time seminars.

The UPV, and the Telecommunications School was working, with several partners, in similar workshops and then, with the help of the IPs, these relationship was even better and the participation of students was increased as well as the duration to create the IP called SUSCOMTEC.

The paper will deal about this IP, how it was created and developed. And, finally, an overview of the next proposal will be given.

2 Intensive Program (IP)

2.1 What is it?

An Intensive Program is a short course curriculum that lasts from ten days up to six weeks. The participants, teachers and academics, should come from at least three different countries and at least one of them should be member of EU. An IP theme should be innovative and not contained within the undergraduate course curriculum of the partner Institutions. The appropriate number of ECTS credits is awarded according to the student workload.

Then, the Erasmus intensive Program allows undergraduate students from different European countries to meet and to learn and to discuss about a topic. It is therefore, a unique opportunity to compare points of view and ways of thinking, which allows them to gain a first academic experience at a European level.

2.2 The partners

The History of SUSCOMTEC started around 2004 when a group of universities joined to celebrate the so call European Students Meeting (ESM) with EU financing total or partially The first two ESMs were located in Gyor (2004) and in Saint Petersburg (2005). Afterwards, ESMs in Leipzig (“Next Generations Network” (2006)), Lille (“Optical Telecommunications and Mobile Telecommunications” (2007)) and Zilina (“Optical Telecommunications and Mobile Telecommunications” (2008)) took place.

Finally, the programme was implemented without EU grant in Sofia (“Optical Telecommunications” (2009)) and in Gyor (“Telecommunication and ICT management” (2010)), while in 2011 a shortened student programme was implemented in Opatija (Croatia).

By then, and once the partnership group was created, consisting of 15 universities, the seed for SUSCOMTEC was ready.

But, what is SUSCOMTEC?. SUSCOMTEC is the acronym of the IP proposal whose whole name is “*INTERCULTURAL KNOWLEDGE TRANSFER IN ENGINEERING FOR A SUSTAINABLE GLOBAL ICT COMMUNITY*”

The partners of SUSCOMTEC were:

1) University of Zagreb, in Croatia
2) HfT Leipzig, in Germany
3) University of Debrecen, in Hungary
4) Technical University of Košice, in Slovakia
5) University P.J.Safarik, in Košice (Slovakia)
6) University of Oradea, in Romania
7) HCTP, Sofia, in Bulgaria
8) Telecom Bretagne in Brest (France)
9) Telecom Lille in France
10) Dublin Institute of Technology in Ireland
11) Széchnyi István University, in Györ (Hungary)
12) University of Zilina, in Slovakia
13) Universidad Politécnica de Valencia, in Spain
14) Technical University of Sofia in Bulgaria
15) St. Petersburg State University of Telecommunications in Russia

Due to the large number of partners, a steering committee is needed in order to facilitate the working process and the written of the proposal, to guarantee the success of the project and to avoid long and improductive meetings. Of course, all the agreements achieved in the steering committee were addressed to all the partners for their knowledge and to have the feedback with their valuable comments.

The steering committee consisted of 3 universities: UPV, in Valencia (Spain), that was the university that was going to coordinate the IP, and Széchnyi István (in Gyor, Hungary) University and HfT Leipzig (in Leipzig, Germany) as the ones that organized and coordinated the last ESM.

2.3 The proposal

The first step in written a proposal is to look for a topic, and for this one the main topic was SUSTAINABILITY, because it is one of the most important topics nowadays, especially in crisis time and to guarantee the future for the next generations.

Additionally, and because all the faculties participating (the 15 partner universities) were Telecommunication Faculties, the selected topic was Sustainability in Telecommunications, or to be more precise, Sustainability in ICT. This is the root of the formal name "*INTERCULTURAL KNOWLEDGE TRANSFER IN ENGINEERING FOR A SUSTAINABLE GLOBAL ICT COMMUNITY*".

A good proposal must justify the selected topic in the frame of the EU policy. And then the activities developed must take profit the best expertizes of each partner, as well as the possibilities that the host university in each edition of the IP gives.

The Steering Committee decided to host the event in 3 different places each year, starting in 2012 in Valencia (Spain), then in Debrecen (Hungary) in 2013 and, finally, in Sofia (Bulgaria) in 2014. The decision is based on criteria of selecting different regions of the EU, from the very west in Spain, then in the Central Europe in Hungary and, finally, in the new EU countries, to give a big spectrum of possibilities to the students participating in the event.

To success in the IP proposal is important, as mentioned, to emphasize the expertize of each partner in the frame of the selected topic. And from this a good schedule for the 2 weeks event will be programmed. In the SUSCOMTEC case, expertizes are as follow:

1) University of Zagreb main expertise: experts in innovation based on ICT and technology policy.

2) HfT Leipzig main expertise: experts in intellectual property and sustainability aspects of ICT.

3) University of Debrecen experts in e-learning and ICT for innovative location-based services.

4) Technical University of Košice main expertise: experts in ICT for mobile users.

5) University P.J.Safarik, in Košice (Slovakia)

6) University of Oradea main expertise: experts in sustainable regional development policies and ICT strategies in the field of EU.

7) HCTP, Sofia main expertise: experts in business aspect of ICT systems.

8) Telecom Bretagne main expertise: experts in intercultural communication and ethical perspective of technology-driven innovation.

9) Telecom Lille main expertise: expert in multicultural relationships

10) Dublin Institute of Technology main expertise: experts in power consumtion of ICT systems.

11) Széchnyi István University main expertise: experts in ICT for smart transport and enterpreneurship based on ICT.

12) University of Zilina main expertise: experts in smart transport and manufacturing as well as tecnology transfer in ICT sector.

13) Universidad Politécnica de Valencia main expertise: experts in transversal skills teaching for engineers and sustainable ICT.

14) Technical University of Sofia main expertise: experts in language teaching for engineers and new generation ICT systems.

15) St. Petersburg State University of Telecommunications experts in multimedia aspects of ICT.

2.4 Schedule

The schedule of this kind of events must include different activities and not only teaching technical topics.

It is important to note that, even all the students participating in the event are master students about to finish their studies in Telecommunications all of them have different specialties and also different backgrounds. And, the more different thing is their nationality and then their customs, languages, etc.

To cover all these differences, the schedule must include intercultural classes and multicultural activities, as well as general lessons about the main topics in Telecommunications.

And, because each year the event is celebrated in a different city and different country, it is also important to link the event with local Telecommunication companies or activities.

Then in each city different visits to companies related with Telecommunications took place, and also some people from the industry were invited to offer the local point of view of the Telecommunication market and applications. Connected with this, also a parallel seminar in entrepreneurship was offered in Valencia to the students to improve their skills not only in Telecommunication topics but also in their possibilities in the future once they finish their master studies.

Finally, and to complete the activities not only technical but also of leisure, and taking profit of the weekend located in the middle of the 2 weeks event, cultural visits and activities were designed for the students and lecturers attending the IP.

2.5 Previous activities

Finally, and before giving the figures that summarize the three years of SUSCOMTEC, an important thing connected with the IP is the previous work.

It is quite clear that 2 weeks, with so many activities, described in the previous point, is not enough to go deep to any specific topic. So, even that this is not so important, as previously stated, a workgroup was proposed by the lecturers. This workgroup started about 4 weeks before the event took place in the host university (Valencia, Debrecen and Sofia respectively) and it was the first opportunity for the students to meet via facebook or other social networks.

2.6 Numbers

To finish the description of the IP activities and organization, it is interesting to show the figures that were involved in the IP each year. This is shown in the following tables:

Table 1. Figures of the 2012 event in Valencia (Spain)

Students	Lecturers	Invited lecturers (local university host and companies)	Aprox. Budget
60	19	5	38000€

Table 2. Figures of the 2013 event in Debrecen (Hungary)

Students	Lecturers	Invited lecturers (local university host and companies)	Aprox. Budget
49	19	5	28000€

Table 3. Figures of the 2014 event in Sofia (Bulgaria)

Students	Lecturers	Invited lecturers (local university host and companies)	Aprox. Budget
40	15	5	26000€

3 Next future

3.1 ERASMUS+

The EU has made lots of changes in the ERASMUS program for the next 6 years, until 2020. The new frame program is called ERASMUS+ [1] and tries to simplify and to unify the number of learning activities that were established in the previous frame programs.

Obviously the IP program is included in the ERASMUS+ program, but not isolated but included in the Key Action 2, together with other programs related with short term learning activities.

3.2 The future of SUSCOMTEC

As a natural next step in the SUSCOMTEC activities, the SUSCOMTEC partners are applying for a new EU project in the frame of ERASMUS+, and the main topic now is INNOVATION, one of the new key words that the EU is addressing for the 2020 objective, not only in learning or teaching activities but also in the research and developing activities.

Then, the new project is called "*Innovative ICT Solutions for the Societal Challenges*" and the acronym is INNOSOC, but this is another history in the partner group and this story is just starting now.

4 Summary

This paper summarized how the IP SUSCOMTEC was created from a group of university partners that started their activity in 2004 and finished in a successful IP program called SUSCOMTEC. And also described the main things to be considered when this short term activities are proposed.

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[1] http://ec.europa.eu/programmes/erasmus-plus/index_en.htm

Determination of interdisciplinary nodes that enhance the humanistic education of undergraduates at the University of Sancti Spiritus as a way of improving the Teaching in Higher Education

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Abstract

In interdisciplinary research nodes that enhance the humanistic education of undergraduates at the University of Sancti Spiritus from teaching, raising the general requirements, individual, unique and procedures since its release in the process of teaching and learning were determined different subjects in higher education. As a result of the institutional research project for Improvement of Teaching the New Cuban University, was designed and implemented reflecting alternative teaching how to proceed with the teacher from the class content, the result was expressed in a greater understanding of different knowledge related to the history of thought in literature, music and the arts as forms of art as well as works and the most important authors of the local, national and universal culture; in raising the capacity to appreciate a work of art, shown in aesthetic taste, creativity, the use of the skills in the expression of accumulated habits of society, the transformation occurred with the modes of action and its relationship to the process of communication; all of which could be achieved from increased motivation.

1 Introduction

Universities as social institutions responsible for preparing high-level human resources of a nation, can not, and should, be unrelated to the urgent need to transform social reality. This requires more and more, and with greater success, which articulate with higher education development projections in each of the organizational levels of a nation and strengthen humanistic training of these professionals.

In the Inaugural Conference of the Eighth Congress of Higher Education, developed in Havana, the then Minister Miguel Diaz-Canel Bermúdez, I said " The university has to be understood as a political and intellectual environment crucial for the consolidation and strengthening human values and civic responsibility as the largest and leading provider of learning opportunities and generating new knowledge at the highest scientific level, able to increase the social impact of the activity of research-development- innovation and extension rushing linked to society, learning from it and by rising to influence its development and transformation... "(2012 : 10-11).

As the country's political will is expressed in the Guidelines of the Economic and Social Policy, "continue to promote the development of social and humanistic research on priority issues in the life of society" (137) and "continue advancing in raising the quality and rigor of the educational process, prioritize the permanent improvement, enhancement and care of teachers (...) "(145).

Considering the above aspects, the institutional research project for Improvement of Teaching the New Cuban University, coordinated by Dra.C. Maria Elena Castro Rodriguez, professor at the Center for Studies in Science Education at the University of Sancti Spiritus " José Martí Pérez " (Uniss), aims to improve the Teaching with an emphasis on the dynamics of teaching and learning from subjects of different university courses that are taught at the university and ensure social transformation with the conception that identifies and characterizes the current Cuban process in which all stakeholders are committed to the community and higher education institutions.

The momentous changes that have taken place in today's world require a review of the quality of the teaching and learning taking place in classrooms today. In the preceding Uniss were obtained research results, but there are still shortcomings that require scientific attention. Keep in mind that both teaching and learning are complex, multifactorial and varied interactions which have developed as a center for human beings, so that conditions help or hinder the process and the result, that the teaching aspect and dynamics play an essential role.

A possible solution to this weakness is the development of humanistic training of undergraduates at the University of Sancti Spiritus from the teaching and learning of electives in the curriculum of the races of Technical Sciences and Agricultural Sciences, which must be an inclusive manner. It was based on the knowledge of different types of knowledge related to the history of thought, each of the forms of art as well as works and the most important authors of the local, national and universal culture; the ability to assess, in the developed aesthetic taste ; in the development of creativity, skills, habits accumulated by society, modes of action and its relation to the process of communication.

The teaching-learning process that is assumed to be 'the time of learning process where the joint activity of teacher and students reach a higher level of systematicity, intentionality and directionality, is the process of teaching and learning in its various organizational forms and especially in the class, as this is where the action is structured teacher training on certain principles that allow it to achieve goals previously established programs, and contribute to the more general raised in the educational process in its entirety '(Montero Rico, Martín-Santos and Viaña Cuervo, 2003:8).

The objective is to disseminate the scientific community the experience gained with the design of an educational alternative that enhances the development of humanistic training of undergraduate freshmen races of Technical Sciences and Agricultural Sciences, drawing sustenance determining interdisciplinary nodes from the class.

Scientific research in different scientific research methods were used. Teaching alternative was assumed as "a scientific result that solves a practical problem of the teaching - learning replacing other result being applied and is a product of an educational research... " (Ruiz Pérez, 2009:5)

2 DEVELOPMENT

In the design and implementation of alternative teaching the essential elements that must be present in the development of humanistic training of undergraduate freshmen races of Technical Sciences and Agricultural Sciences were taken into account:

□The characterization of the current situation of the process status of humanistic education that students have undergraduate freshmen races of Technical Sciences and Agricultural Sciences. The application of different methods, techniques and tools which allow to clearly identify the strengths and weaknesses that really deserve higher priority in the proposal that is designed to achieve the humanistic education that are desired.

□ The alternative design of the teaching based on the determination of interdisciplinary nodes converge between subjects and integrate from the teaching-learning process, from conducting methodological work as a means of self-preparation Teacher manner that ensures the focus is expected.

Implementation of alternative teaching from class.□

The final evaluation of the results from the use of different techniques to obtain the necessary results.□

Organization educational alternative.

The teaching is organized alternative given the constant movement, the development of educational activities and professional teaching from concrete historical - University of Sancti Spiritus "José Martí Pérez", which allowed conditions to guide and direct the changes that are accurate for the proper performance of his duties as an educational institution that assumes critical challenges in terms of comprehensive professional training from the contradictions that may arise as a development in the educational activity.

The proposal was based on alternative teaching general requirements:

Scientific nature: based on Martí's concept,□from conceiving the contents of each subject as provided in the educational policy of the Cuban Revolution.

□A leading, developer and active learning by students: allows you to exchange ideas, views, opinions, make decisions and accept. Becomes the protagonist of their own learning from the systematization achieved as a result of their own practice from the teaching-learning process.

□A cooperative and collaborative learning: allows the participation of all members of the group in finding solutions for a task, the exchange of knowledge acquired through different subjects and facilitates knowing the thinking of each of the members. However learning is individual, where everyone is involved in the task, be aware of how learning takes place and the metacognitive process to achieve the desired development of humanistic education.

□The unit of education and instruction of students is precisely to give to know the existing general culture and instill the knowledge, attitudes, accumulated by society, modes of action and spiritual values and habits models (read rules) of conduct allowed her to expand the universe of cultural information and, in turn, develop their creative potential, sensitivity and taste for beauty so that there is a transformation.

A contextualized learning : takes into account the actual context□and specific situations in which learners operate, so the teacher takes into account the potential, needs, motivations, problems and interests of students.

The interdisciplinary humanistic education that enhances the different electives from the curriculum.□

Particular requirements focus on the determination of interdisciplinary nodes and unique requirements in the teaching of each subject at this level.

Subsequently, as a result of various investigations Sciences Education tutored by members of the project mentioned research; the organization of the content in each of the subjects was designed according to race, curriculum and thematic unity. Components involved in the process of teaching and learning: personal (students, teachers) and custom (target, content, methods, teaching aids, evaluation and organizational forms).

The process of humanistic training ran from the use of novel methods from the educational point of view. The novelty of these is that:

They promote interdisciplinary, which allows for greater□assimilation of knowledge from different knowledge related, raising the capacity to appreciate a work of art, the development of skills and communicative competence.

They are based on the student's motivation towards art and help raise permanently.□

They promote intellectual development and aesthetic sensibility of the students.□

Ensure the efficient use of different teaching aids.□

Conducting a greater number of extension activities, which favors□the link with the socio-cultural institutions of the territory.

The interdisciplinary approach to teaching alternative proposal of the professional model of each career and curriculum design; focuses on the determination of interdisciplinary nodes. The following diagram shows the sequence of the proposed educational alternative.

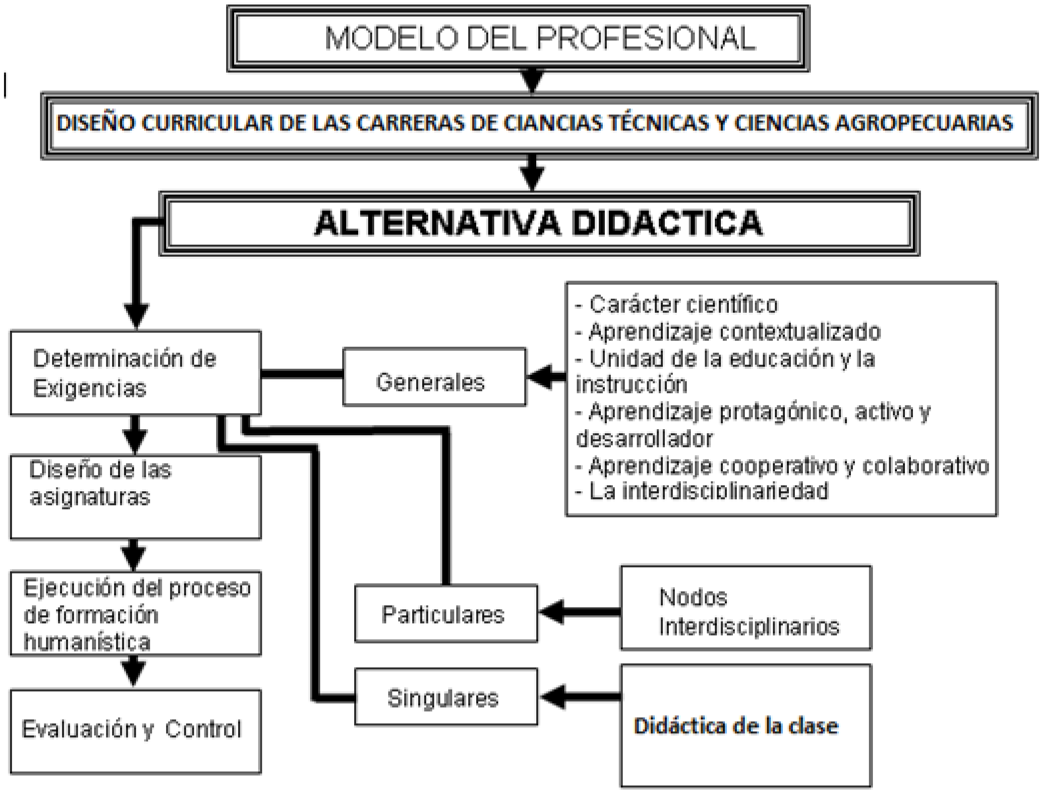

Figure1. Stream didactic alternative proposal.

Procedure for determining the nodes interdisciplinary view of humanistic education process:

Analysis of syllabi to identify knowledge elements that have convergence.

Determination of general intellectual skills and teaching character to be prioritized to enable learning of the links established between systems previously identified knowledge.

Identifying value orientations to be prioritized from the treatment of certain knowledge and skills above.

Although taken as pedagogical foundation principles for effective management of teaching and learning, held by DrC. Addin Fátima Fernández, when these are presented as general educational requirements of the alternative, he adds that enhances interdisciplinary humanistic education from subjects in the curriculum, which allows the integration of knowledge. It enables the student to make a cognitive synthesis, capacity building, integrated skills and communicative competence. Thus, interdisciplinarity is crucial to humanistic education, so it is not a simple transposition of elements, but a partial recreation of these principles depending on the nature and needs of the investigation.

From the practical limitations detected in the acting model is included, from the class, conducting information readouts flat press, magazines, videos or materials on magnetic media, as this helps to stimulate the desire to possess, use and exchange information, learn to enjoy reading, feel the satisfaction of turning itself into knowledge, use these procedures in extraclases actions, participation in fairs, exhibitions and related activities such as : visiting bookstores, libraries, other.

The teacher of the subject was required to create the conditions to ensure that students understand the content. Based on imagination, verbal activity was stimulated; through the analysis of artistic works created in them the need to verbalize the knowledge acquired, the conditions for independent thought occurred.

RESULTS AND DISCUSSION

He went to the criteria of experts in order to assess the feasibility, objectivity and validity of the aspects that provide the alternative. The processing of these ratings was made taking into account proposed by DrC. Thomas Crespo Borges.

Selected experts have an average experience of 35 years; all are graduates in Education, 21 specializing in Spanish - Literature, seven are music and four specialty of Plastic Arts. Of these, three are Assistant Professors; One is Assistant ; six Masters of Science in Education , two are Doctors of Pedagogical Sciences. 90% have experience working as a teacher in Art Education. All agreed to cooperate with the investigation.

In Figure 2 the values of the calculated probabilities and scale values of the indicators are shown, allowing alternative claim that teaching is relevant to develop the humanistic education of undergraduate students of the first year of technical sciences and Agricultural Sciences and fill the basic requirements to be implemented for such purposes, from the preliminary score of a group of experts.

	C1	C2	C3	C4	Suma	Promedio	Valor de los indicadores	Evaluación del indicador
I1	-0,78	0,40	3,49	3,49	6,61	1,65	0,50	Bastante adecuado
I2	-0,49	3,49	3,49	3,49	9,98	2,50	-0,35	Muy adecuado
I3	0,16	3,49	3,49	3,49	10,63	2,66	-0,51	Muy adecuado
I4	0,00	1,86	1,86	3,49	7,22	1,80	0,34	Bastante adecuado
I5	0,08	1,86	1,86	3,49	7,29	1,82	0,32	Bastante adecuado
I6	-0,67	3,49	3,49	3,49	9,80	2,45	-0,30	Muy adecuado
Suma	-1,70	14,60	17,69	20,94	51,52			
Promedio	-0,28	2,43	2,95	3,49				
	Puntos de Cortes							

Figure2. Chart values calculated odds and scale values of the indicators

To evaluate the validity and effectiveness of teaching alternative proposal in practical conditions of humanistic education, a pedagogical pre - experiment was conducted . Was applied in accordance with the requirements laid down in these cases , we worked with an experimental group in Industrial Engineering (Technical Sciences) , which in turn constituted the control group before and after the implementation of the alternative (type O1 X O2) .

The design of the pre- experiment was planned on the basis of the following phases:

First stage: Phase diagnostic instruments of educational research were applied , including: observation, document analysis , interviews with the goal of diagnosing gaps and potentials in humanistic education possessed by the freshmen of Industrial engineering that made up the sample. As part of the initial stage of this phase pedagogical test was applied as pre-test to diagnose the state of the knowledge and skills of those students.

Second phase: formative phase: teaching alternative was implemented from the class.

Third phase: Phase Control: This consisted in the application of a pedagogical test and post -test to assess cognitive achievement of students, as well as the observation of these to record changes in the way they act in their affections and attitudes. The creation of two discussion groups was necessary to note once again the cognitive, emotional, attitudinal and communicative competence which achieved such maturity.

The frequencies observed in the indicators of the dependent variable and the comprehensive evaluation of this, before and after the pre - pedagogical experiment are presented in Figure 3. Posttest data collected showed that there was a transformation in all aspects evaluated for the results of the pretest, it showed the highest category increased to 77.5 % (31 students) and the decline in medium and low categories.

For comparison of before and after implemented alternative teaching from class , a data file was made for storing the values obtained in each of the indicators of the dependent variable, using SPSS, version 15.0 for Windows.

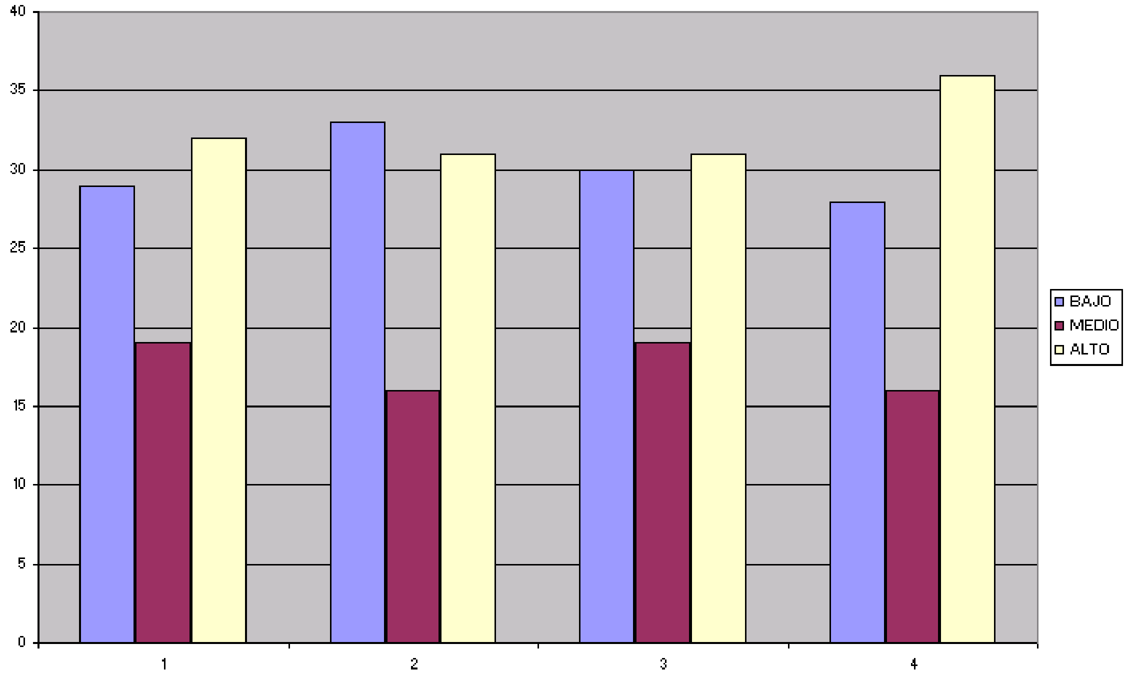

Figure3. Comparison of the results pre-test and post-test.

CONCLUSIONS

The experts consulted felt that teaching alternative applies, feasible, relevant, original and valid, he is has all the resources to materialize their design meets the specific historical - University of Sancti Spiritus conditions "José Martí Pérez", correspond to the educational level enrolled, support the lead, active, cooperative, socialized and contextualized learning from them. It is a necessity today the development of the humanistic education of these students.

The pre pedagogical experiment corroborated how humanistic education of undergraduates at the University of Sancti Spiritus as a way of improving the Teaching in Higher Education was developed, which was expressed in a greater understanding of different knowledge related history of thought in literature, music and the arts as forms of art as well as works and the most important authors of the local, national and universal culture; in raising the capacity to appreciate a work of art, shown in aesthetic taste, creativity, the use of the skills in the expression of accumulated habits of society, the transformation occurred with the modes of action and its relationship to the process of communication ; all of which could be achieved from increased motivation.

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DELIVERING AN OPEN INNOVATION CULTURE TO THE INDUSTRY: A NEW WAY TO CATALIZE TECHNOLOGY TRANSFER FROM A SCIENCE TECHNOLOGY PARK (CPI)

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Abstract

Private organizations are using several well-established strategies to manage innovation in-house and also to monitor and transfer *know-how* from outside of their own box. Specially, large organizations are working in an Open innovation culture and methodologies trying to co-develop new products and services together with entrepreneurs and academics.

However, an unmet need is still not really achieved: How to align your innovation challenges (ideas, opportunities, projects, people) with the management of potential external know-how. Precisely, the relationship between the academic sector (where this external know-how is mainly allocated) and private sector is remaining unclear in many cases and fully productive for both sectors.

The academic sector is willing to create innovative ways to improve this relationship in order to optimize technology transfer.

Because of that, at the Ciudad Politécnica de la Innovación (CPI), we are developing novel initiatives to engage our know-how with the private sector: TBI and CPI2020.

TBI is a unique hybrid model that combines innovation consulting firm practices with technology transfer execution.

CPI2020 is an initiative addressed to help the academic community to surpass the EU funding (Horizon 2020) barriers that requires private-academic proposals in most cases.

1 Introduction

The Ciudad Politécnica de la Innovación (CPI) is the Science Park of the Universitat Politècnica de València (UPV). The CPI was built as an open collaboration network that brings together both public and private agents to share, voluntarily, their knowledge and resources. Business associations and promotion bodies from the Valencia region participate, at national level, with the collaboration of more than 100 public and private bodies of the Spanish R&D and innovation system, and at international level, with the collaboration of more than 200 worldwide public and private entities of research and promotion of innovation. CPI works with three types of agents: research centers, antennas of innovation and centers of business innovation.

Ultimately, CPI is oriented to optimize the academic-private relationship in order to improve technology transfer from the academic sector to the industry. Because of that, two innovative models are emerging at the CPI: the CPI2020 initiative and Tech and Business Innovation (TBI).

2 TBI

TBI (www.tbinnovation.com) is a unique hybrid model that combines innovation consulting firm practices with technology transfer execution. TBI is owned by the University and focused on delivering business solutions and consulting services based in our global knowledge in open innovation and technology transfer. TBI operates global and our clients are large or medium organizations willing to achieve unmet needs in innovation and technology transfer.

TBI engages with the industry by together identifying company innovation challenges (FIGURE 1). Applying the open innovation methodology develops this innovation process. Therefore, these challenges leads to ideas, opportunities and finally projects that require a technology transfer process. TBI supports both processes.

For example, How Companies Manage their KNOW---HOW is one of the most valuable issues in order to address a key economic objective: to develop a dynamic of innovation at companies that increase competitiveness and enhance a sustainable economic growth. Large companies are using several well---established strategies to manage know---how in---house and also to monitor and transfer know--- how from outside of their own box. However, an unmet need is still not fully achieved: How to align your innovation challenges (ideas, opportunities, projects, people) with the management of your know---how (in---house or external)?

FIGURE 1

Our TBI model at the CPI, allows private clients precisely to align their innovation challenges with an optimal technology scouting and transfer process.

Also, TBI is allowed to:

a. Define a culture of open technology transfer and innovation
b. Develop novel business strategies based on internationalization of innovation
c. Create a new competitive advantage with disruptive technology
d. Balance innovation company portfolio.
e. Provide valorization services and audit innovation capabilities
f. Promote entrepreneurship & venturing; and create social shared-value
g. Establish a technology transfer strategy inside a company
h. Customized corporate training and workshops

3 CPI2020

Horizon 2020 is the biggest EU Research and Innovation Programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020). By coupling research and innovation, Horizon 2020 is helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

Horizon 2020 provides an excellent framework for Research and Innovation collaboration among different stakeholders but especially for the academic sector and industry. Nevertheless participation in European projects has a number of barriers. Among these the most important for the academic environment are:

- Strong competition.
- Grand variety of instruments and calls.
- Increasing complexity in preparing projects, especially for researchers, resulting from the fact that the factors of project approval are not only scientific-technical ones (in fact only 1/3 of the evaluation criteria are scientific type).
- Derived from the above aspects, preparing a winning proposal is high time consuming process.
- Role of lobbies and relevant networks that influence the design of work programs and have relevant participation in approved proposals.

A successful and continued engagement in EU Programmes requires integrated action plans to be drawn up including short and medium term plans for proactive participation. To this end, it is necessary to identify and create opportunities from the different work programmes and to develop networking opportunities through partnership and strategic alliances. In terms of proposal preparation, for a successful outcome, a professional approach is required from idea selection and filtering, to consortium building and proposal writing. Besides the increased competition in EU Research programmes requires specific training in proposal preparation and writing.

FIGURE 2

CPI2020 (FIGURE 2) is an initiative of CPI addressed to help the academic community to surpass the described barriers. To this end CPI2020 has been launched offering a series of services to the UPV Academic Community:

2.1 Strategy Development

Our highly experienced CPI2020 staff, will identify, in collaboration with the research group, the main interest areas in Horizon 2020 and will design action plans including:

- Interest areas and actions needed to define and implement a European Research Strategy.
- Strategic Alliance identification and formation.
- Networking opportunity identification and deployment.

These studies will be developed at the request of UPV research groups previously registered in CPI2020. Those registered groups that did not coincide with formally recognized groups in departments or with other research structures -centers or institutes- will have to send a brief summary of their capacities, composition and previous experience. In any case, a preliminary analysis of applicant group experience and capacities will be done before making the study. CPI2020 staff will actively participate in the implementation of the Networking and Strategic Alliance development activities, leading them or collaborating with research groups in their deployment.

2.2 Proposal preparation

CPI 2020 offers proposal writing services for those UPV Research Groups that had a European Research Strategy for Horizon 2020 and require it. These services consist of:

- Identification of potentially successful ideas from an initial stage and direction to the appropriate programme.

- Formation of winning consortium.

- Proposal writing of identified potentially successful ideas. This includes critical integration of the work plan and State of the Art, provided by the research group and partners. Scientific-Technical information provided by researchers will be complemented with commercial and EU policy objectives. This will be done from the initial idea selection, to the consortium building and proposal writing.

- Training of researchers in key success factors of EU research proposals.

This service is provided only for UPV research groups registered in CPI2020.

2.3 Training

The increased competition in EU Research programmes requires specific training in proposal preparation and writing. CPI2020 offers high-quality training services to the UPV community at two levels:

- Organization of training courses and workshops on proposal writing. The training courses will be addressed to all the UPV personnel involved in proposal preparation.

- Direct involvement in proposal preparation. This will consist of working as a freelance writer in a fully coordinated way with our team for up to approximately 3 months. This activity is aimed at PhD students and researchers.

2.4 Expected Impacts

The expected impact on the UPV are:

- Increased overall participation of UPV in European Projects.
- Increased participation of UPV as coordinator of EU projects.

- Increased revenue in R&D projects.
- Increased number of research groups involved in European projects thus increasing their scientific excellence and European integration.
- Improved relations of UPV with both Spanish and European companies since one of the goals of Horizon 2020 is the industrial participation and exploitation.
- Enhancing international position in international forums.
- Improved coordination and collaboration between research groups UPV through synergies arising between research groups that so far have little relationship.
- Decreased workload of professors and and researchers in the preparation of proposals while increasing their success in European calls.

4 Summary

In summary, both initiatives described in detail in this paper propose two separate approaches to optimize this academic-private relationship. TBI approach is focused on the private-pull demand and CPI2020 is oriented on the academic community technology push.

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A NAVIGATION TRAVEL AID SYSTEM FOR BLIND PEOPLE

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1. SUMARY

This communication exposes the background and environment that have led to the definition and execution of a set of activities focused in the development of a tool to aid blind people.

Nowadays, the evolution of the technology of the artificial vision allows its employment in a wide range of military and industrial applications. The trajectory and route of different devices could be guided with extremely high accuracy.

It seems paradoxical the fact that the technological employment and investment in this area have left apart one of the main needs of a group of people who have lost their sight.

The CITG (Research Centre in Graphic Technology) of the UPV has been working in this field for ten years. This contribution summarizes the analysis process and the development proposal carried out for the creation of the autonomous device for blind people knows as EYE21.

2. INTRODUCTION

285 million people are visually impaired worldwide: 39 million are blind and 246 have low vision, [1, 2]. Over 90% of visually impaired people in the World live in developing countries. Blind people and people with low vision can find support by using vision technology tools.

In SXXI, autonomous robots with artificial vision system are able to avoid obstacles and navigate, but there isn´t any tool able to convert the 3D information into comprehensive and useful information for a Blind user. Blind people can think, so we don't need a robot dog guide, we should give them the information and let them use it.

We propose a Sensory Substitution System capable to translate the visual information of the surrounding environment using auditory stimuli. This involves a combination of Scene Description and Object interpretation plus Sound Positioning system.

On this paper a summary of what has been done until the actual development of the EYE21 glasses is shown as an example of an international improvement of the knowledge oriented to increase the quality of life of the Blind people.

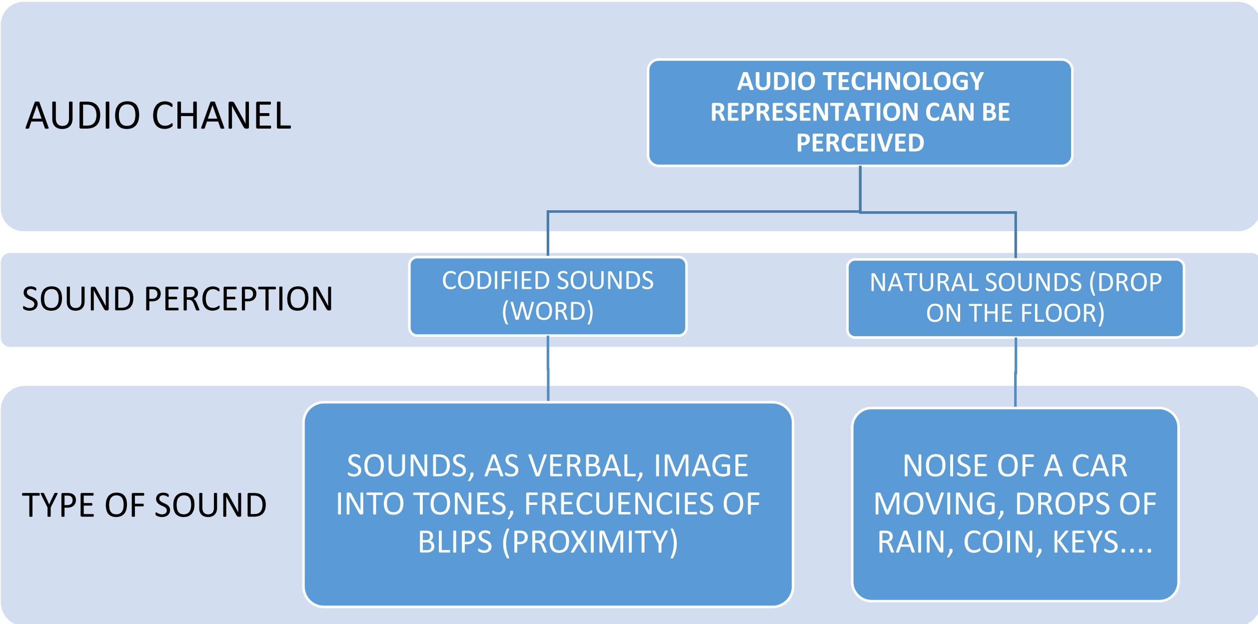
3. STATE OF THE ART

As it is going to be shown, most of the device are an extension or modification of the cane. So 3D information is given to the user by a tactile device. Only few cases as VOICE developed a glasses able to transform image into sound. [3]. But in this case information is encoded whit a sound codification, and the image is generated slowly with and ordered sound able to scan the image in an order and transform the image into sound with a correspondence between sound and color tone, and the position is given because the order of representing the mage is always the same. The more relevant technology appeared as a Patent in 1999 is the one created by "ULL-Instituto Astrofísico de Canarias", where the bases of a portable glasses with cameras able to generate 3D sounds is described.

After this two ones, there are many others, in the whole world, there are more than 45 electronic devices which help blind people to perceive the environment. Almost all of them are devices based on ultrasounds and sensors [4].These devices are mainly designed to detect environmental obstacles and represent this information to the blind user through the touch, sounds or vibrations. Through this group of Electronic Travel Aids we can find the Mowat Sonar Sensor, the Sonic Torch or the Sonic guide.

The most modern devices are based on the stereovision acquisition system. These devices have not only the objective of object detection but also to represent the whole environment. As a good example we can find the Voice system, which informs the user about the environment through acoustic signals.

The way to process audio information is quite important for the comprehension and the mental effort on the global process of acquiring 3D information on a comprehensive and usable way.



BRAIN PROCESS: The brain processes a sound in different stages areas, i.e.: when we hear a shout of a person, before understanding the word, we have already detected where it was generated, and this process doesn't even need the processing of the word, so it can be finished just before only a part of the word has been heard

The next projects are known on the world of tool for helping blind users. As it can be reviewed, no one of them includes a real 3D acquisition and representation or neither an analysis of the scene and object detection. Some of the most relevant devices are shown in table:

Ultrasonic		
	Nottingham Detector [5]	-Obstacle detector hand device.
	Sonic Torch [6]	-Hand-held narrow-beam system
	Mowat Sensor [7]	-Hand-held system. Sonar and tactile output
	Sonic Pathfinder [8]	- Head-held device, audio signals outputs
	Sonic Guide [9]	-Binaural system, head-mounted device
Laser		
	Laser cane [10]	-Acoustical signals at the output- Laser
	Talking signs [11]	-Infrared wireless communication, Hand-held device
	SONA	-Environmental system, Radio-activated auditory beam
	MARCO	-Infrared light transmitter and receiver system Hand-held device
	CASBliP M1	-Object detection device, acoustical pitch output
GPS		
	MoBIC	-Orientation and navigation system, Acoustical signals
	Makino	-Orientation and navigation device, Computer central unit

	Electronic Guide Dog	-Orientation and navigation system, Mobile phone and central unit, Hand-held system
Artificial visión		
	vOICe	-Navigation system,Camera,Acoustical sounds and tactile maps output http://www.seeingwithsound.com/
	CASBliP M2	-Object detector and navigation system,Two cameras, inertial sensor, PC Static and dynamic object and free path detection acoustical signal output
	EPEL	-Stereoscopic sonar system, Vibrotactile output
Combined		
	CASBliP	-Time of flight sensor, two cameras, inertial sensor, PC, Static and dynamic, free path detection, Acoustical sound output www.eye2021.com
	SWAN	-Navigation system -Tactile, GIS four cameras, GPS, digital compass PC, Audio output
	Eye PlusPlus (FSRS)	-Videocamera, Vibrotactile output, Glasses and body belt

	Kinect	-QR codes http://www.levante-emv.com/tecnologia/2011/03/19/kinect-alertara-ciegos-obstaculos/791545.html

4. CASBLIP PROPOSAL:

Considering the limitations of the existing devices, researchers from the "Universidad Politécnica de Valencia" in collaboration with six European institutions decided to develop a new cognitive navigation device, which will be able to detect the obstacles from the environment and represent them through acoustical signals CASBliP (Cognitive Aid System for Blind People.)

The CASBliP system is a more complex and wearable system for navigation and orientation using stereovision, sensory system and GPS for extraction of the environmental information, transforming the received information into acoustical signals [11, 12]. The CASBliPimproves the system"Virtual Acoustic Space", developed by Universidad de la Laguna and the Instituto de Astrofisica de Canarias [13]. The innovative aspects of CASBliP system overcome the limitations (accuracy and precision on environmental data representation, difficult utilization, unclear outputs, non-universality, etc.) of the currently existing devices.

CASBliP system has been designed and developed separately in two different devices which can work individually or together; the Acoustic Prototype and Real-Time Assistance Prototype (Figure 1) [14, 15].The whole CASBliP weight is the sum of 139g (weight of the glasses with the laser modules and lenses), plus 688g (weight of the Real-Time Assistance Prototype, which include the cameras lenses and helmet plus the weight of the laptop and FPGA).

The surrounding information, in the Acoustic Prototype, is collected by a laser sensor, the distance information from the sensor and the detected object is collected and processed in real time for every single pixel, and a sound previously stored in the same position were the element is detected is reproduced. By this "simple" substitution of 3D points by sounds, a blind user can generate a 3D audio mat of the surrounding space. Due to the sensor properties and high perception reliability, the system is able to accurately work both in indoor and outdoor environments.

The acoustical task generates the cognitive load while blind user walks around the environment. An acoustical map is created which attributes one sound to every distance at a particular azimuth.

Figure 1 –Cognitive Aid System for Blind People

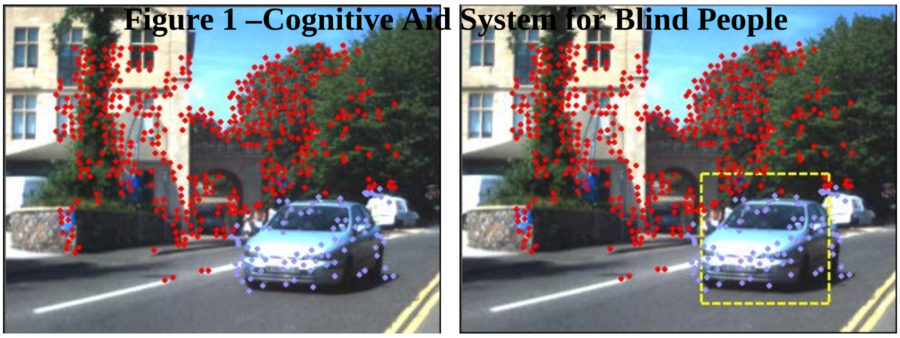


Figure 2– Object detectionusing stereovision

A small Toshiba laptop was used as an operational system. The implemented strategy is expected to generate in the user a visual-like auditory perception. According to the listened sounds, the user is able to take a decision in order to avoid the obstacle appearing in the system area of view. With a minimum practice, the user can easily detect the size of the obstacles. Different acoustical outputs were generated for obstacles and free path.

The integration of both systems into one single unit intends to provide more information about the surrounding environment to the blind user. Using both systems at the same time, the user will be able to detect the obstacles in an area between 0,5 and 15m.The sensory system of the

Acoustical Prototype will provide precise information on the nearest obstacles up to 5m, whereas the artificial vision will provide the information of the farther environment up to 15m.

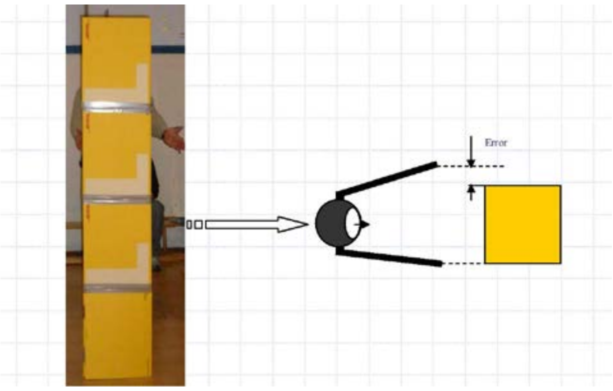
The CASBliP system was designed to overcome all the limitations of the existing devices, to integrate the object detection with navigation devices in one single unit. The approach of robust real-time of static and dynamic object detection for indoor and outdoor environment and navigation system was achieved. The main goal for the near future is focused on the processing and hardware improvement.

5. VALIDATION

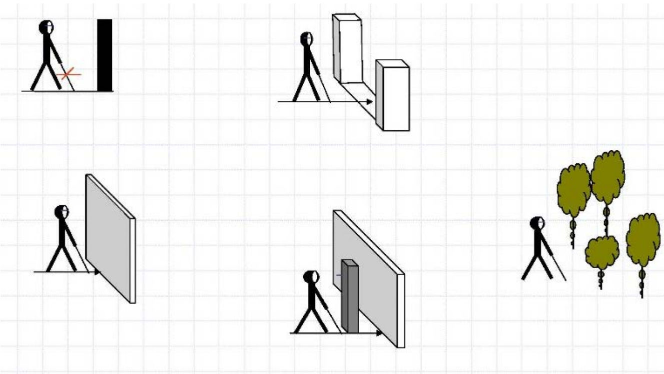
The CASBliP presents a new navigation and object detector device for blind people based on Time-of-Flight technology and acoustic sounds. The device has been developed as a complementary device for blind people. Its main objective is to detect and localize the obstacles from the environment and inform to the user about their presence through acoustic sounds, both in distance and in azimuth. The device working area is from 0,5m up to 5m in distance and between 30º left and 30º right of the human head, with a precision of 0,9º.

The device architecture is based on glasses which contain a 3D-CMOS sensor, an FPGA with the whole electronics and software. After a short experimental period it was possible to demonstrate the importance of the development of such device for the blind community. Due to the acoustic device, blind users were able to detect obstacles from the environment, localize and avoid them.

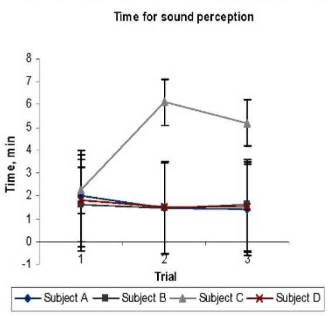
Thirty blind users tested the system both in indoor and in outdoor environments, in unfamiliar areas. Neurology specialists and mobility trainers from the DeutscherBlinden-und Sehbehindertenverbande.V. (DBSV) from Germany and InstitutodeiCiechi "F. Cavazza" (IFC) from Italy and from Spain evaluated the travel performances. Seven training exercises were performed with the objective of the sound externalization, distance and direction perception. After the training period, blind users participated on the navigation tests in the laboratory and open environment. The laboratory test consisted of the navigation through a 14m labyrinth, where the user should detect the two rows of four pairs of soft columns placed at a distance of 2,5m and pass through them.

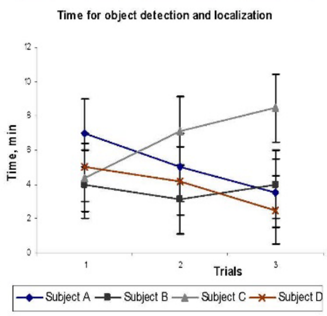


The open environment consisted of two exercises, the first exercise was based on the navigation through a known environment and the second exercise consisted of the navigation through an unknown street and a shopping mall. During the experiments the main parameters measured were: the absolute walking time, the number of hits and the number of corrections (when the user was leeway from the route).



The users confirmed that with the Acoustical Prototype and Real–Time Assistance Prototype they travelled with more confidence than when they did with only the white cane. This enabled to increase their surrounding perception and walking speed.





6. CONCLUSIONS

Casblip concluded there is a real option of use a device to represent the 3D space with sounds which is useful for blind people and can be technologically developed.

For this reason the CITG proposed to go ahead with the total reengineering of the system with a much more reduced device and created the EYE21 unit, which was tested by a group of blind users with similar trials used on CASBLIP, obtaining similar results, but with a much lighter system.

EYE21 is the best conclusion of what the authors consider the new generation of tools for helping blind people or a noninvasive way should be done.

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"GAMIFICATION" AS A TOOL FOR ENGINEERING EDUCATION

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Conference Key Areas: Education and Research
Keywords: Gamification, Engineering

Abstract

The introduction of "Gamification" in the field of the higher education is a recent and uprising tendency. Gamification is the process of integrate the philosophy and mechanics of game playing into new areas totally aside of video games to engage users. The incorporation of games of different complexity in education has proved to increase motivation and facilitate the acquisition of many interesting skills. Games are based on overcoming a series of phases in which the user acquires knowledge and put it into practice. The key aspect of Gamification is making the users enjoy themselves: what matters is the experience they have of that game, not the game itself. Gamification has become a valuable tool to increase learning motivation in all educational ambits, and particularly in disciplines such as engineering.

1. Introduction

"Gamification" does not refer to the creation of games for consoles or social networks exclusively. The concept is wider and involves the strategies where entertainment is as aspect, an element, but is not the objective. This discipline derives from the "Games Theory", introduced by the Dutch historian Johan Huizinga in his book "Homo ludens" [1], where he stayed that games are the main educational element of human culture.

Gamification consists in using the mechanics and ideas of game playing in a different context aiming to keep the attention of the user, motivate action, promote learning and solve problems. As a discipline, it looks for stimulation and so to achieve a high level of satisfaction for the planned tasks. The objective is to achieve the active participation of the person involved in the task. Gamification leaves aside learning as a way of attention, and considers it as a behavior. The playful technique can aim people to do tasks that they normally consider as boring, such as fulfilling questioners, solving problems or mathematical algorithms, or designing mechanical devices of high mechanical complexity.

The new generations of students born from the 90s on, have always coexisted with console and now smartphones and tablet games. New students are used to play with the different platforms and have developed experiences with complex games, assuming different roles to overcome the challenges they had to solve in their games.

Nowadays, Gamification is also used by multinational companies to keep the loyalty of their costumers to their products and trademarks, in a way almost imperceptible.

2. Employment of Gamification

Videogames are the dominant way of entertainment these days, since they are powerful tools to motivate behavior. Effective games take advantage of both psychology and technology, so that they could be applied outside the immersive environment on games themselves. Gamification is an uprising commercial practice, especially for the past two years. Organizations are applying it to areas such as marketing, human resources, productivity improvement, sustainability, education, health, welfare, innovation and costumer compromise. Thinking game means more than believing insignias and leaderboards, it requires a reflexive understanding of motivation and design techniques.

Gamification is being used in very diverse fields such as marketing as loyalty elements. This is the case of Samsung Nation [2]. This game has being designed to motivate the users of Samsung to register their products through the web of the company, something they would not do without this motivation through Gamification. The game also stimulates the visit of the different websites of the company, watch promotional videos and investigate new products, so the users obtain insignias that allow them to level up and discover unpredictable surprises during the game.

Gamification is also used as a training element for sport practicing. Nike, Adidas, Reebok, etc., integrate pressure sensors and accelerometers in their sneakers to count steps, measure distances, calculate calories consumption, etc. With this information they monitor each user and could propose them new levels to overcome and challenges, to take on their own or against other users [4].

Today, from nursery to business schools, as much as in universities, Gamification is used to improve learning and make teaching more entertaining and amusing and so achieve a higher motivation of the students for further progress in the learning of certain subjects.

3. Gamification as a help in education

It is to notice that the introduction of new tools in education do not guaranty the success of the same as dynamic elements. It is very important to have the adequate resources [3]. In the last decades there has been an overwhelming quantity of new tools and approaches and not all of them have been adequate to promote learning.

One of the key elements of Gamification is to keep the user hooked to the game. Such engagement keeps the level of attention of the user always high, and makes them to want playing in the short and long-term. It is very important that the playing experience responds to the designed problematic and fits the profile of the audience.

Creating games for learning is not an easy task since the objective of the game is capture the attention of users, and prevent users from loosing motivation so that they stay playing and are able to finish the game or, at least, achieve the highest level possible.

Some characteristics of the experiences of Gamification offered to the users are those of the videogames:

- ✓ There are not activities, but challenges.
- ✓ There are successive levels to overcome, to stimulate participation and competition within users
- ✓ There are benefits such as points gained by overcoming the different levels
- ✓ The objective is no to accomplish a duty, but to obtain an achievement

The main advantages offered is the overcoming of individual and collaborative challenges, to which the new users of education are already used, like the employment of consoles and games for tablets and smartphones.

An example of an educational game based in Gamification is “The Fresh Connection”. This game simulates the production line of a company of perishable fruits [5]. Players are divided into specific roles with different responsibilities. Students could interact to determine the best solution to the changing conditions of the line, and manage the new capabilities and options introduced in the suppliers’ chain. This game could be played in a session of one day or once a week [6].

Another example of game base in Gamification is “Port Simulator 2012 Hamburg”. This also a logistic game, which permits to keep competition between the different players [4].

4. Gamification experience

In the diploma "Especialización en Tecnología de Producción Cerámica" managed by the Research Center in Graphic Technology, an experience of Gamification has been set up. In the course of History of Ceramics, students should elaborate an engineering project to build a ceramic company of the 60s. Students should overcome a set of specific challenges step by step, level by level. They do not have other information apart from the list of elements which are part of this project, and so they should look for the rest of the information themselves.

The challenges are the following:

- ✓ 1st level. Getting the best price of the 60s
  - Each element should be priced
  - Finding the lowest price of the elements

In this phase students gain points for each achieved milestone as much as for finding the lowest price of the elements, comparing all the prices collected by the group.

- ✓ 2nd level: Integration of all the elements of an engineering project of that time
  - Integration
  - Localization
  - Price of soil

In this phase students gain points for each achieved milestone as much as for finding the lowest price of the soil and the best location, comparing all the results presented by the group

- ✓ 3rd level: Final project presentation
  - Budget
  - Term of execution

In this phase students gain points for each achieved milestone as much as for presenting the best budget and plan of execution, comparing all the results presented by the group

All data of the project should come from different bibliographic resources, such as libraries, historic museums and centers of documentation.

This experience has been well accepted by students, who achieved a high level of knowledge about the history of the ceramic industry and engineering.

5. Summary

The overall objective of Gamification is to influence and motivate users to make them gain habits and achieve goals. The player is stimulated to participate, share and interact in some activities individually or as a part of a group. An effective Gamification, dynamic and rich could be used to undertake a wide variety of educational objectives.

It is to remember that to create a good experience of Gamification for education is not an easy task. The student should learn the planned knowledge previously, and the game could keep an adequate level of attention and loyalty, so that the student wants to keep on playing without giving up.

Many games do not succeed because they do not engage users, who leave the game if they are not able to overcome the different challenges. Gamification for education is a very useful tool but its implementation is not trivial at all: it requires high specialization, and validation phases before a definitive implementation in a particular subject. For engineering, it could be very dynamic tool.

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Geographical Information System (GIS) Analysis of Earthquake Destruction Pattern in Pakistan

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ABSTRACT

This research paper used the Geographical Information Analysis (GIS) and Global Mapper to plot the threatening sources of earthquakes in Pakistan based on the recorded data of seismic activity by Geological Survey of United States of America for the period of five years from 2005 to 2009. Two threatening earthquake sources were found right inside Pakistan, around Muzaffarabad in Kashmir and around Quetta in Balochistan. While the third source was in Hindu Kush in North-eastern corner of Afghanistan which happens to be very near the North-western border of Pakistan and the neighboring areas of Chitral, Ghizer, Dlamir, Drupper, Swat and Kohistan of Pakistan can be seriously affected. The results on seismic activity obtained in this research work verified that the recorded results of USGS database were accurate and reliable so far the commonly 90% earthquakes happening along the tectonic plate boundary in the real life experience of earthquakes have proved. The other half of the results showed the 100% matching with the real life earthquakes that occurred in Pakistan in terms of the depth and month of seismic activity. For the 5-year period from 2005 to 2009, the maximum seismic activity depth and month were found to match with the month and depth of occurrence of both earthquakes, that of Muzaffarabad on October 08, 2005 and that of Ziarat earthquake on October 29, 2008. Both earthquakes occurred in the month of October and the depth of 10 km was most crucial in causing the collapse of houses and destruction of property and civil structures.

1 Introduction

This research on analytical evaluation of earthquake destruction pattern in Pakistan became essential as the earthquake of magnitude 7.6 in Seattle, Western Coast of USA had no casualty, i.e. zero loss of life while the earthquake of same magnitude of 7.6 at Muzaffarabad on October 08, 2005 played havoc in the region and took the toll of more than 80,000 lives. Furthermore, the recorded data on earthquakes from magnitude 2.5 and above since1973 till today is readily available as the most reliable database of Geological Survey of United States of America (USGS). In this research work, only the part of database has been used only for the period of five years from 2005 to 2009. It was believed that the combined use of Geographical Information System (GIS) Analysis and Global Mapper on the USGS data base will give dependable results as the accuracy and reliability of USGS are high.

2 Research Methodology

The data base of Geological Survey of United States of America was used and with the help of Global Mapper Software package, the data from USGS was plotted on the specific geographical areas in the region to evaluate the frequency of the seismic activity so that the crucial sources of earthquakes can be identified in Pakistan for proper planning and streamlining of the loss mitigation efforts which can be directed effectively to save precious lives and protect property and civil structures of the country in the future earthquakes. The results were scheduled to go under the process of statistical analysis so that the verification check of the results can also be safely carried out.

3 Results

The USGS database which records the earthquake events of almost all magnitudes from 2.5 to 9 and above for the entire world, was used for the period of 5 years from 2005 to 2009 to plot the earthquake events of magnitude above 4.5 to identify and evaluate the threatening sources of earthquake disasters in Pakistan. The Geographical Information System (GIS) Analysis was used to specify the geographical locations in Pakistan using the software package of Global Mapper for this purpose.

The results obtained through the above mentioned methodology have shown tremendous matching with the real life experience of the earthquake events occurring throughout the world to the extent that the plotting resulted on the global map to show the clear demarcation of the global tectonic plates. It is geo-seismological fact that the boundaries of tectonic plates provide the weakest joints for the release of accumulated slip energy resulting into the 90% frequency of the earthquakes to occur along these tectonic plate boundaries.

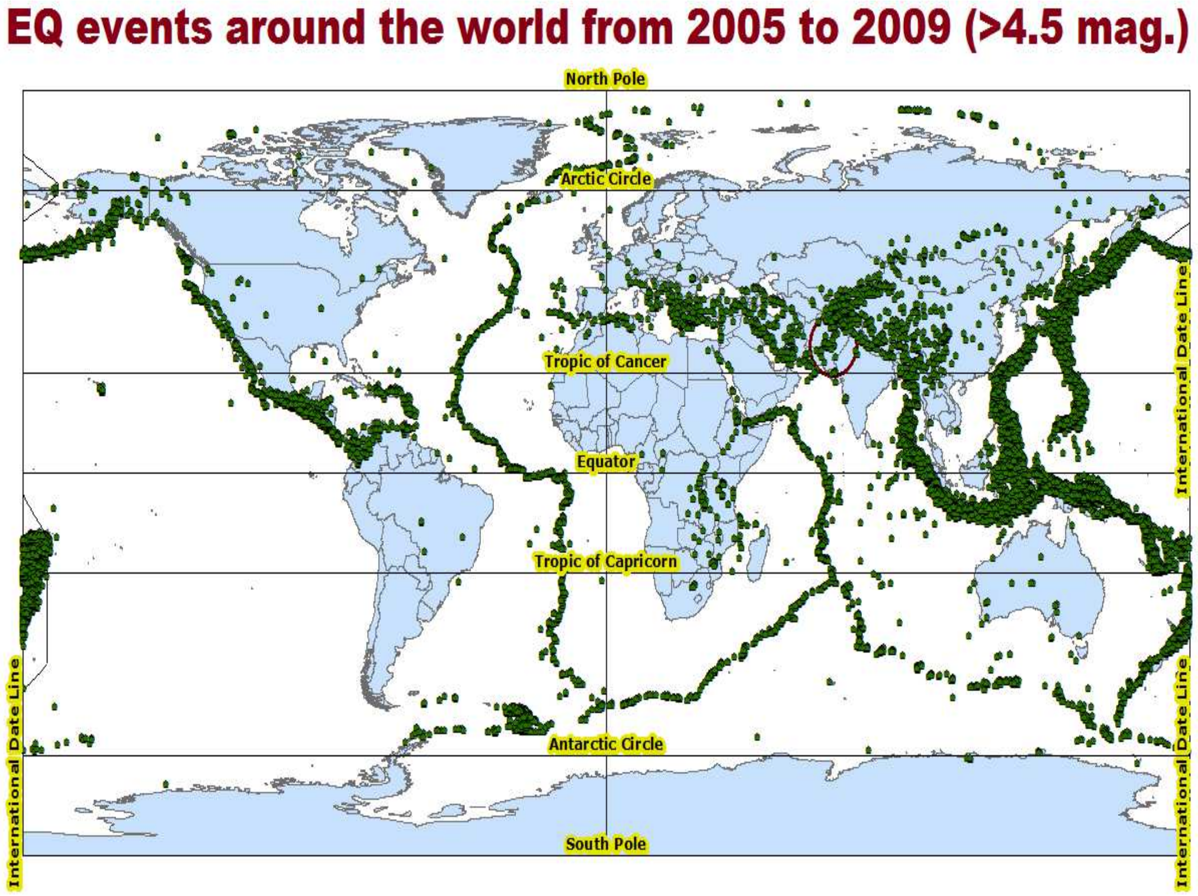

Fig.1. EQ events around the world from 2005 t0 2009 (> 4.5 mag.)

3.1 Result One

Pakistan is shown in a small circle with seismic activity along the boundary of Indian tectonic plate with Eurasian plate through Pakistan Karachi-Khuzdar-Quetta-Derar Ismail Khan-Dera ghazi Khan-Peshawar-Islamabad- Muzaffarabad crossing Indian border to Himalayan footsteps.

The first result has confirmed the fact that the USGS database of the recorded earthquake (EQ) events by the monitoring stations of USGS, are accurate and reliably dependable.

Furthermore, the plot has clearly demarcated the world tectonic plates by simply plotting the frequency of EQ events telling us the geological fact that 90% of earthquake events occur at the borders of the tectonic plates which are the joints between huge tectonic plates that naturally provide the weakest areas from where the accumulated slip energy is released causing more frequent earthquakes along the main fault lines of the boundaries of the tectonic plates.

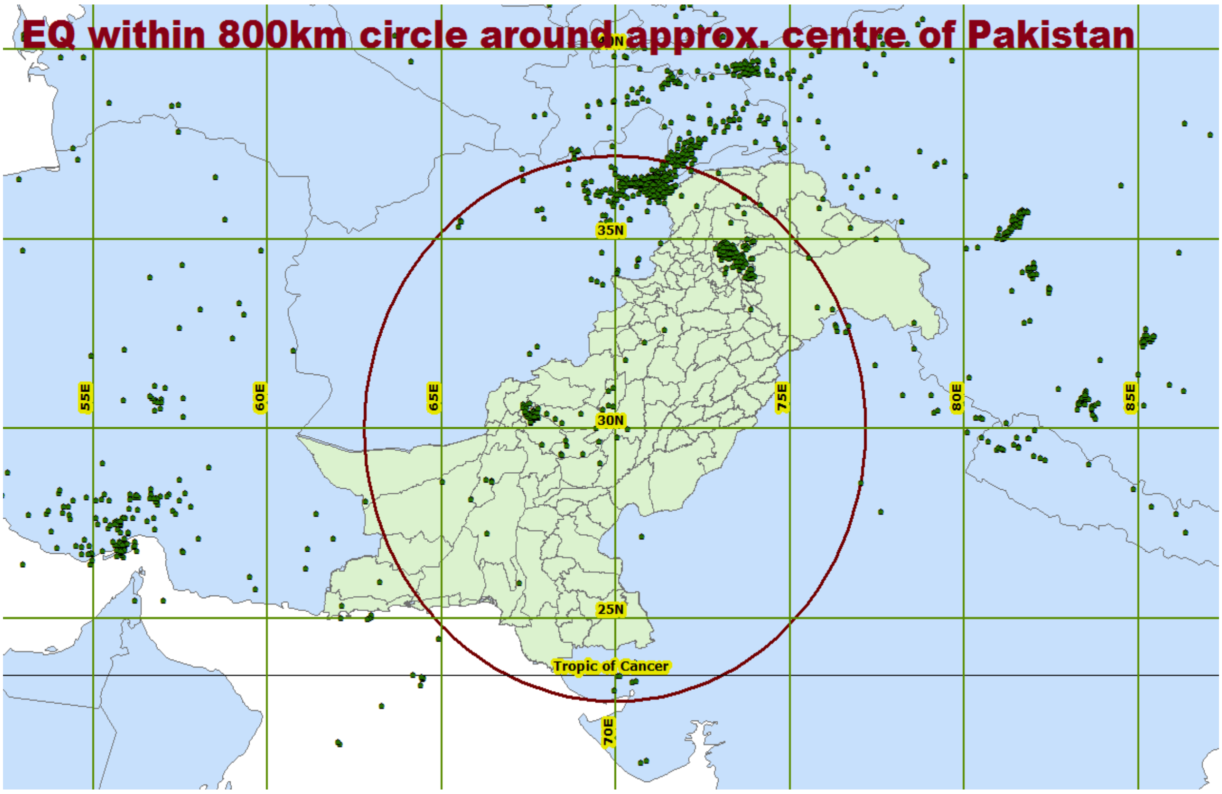

Fig.2. EQ within 800km circle around approx. centre of Pakistan

3.2 Result Two

Three areas (Hindu Kush, Muzaffarabad and Quetta) seismically active within 800 km from the center of Pakistan.

The second result shows clearly that the seismic activity threatening Pakistan are concentrated at three locations of Hindu Kush, Muzaffarabad and Quetta. Although the Hindu Kush is in Afghanistan but it is very close to its border in North-West of Pakistan and its seismic activity poses serious danger of earthquake destruction to neighboring areas of Chitral, Ghizer, Dlamir, Drupper, Swat and Kohistan of Pakistan, in case a major earthquake erupts from Hindu Kush.

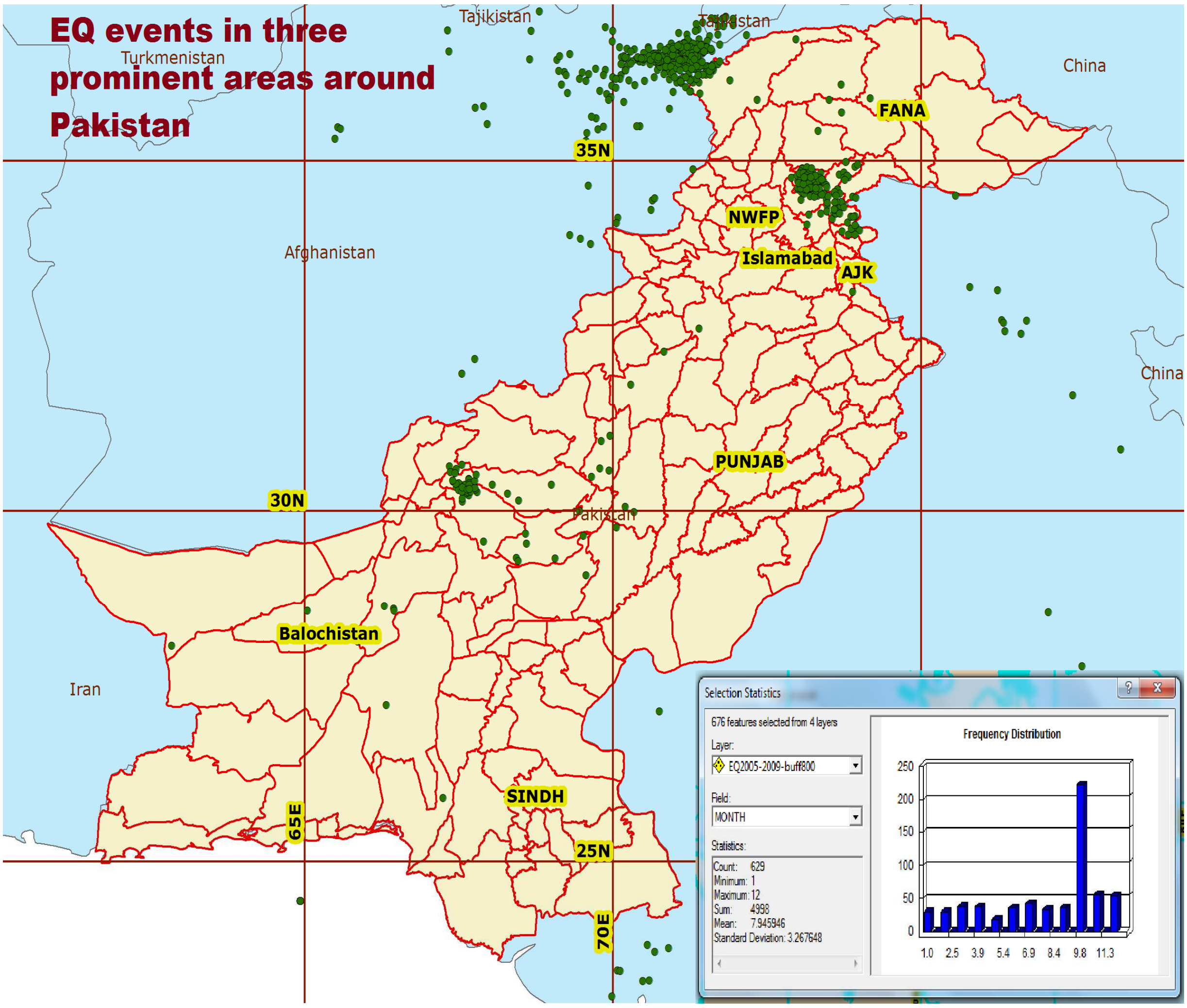

Fig.3. EQ events in three prominent areas around Pakistan

3.3 Result Three

Mapping of earthquake events for three areas (Hindu Kush, Muzaffarabad and Quetta) to show the month of peak seismic activity every year in the period of five years from 2005 to 2009.

The third result has also evaluated the month of maximum seismic activity which is clearly the month of October.

This result was obtained from the database just for the 5 year period from 2005 to 2009 which helps to understand why the major earthquakes like Muzaffarabad earthquake of 7.6 magnitude happened on October 08, 2005 and Ziarat earthquake of magnitude 6.4 on October 29, 2008 also occurred in the month of October coinciding with the maximum seismic activity peaking in the month of October as it has happened in every 5 year period from 2005 to 2009.

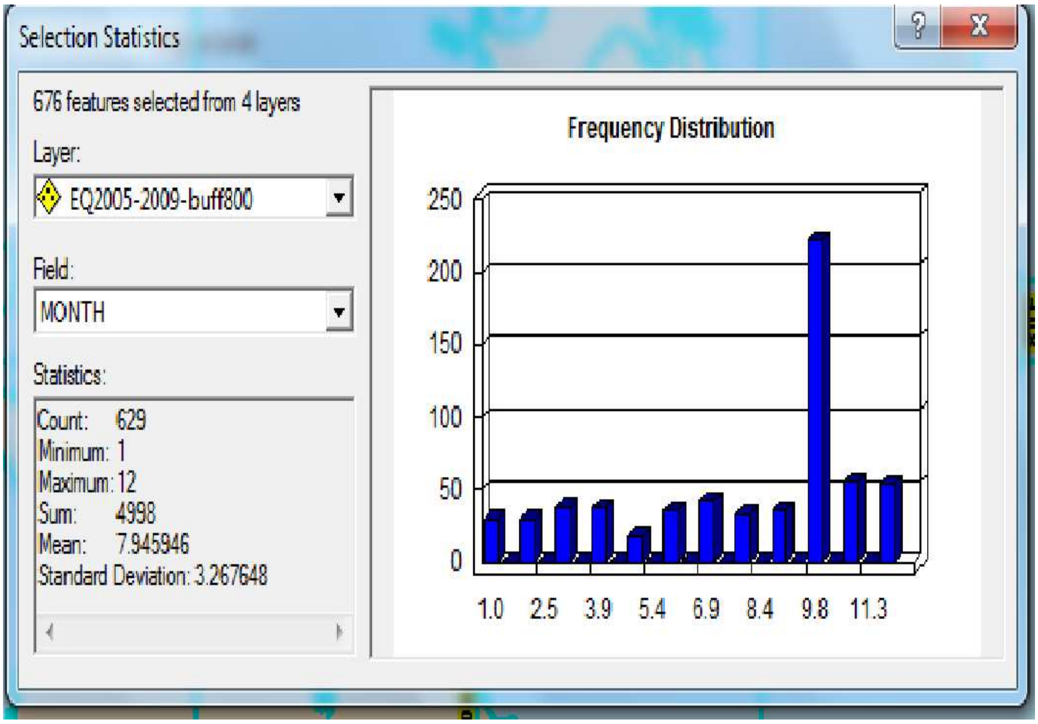

Fig.4. EQ events frequency for three prominent areas around Pakistan

3.4 Result Four

Statistical analysis of seismic activity based on USGS data base for the period of 5 years (2005 to 2009) to find the month of maximum seismic activity.

The fourth result clearly shows separately the peak concentration of seismic activity in the month of October. This is obtained as the result of statistical analysis of the total 629 events recorded by USGS database in the 5 year period from 2005 to 2009.

The reliability of USGS data base is once again verified to be accurate and reliably dependable due to the fact that the month of October has remained as the month of maximum seismic activity for Pakistan every year based on the seismic activity recorded by the monitoring stations of USGS throughout the world for the 5 year period from 2005 to 2009 when two major earthquakes in Pakistan occurred in the month of October coinciding with the recorded maximum activity by USGS.

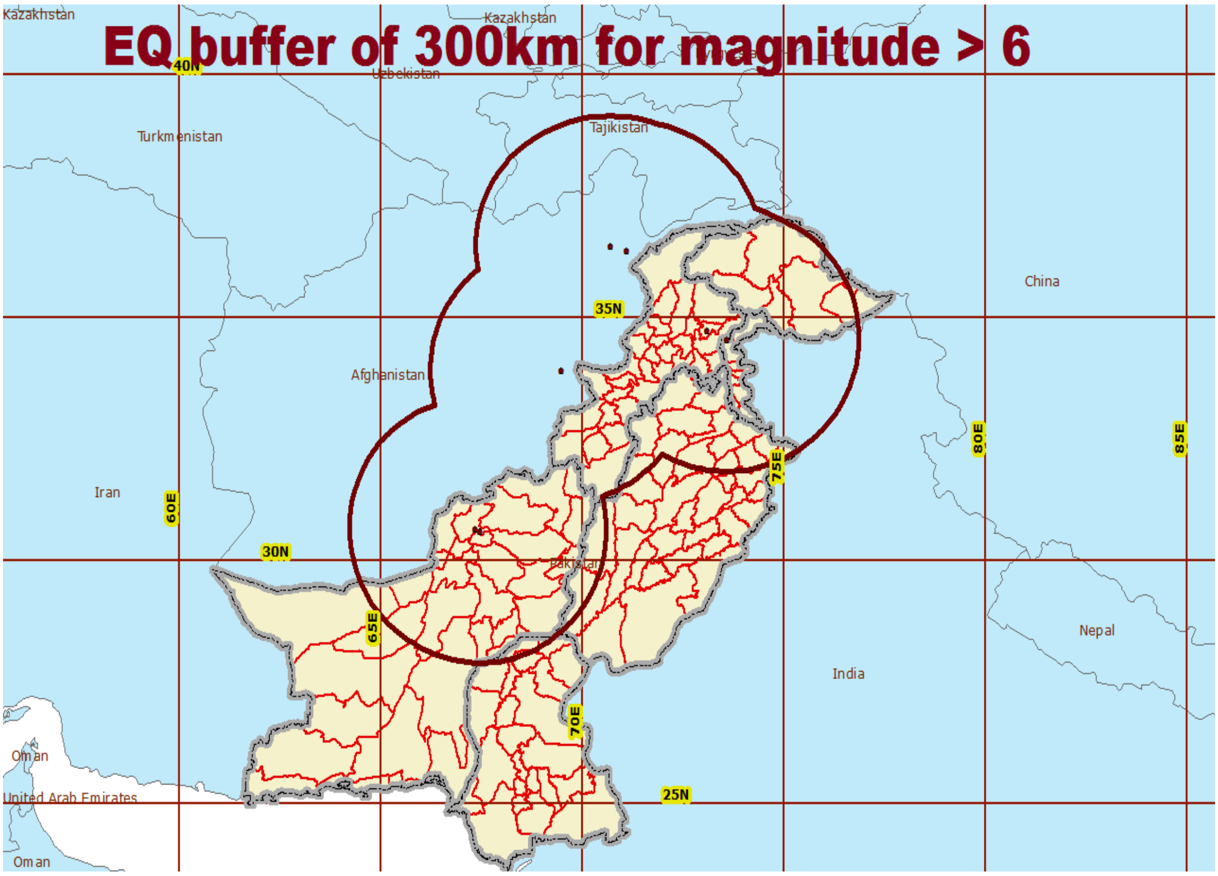

Fig.5. EQ buffer of 300km for magnitude > 6

3.5 Result Five

The region in Pakistan and Afghanistan to be affected by the seismic activities of three areas of Hindu Kush, Muzaffarabad and Quetta are clearly marked out of the map of the region.

The result five shows clear cut parts of Pakistan, Afghanistan, India and Tajikistan forming the vulnerable zone receiving the effects of tremors originating from three sources, i.e. Hindu Kush, Muzaffarabad and Quetta. The planners of the disaster management in each country can devise their appropriate measures for preparedness to mitigate the loss of precious lives and valuable infrastructure, property and important civil structures of public convenience.

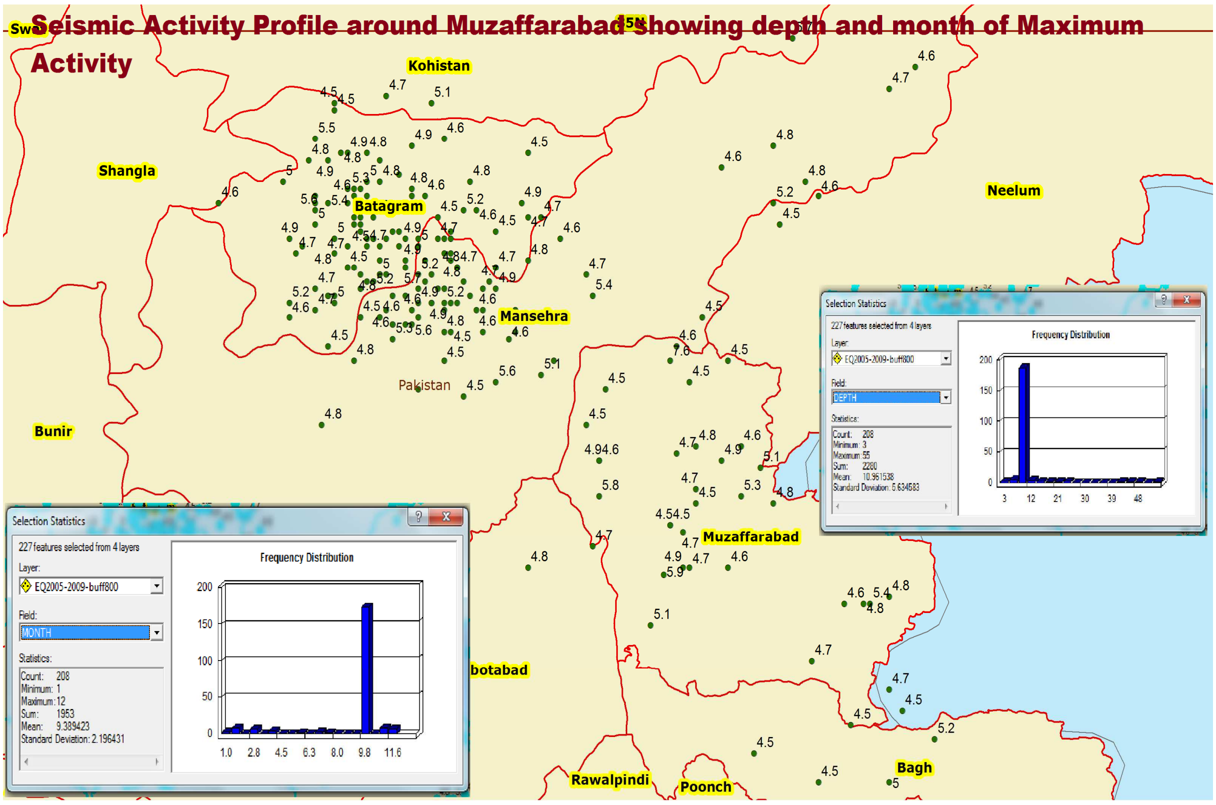

Fig.6. Seismic Activity Profile around Muzaffarabad showing depth and month of maximum activity

3.6 ***Result Six***

Seismic Activity Profile around Muzaffarabad showing depth and month of maximum activity.

The result six shows the statistical results, with respect to depth and month of maximum activity, in what concerns the seismic activity profile of Muzaffarabad area, obtained from USGS for the 5 year period from 2005 to 2009.

The range of depth was from the minimum of 3 km to the maximum of 55 km, but in terms of the frequency distribution of occurrence of the events, all depths from 3 km to 55 km were negligible except the depth of about 10 km which became prominent above the total of 208 events out of 227 events.

Similarly, as shown in the inset on the left side of the map, the prominence of frequency distribution of events in the month of October has been statistically analyzed and exhibited.

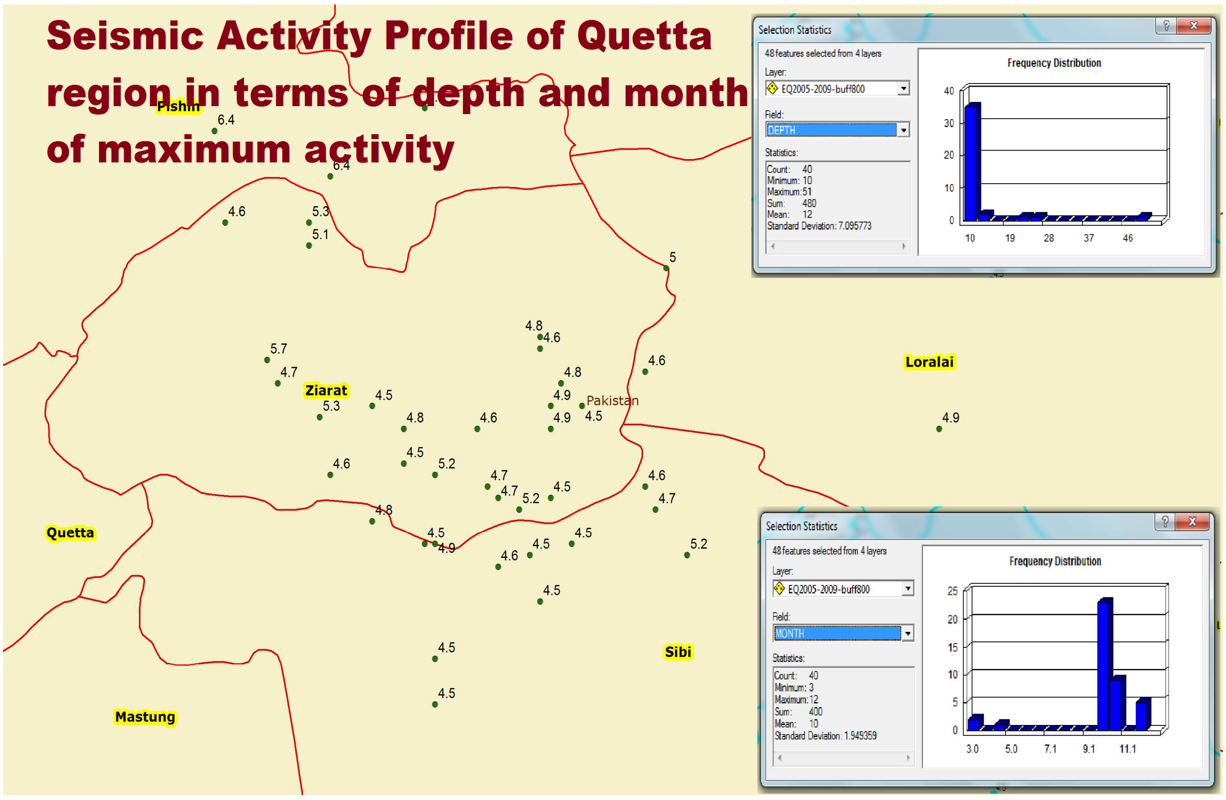

Fig.7. Seismic Activity Profile around Quetta showing depth and month of maximum activity

3.7 Result Seven

Seismic Activity Profile around Quetta showing depth and month of maximum activity.

The result seven shows the profile of seismic activity for Quetta region which has also been statistically analyzed. Statistical analysis conducted on the events in terms of the month and depth of maximum seismic activity reveal that the seismic activity around Quetta remained maximum around the month of October where the first half of the month of October showed about double activity than the latter half of the month of October for all the five years from 2005 to 2009, as exhibited in the lower inset of the map.

Out of the total count of 48, the majority of 40 counts contributed to the prominent result for the month of October throughout the period of five years under consideration.

Similarly, as shown in the upper inset in the map, the frequency distribution clearly reveals the prominence of the depth of 10 km which falls in the category of shallow earthquakes causing more damage to muddy houses and civil structures on alluvial soils and sedimentary layers in the basins.

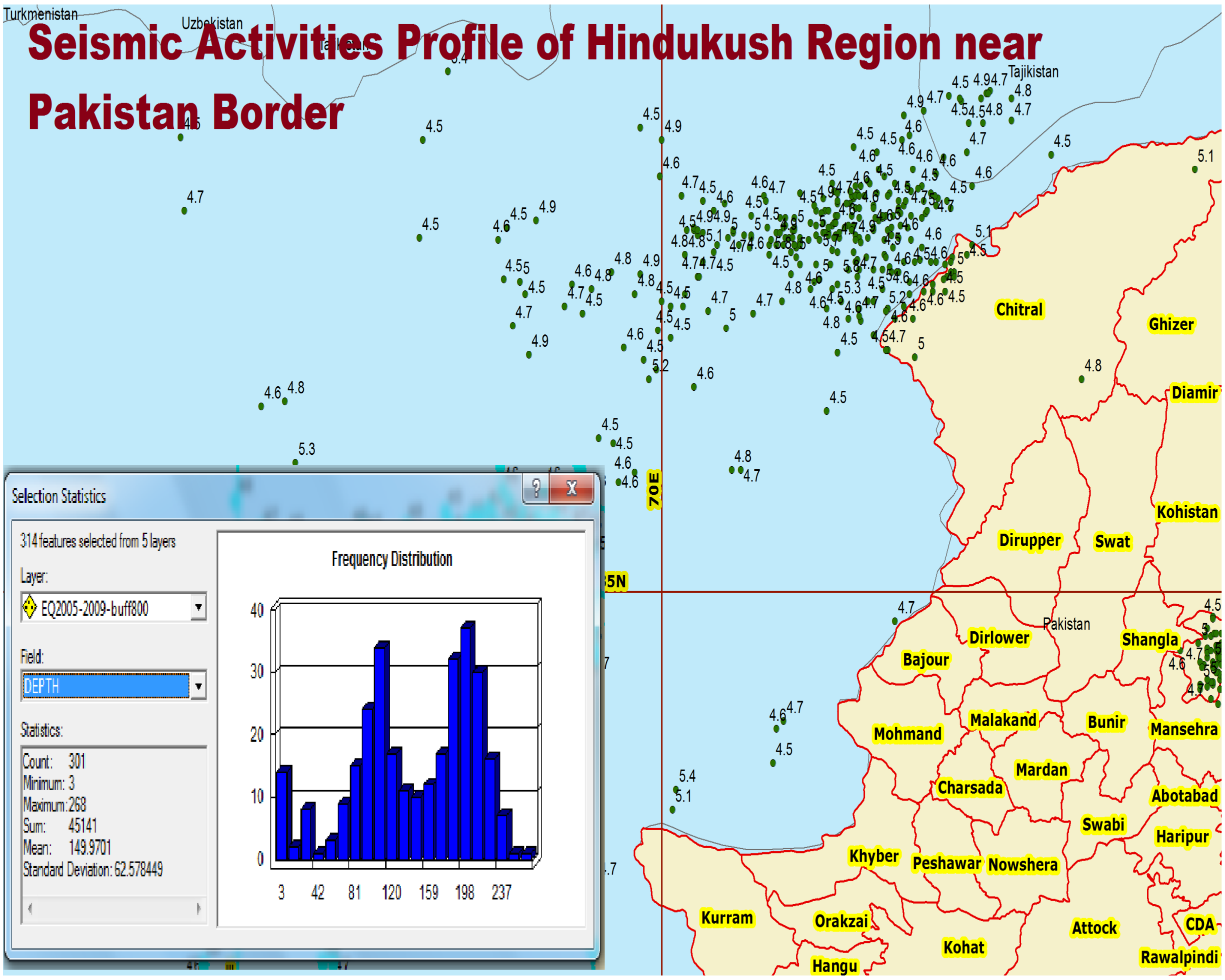

Fig.8. Seismic Activity Profile of Hindukush Region near Pakistan

3.8 Result Eight

Concerning vulnerability of Chitral, Ghizer, Dlamir, Drupper, Swat and Kohistan to seismic activity in Hindu Kush which happens to be close to the border with Afghanistan. Hindu Kush shows seismic activity peaks at two depths, 115 km and 200 km.

The result eight shows the profile for seismic activity for Hindu Kush region being close to the north-western border of Pakistan and points out to the statistical analysis result obtained with respect to the depth of seismic activity in the area shown as inset in the map. Out of the total count of 301 events, only 3 events contribute to the minimum and 268 events contribute to two peaks shown at 112 km and 210 km depths however, there is considerable contributions from the depths around the maximum of 112 km with the swing of variation of 15 km on either side of the maximum forming the cluster of varying depth activity. Similar cluster of varying depth activity is recognized around the 210 km depth.

4 Summary

Although subduction boundary fault of Indian tectonic plate with Eurasian plate passing through Pakistan starts near Karachi and goes straight to north via Khuzdar to Quetta from where it curves around in a loop passing through Dera Ismail Khan and Dera Ghazi Khan and touching the border of Afghanistan at Peshawar goes to Muzaffarabad in Kasmir via Islamabad. But, the threatening sources of earthquakes for Pakistan were located at three different areas. Two sources were inside Pakistan, one around Muzaffarabad in Kashmir and the other around Quetta in Balochistan, while third was located inside Afghanistan but very close to North-western border of Pakistan which can affect the neighboring Chitral, Ghizer, Dlamir, Drupper, Swat and Kohistan of northern Pakistan. After the jolts of October 08, 2005 earthquake of Muzaffarabad and the subsequent long trail of aftershocks have caused the serious geological changes in the affected areas with the result of opening the corridor of seismic activity flow of tremors and jolts even originating from Hindu Kush to easily travel from Islamabad to reach even Multan via Lahore when Lahore was considered safe before the advent of Muzaffarabad earthquake in 2005.

Results 1, 2 and 3 have revealed the accuracy of USGS database through full matching of the results with geo-tectonic boundary lines and the seismic activity frequency mapping in Pakistan as well as location of three sources of earthquakes for Pakistan by considering the circle of 800 km from the center on the map of Pakistan. Result 4 has shown the statistical analysis of the result of frequency of seismic activity in terms of the maximum activity month of the year for all the data pertaining to the period of five years from 2005 to 2009. The remaining results from 5 to 8 have concluded that the real life earthquakes in Pakistan in 2005 and 2008 and the involved areas of Muzaffarabad and Quetta are matching with the results obtained from the USGS database so far the month and depth of maximum activity are concerned.

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Teaching the 'YouTube' Generation:

Exploring the benefits of an interactive Teaching approach in Sustainable Product Design

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Conference Key Areas: Design Education, Sustainable Product Design, Audio Visual Resources.

Abstract

This paper presents findings from a doctoral study, which investigated effective methods for teaching social sustainability within product design courses in British and Irish universities. Specifically exploring, how to foster a holistic understanding of the social aspects of sustainable product design amongst undergraduate and postgraduate students, through design thinking.

Perceived relevance is considered as a fundamental aspect in enabling students to engage deeply with sustainability [1]. Authors [2;3;4] note that 'Net Generation' learners have specific learning preferences that can be targeted in order to improve the students learning experience. Through the careful design of materials which build upon the students tendency towards visual learning and seeking increase relevance and motivation, by offering opportunities for collaborative learning and learning through discovery.

Three 'Rethinking Design' workshops were designed and developed as part of a doctoral study to introduce students to the wider social aspects of sustainability and these were conducted in five universities in Britain and Ireland. The workshops featured visually rich audio visual introductions followed by collaborative group based mind mapping activities, which were successful in fostering deep learning by facilitating learning through discovery, critical reflection, peer learning and creativity leading to an exploration of design thinking solutions.

1 Introduction

This paper presents findings from a doctoral study, which explored effective methods for the teaching of the social aspects of sustainability in sustainable product design (SPD). Specifically this paper considers how the learning preferences of the 'Net Generation' learners were fostered through the careful design of learning materials in the 'Rethinking Design' workshops, which were conducted at 5 universities within the UK and Ireland.

The paper begins with a literature review, which considers the 'Net Generation' and their specific learning preferences, which informed the design of the 'Rethinking Design' workshops. The design and content of these workshops are then described and the findings relating to the relevance of the 'Rethinking Design' workshops and the ability to foster collaboration, reflection and design thinking are outlined and conclusions are drawn.

2 Net Generation Learners

In order to increase the relevance of the workshops the students learning styles, both as designers and 'Net-Generation' learners was considered.

Authors use multiple terms to describe the current generation of students, including the Net-Generation. Oblinger and Oblinger [5] define the 'Net Generation' as individuals born from 1982 onwards [6;3]. This generation would have all typically been using computers before they were 16 to 18 years old [3]. However Oblinger and Oblinger [3] note that the differentiating factor for the 'Net Generation' may be their technological experience rather than just their age. Whilst Tapscott [7] defines the 'Net Generation as those born after 1977, the generation born after 1982 are also referred to in the literature as the 'Millennials' [6;8] and 'Digital Natives' [9]. The Net Generation would typically apply to the vast majority if not all of the students involved in undergraduate and postgraduate study in the UK during the period of the study (2010-2011) and all those students subject to this research study. Allowing for mature students, as an individual born in 1982 would be 28 years old at the start of the main study trials, whilst traditional undergraduate students were be aged between 18 and 22 years.

The Net Generation have differing learning styles and preferences to the generation that preceded them [2]. This is partly due to the influence of computer technology, the internet and the social media upon their lives and also partly subject to the social climate [4] in which they are raised and their response to the attitudes of the previous generations [6].

2.1 Autonomous

'Net Generation' learners in Higher Education prefer to be autonomous learners with a preference for experiential [2], learning by doing [10]. Such students place a greater emphasis on exploratory learning by discovery, whether individually or collaboratively with their peers, to the traditional lecture format where information is given to them [3;4]. Tapscott [7] notes that this exploratory learning style improves students' retention of information, allowing for more creative and meaningful use of knowledge [7].

Oblinger and Oblinger [5] note that the Net generation are very achievement oriented and have a preference for structure, seeking parameters, rules, priorities, and procedures; they are keen to know what it will take to achieve a particular goal.

2.2 Socially Orientated

Net generation students are attracted to activities that promote and reinforce social interaction including interactive learning [2;4], peer to peer learning [3] and teamwork activities [6;3;2;4]. This social nature of the Net generation means that they typically dislike online learning environments or distance learning, [10] despite the technological focus because distance learning lacks the social interaction that a traditional learning environment offers. Tapscott [4] notes benefits of this social approach describing how students start to internalise their learning when they start to discuss it amongst themselves [4]. Oblinger and Oblinger [5] note that a peer-to-peer approach, where students help each other is seen by Net generation students as more credible than a teacher led approach.

Of particular interest to sustainability, it is noted that the Net generation are keen to engage in community activities, preferring to work on things that matter, such as addressing an environmental concern or a community problem [3]. Howe and Strauss [6] similarly note that there is more emphasis on academic programs that serve public rather than individual interests [6].

2.3 Visual Learners

Net generation students are visual learners [8], with enhanced visuo-spatial skills [3;4], who are more comfortable in image-rich environments than with text [3;11;4]. Net generation students retain on average 30% of what they see but only 10% of what they read and prefer to have graphics before text rather than graphics following text [3]. Oblinger and Oblinger [5] note that Net generation learners have a highly developed visual literacy, with the ability to read images and instinctively communicate through visual methods. They are also capable of combining images, text and sound seamlessly [3] and this is demonstrated by the prevalence of amateur You Tube content.

2.4 Multitasking learners

Net generation learners seek and handle information differently to previous generations. They multitask [8;2], quickly shifting their attention from one task to another and can work on two tasks simultaneously [3] and deal with information in nonlinear ways [3]. Net generation learners respond more quickly than previous generations and expect rapid responses in return [3]. However it is suggested that this rapid pace may be detrimental to the student's ability to reflect and adopt critical thinking skills, which is cited as a weakness of the Net generation [8;3].

3 Design of workshop Activities

Three 'Rethinking Design' workshops were developed to introduce students to a range of social aspects of SPD, these workshops were conducted at 5 universities 4 in the UK and an Irish university and were conducted with approximately 150 students in total. Each workshop consisted of two elements, a 3-5 minute audio visual (AV) introduction and a 45 minute group based workshop session in response to the AV introduction.

The choice of these particular elements was supported by the literature, which suggested that the audio visual and group based approach taken with the workshop should be beneficial to the students' learning in a number of ways, such as:

- Increased relevance through the visual methods used [3;11;4] and team work [6;3;2;4].
- Encouraging students to personalise aspects of sustainability through indirect experiences [12] by using carefully selected photographs.
- Group work that builds opportunities for discussion, debate and critical reflection as well as engagement [13;14].

The A/V presentations were designed to be contemporary in style using photographs and music to capture the students' attention, deliberately mimicking internet based media content such as You Tube, where images or silent video are overlaid by a piece of popular music. This style was adopted so that the A/V material was more readily relevant to the 'Net Generation' audience, who are able to weave text, images and sound in a natural way [3].

The photographs used were intentionally selected to portray a number of different aspects echoing the well-known Chinese proverb, "one picture is worth ten thousand words", so that each A/V introduction could introduce a much larger range of social issues than a traditional lecture format could accommodate, if only at superficial level. The use of photographs was also chosen as the literature findings suggest that the use of images can elicit an indirect experience that can foster personalisation of sustainability [12]. Furthermore, Griffith [15] cites the use of introductory audio visual presentations as a means of promoting interest in responsible design amongst students, as well as supporting lecture content and stimulating discussion and activities in tutorials.

The group based aspect of the workshops was developed to further adopt approaches that intended to meet the learning preferences of the students. Including:

- Contextually relevant content in each of the workshops to suit the modules being undertaken at each university.
- Opportunities for collaborative group work to enhance peer learning and critical reflection.
- The use of questioning to elicit reflection amongst learners.
- Fostering deep learning through critical reflection.
- Enabling learning by discovery a learning preference of students.
- Fostering a holistic approach to enable systems thinking.

4 Methodology

The 'Rethinking Design' workshops were conducted at 4 universities in the UK and an Irish University amongst undergraduate and postgraduate product design students. The total sample size was approximately 150 students and the workshops were conducted within modules which considered sustainable design. Data was collected via a mixture of methods including two student questionnaires which were completed prior to students commencing the workshops and immediately after completion to measure differences in individual students understanding and attitudes. Audio recordings and photography was used to record the students interactions during the workshops and the audio recordings were transcribed and analysed alongside the images using coding and clustering techniques. Student reflective diaries were additionally evaluated from the in-depth case study institution and were also analysed using coding and clustering techniques. Coding and clustering was used to analyse the qualitative data because this approach enables data to be reviewed and dissected in a meaningful way whilst still keeping the relationships between the data intact [16].

5 Workshop Findings

The students enjoyed 'Rethinking Design' workshops particularly noting preferences for the A/V and group based nature, which enabled students to demonstrate collaboration, critical reflection and design thinking techniques and each of these is discussed in further detail below.

The group based discussion and workshop exercise demonstrated detailed consideration of the material with students exploring the A/V introductions at a deeper level. Students engaged with the content of the A/V introductions at both a personal level and corporate level.

5.1 Visual nature

The use of photographic images and the visual nature of the audio visual introductions were widely noted amongst the students in their reflections, who described the *'striking'* nature of the photographs and composition and *'the wonderful selection of photos that made them stop and think'*. Students also described how the video nature of the presentations helped them think and remember aspects more easily, with many students noting specific images that were used in presentations. Students also described how they related to particular aspects portrayed in certain images or found specific images inspirational. Whilst specific photographic images were widely noted, a number of students also cited text based quotes from the A/V introductions that were memorable suggesting that headline like quotes were also culturally appropriate, however discussion and reflection was not evident in respect to the text based quotes, whilst the subjective nature of the photographic images prompted discussion, debate and critical reflection.

5.2 Audio nature

Students commented positively in respect to the inclusion of music within the workshops and made links between the music and the visual content. Students made comments relating to the emotional nature of the music and discussed the nature of the lyrics in relation to their enhanced learning and understanding in one workshop in particular 'Step into my World' with a song of the same title. The song lyrics were effective in triggering discussion and thinking that led to a variety of user centred empathic research approaches being suggested including ethnography and co design. With student taking the lyrics literally and considering what it would be like to step in the world of the individuals portrayed in the photographs which accompanied the music. "Lyrics of the song – take a step in my world, this suggests living in one of these peoples shoes for a day". However across the inclusion of music was noted and discussed less than the photographic visual elements.

5.3 Effectiveness of the workshop style and format

Students discussed the effectiveness of the audio visual introductions in particular students responded positively to the style of the A/V introductions, citing the short length and simplicity of the A/V introductions, the thought provoking nature and ability to evoke discussion. The A/V introductions also provoked an emotional response amongst students who commented on how they found them *'powerful'* and noted the emotive nature of the music. *"You look a bit affected by that yeah, it was an emotional video, it was yeah I was a bit upset."*

Students cited the workshops as enjoyable and beneficial, whilst describing how the workshops had helped them broadened their thinking and outlook in respect to their design solutions. "Overall

I thought the workshop was very beneficial as it opened my mind to looking beyond the obvious problem and look deeper into the situation to come up with a good solution."

Students also cited the group work and group discussion aspect of the workshops, recognising the benefits such as the consideration of different opinions and viewpoints. "We then broke off into groups and discussed what we thought of the videos. We had to group with people we don't normally group with which was quite good because we saw different opinions"

One student noted that the group work element of the workshop was particularly beneficial to his learning, echoing the literature, which suggests that the current generation of students find a peer-peer learning approach more credible than a teacher learning experience. "I felt that the group discussion was an excellent approach to the learning outcomes. It is in my opinion that students learn more from each other if they carry out projects in groups."

Students also reflected the conflicting views that arose within the group discussion, recognised that there are often two viewpoints or arguments to a particular issue, grasping an important characteristic of the complexity of sustainability and demonstrating critical reflection.

6 Conclusions

The audio visual method used within the workshops was described as relevant, effective and enjoyable by the students. The students reflected on how the workshops enabled them to engage collaboratively and explore multiple perspectives through consideration of the opinions of their peers, addressing a key element in the understanding of the complexity of sustainability. The workshops also fostered autonomous learning through discovery enabling the students to explore the implications of the content explored within the A/V introductions through peer discussion and debate.

The style of workshops was therefore effective in addressing the learning preferences of the 'Net Generation' and were perceived as relevant and engaging by the students additionally encouraging peer learning and critical reflection. The visual element of the A/V introductions was clearly the most memorable to the students, however the effectiveness of the music was more difficult to measure and appeared to differ dependant on the workshop in question. However it was the combination of both the audio, visual and group based mind mapping aspects together that fostered the learning preferences of the 'Net Generation' and so consideration of the relative effectiveness of individual elements of these is not an easily demonstrable or measurable factor.

The workshops represent a container for the key elements needed to create a learning atmosphere where students can creatively explore the social aspects of SPD holistically through reflection, personalisation and collaboration. Rather than representing a one size fits all approach to the fostering of a holistic understanding of the social aspects of SPD.

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High Academical Performance Program. A Methodology Design for Systemic Improvement of Technological Degrees: Application to Aerospace Engineering.

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Abstract

The Spanish Higher Education system adopted important changes in order to follow the European Education Degree Harmonization. One of the results of this process was the implementation of the High Academical Performance Project [HAP] by public Universities of the Valencian Community in Spain. The aim of HAP is to strengthen the potential of the most outstanding students from their first year to accomplish the highest academic achievement possible. This paper develops an assessment of the implementation of HAP in the degree of Aerospace Engineering (AE), more precisely in the compulsory subject of Business.

1 Introduction

The literature shows how there is relevant research carried out to ensure better training of engineers [1, 2, 3, 4] where interesting methodologies and techniques ranging from (PBL, teaming, curricula development, teacher training), are applied. However, not much work has been developed about the training of engineers with high academic performance.

This paper proposes a methodology, HAP, to improve the quality of graduate students in engineering disciplines and satisfy their motivations. The main objective of the HAP project is to strengthen the potential of the most outstanding students from their beginning at Universitat Politècnica de Valencia (UPV), so as the talented students with the best skills, will get the required help and support to accomplish the highest academic achievement possible. At UPV 5 degrees implement the HAP methodology (i.e., Biotechnology, Computer Sciences, Aerospace Engineering, Business and Management, Electronic Engineering).
This paper focuses on the assessment of the application of the HAP project in the degree of AE, more precisely in the application of the HAP in the subject of Business, a compulsory subject of the first year of AE.

To achieve the aforementioned goals, several actions are implemented:
-Provide the highly motivated students the tools that permit them to develop their skills.
-Development of collaborative work and diffusion of knowledge.
-Meetings with relevant professors and/or practitioners.
-Improve English language skills.
-Development of cross-competences.
-Optimize the size of the group, (max 50 students).

Among the main characteristics of the HAP, the following can be named: 50% of total courses of the HAP degrees are taught in English. In order to enroll the HAP program, the student must show a minimum high school transcripts score of 7.5/10. Likewise, an English level B2 is required. The students must pass their courses in order to stay in the HAP and also must attend extra-activities. These activities consist of attending conferences of professors from top ranked international universities or practitioners with expertise; visits to companies and conferences/workshops. On the other hand, the lecturers who teach at the HAP degrees are required to have earned their tenure, be engaged with the implementation of ICT technology in the learning process and be capable of teaching as an exchange between academic staff with top ranked Universities.

Between the advantages the student gets after participating in the HAP [5] project are:
- Special Mention accredited in the European Supplement of the Engineer Title.
- Preference to obtain scholarships for research from Ministry [6].
- Preference to obtain scholarships from European Union programs [7].

This paper develops an assessment of the implementation of the HAP in Business, a compulsory subject of AE. The degree of AE embraces 4 scholar-years. The course of Business is taught in the first semester of the first year. The subject is an introduction to the management of the company, which implies the knowledge of the companies' environment, production system, marketing plan and financing-investing-process-decision making.

2 Methods

2.1 The HAP

The HAP becomes an access barrier, due to the extra effort that the student is meant to perform.

The main hypothesis (H1) of the study is to show how the implementation of a new education program that co-exists with the previous one in the subject of Business, produces a natural classification of the students based on their attitudes towards future's expectations and self-motivation. As consequence of the first hypothesis, the student enrolled in the HAP achieves a higher performance than the non-HAP (H2) showing a challenging attitude towards future professional expectations, inverting a possible thread into strength.

In order to test H1, we assume that there are not differences related to business knowledge between both groups, but also HAP students may show more interest on the course (self-motivation) (H3). Finally we want to test the HAP student is more likely to achieve an excellent score than the non-HAP student (H4).

However, we assume, HAP and non HAP groups should not show significant differences to reach a pass in the course since all students accomplish the requirements to be accepted in the Degree of AE, which is highly demanded (with a maximum number of 100 students per year), what makes them capable to achieve a pass. Also, the contents, structure of the class sessions, and the professor are the same in HAP and non HAP group.

2.2 Description of the course

The subject of Business is a compulsory course for first year students of the Degree of AE at UPV based on continuous learning process according to the Bologna Agreements [8]. The course means to be an introduction to business environment in aeronautics and there is not required previous knowledge about economics. The content of the course is divided into five modules embracing 15 chapters. The first module is an introduction to business, the second one is related to the production system, the third module bases on marketing, the fourth one focuses on the financial-investing decision making process, and the final one is related to the accounting cycle. Each module is composed of 4 chapters except the accounting cycle module that is structured in three. The duration of the course is 150 hours, spread along the first semester (from the first week of September until the last week of January). The methodology of the course consists of theoretical classes (1.5hour/week), lab sessions (1hour/week), and applied classes (1,5hour/week).

Table 1 shows the methodology applied to the course and its relationship with the number of hours the student devotes to each activity.

Table 1. Methodology of the course and distribution of the time by activities.

	ACTIVITIES (number of hours)				
	Class attendance			Home work	Total
Methodology	TS	LS	PS		
Explanation of concepts	30			30	60
Solution of exercises		15	2	10	27
Work in groups			3		3
Case studies			2		2
Learning based on problems			3	13	16
Learning based on project			3	20	23
Presentation of projects			2	13	15
Evaluations		4			4
Total	30	15	15	86	150
TS=theoretical session; LS=laboratory session; PS=Practices session					

About the requirements of the course, it is relevant to mention that the students must attend at least the 80% of the theoretical sessions, the practical and lab sessions and also obtaining a final grade equal or higher than 5 to pass the course.

2.2 Sources of information

The sources of information of the research can be divided into previous source of information and post source of information of the Business course.

2.2.1 Previous Sources of information

The first day of class, the students were asked to answer a questionnaire in order to measure:

-Their level of knowledge of Business, (from 1 to 10)

-Their level of interest in the subject, (from 1 to 10)

-The grade they would like to achieve at the end of the semester (from 1 to 10)

-The grade they thought they would achieve at the end of the course (from 1 to 10)

2.2.1 Post Sources of information

An important part of the continuous learning system is the constant evaluation of the acquired learning by the student and testing if the concepts and ideas are apprehended. The continuous evaluation is presented as the tool the lecturer uses to check if the student makes progress in the learning process [8]. The learning process is graded through 4 systems of evaluation expressed as follows:

1. Multiple choices exam: written exam with several questions in which the student has to pick the right answer. The evaluation through multiple choices weights the 40% of the final grade. The student has to perform 4 multiple choices along the semester using the Poliformat platform of UPV [9] where the multiple choices evaluation is timed. Each exam weights 10% of the final grade, consisting of 20 questions with 4 possible alternatives where just one answer is right. A wrong answer subtracts one fourth. To pass the semester the student has to obtain a minimum average grade of 5.

2. Project: a didactic strategy in which the student develops a new product through the development of tasks and effectively use of resources. At the beginning of the course, teams of 3 students are organized. Each team chooses a chapter of the course to develop a project. The project will be presented to the rest of their classmates on a specific date. The project report scores 15% of the final grade, while the presentation of the project represents the remaining 15%. The presentations are performed at the end of each chapter.

3. Observation: strategy based on the collection of data related to the topic learnt and development of tasks and exercises. During the lab sessions the students develop exercises and tasks related to the concepts and ideas explained during the theoretical sessions. The weight of this evaluation system will be 15% of the final grade.

4. Co-evaluation: Activity in which the student evaluates his classmates. Each team prepares an exercise about the presented project to evaluate their classmates. In this way, each student performs 14 exercises proposed by their classmates. The weight of this system of evaluation is 15%.

2.3 Research Method

Previous to the course, the students were tested in order to evaluate: their knowledge of Business, their declared interest on the course, their dream grade, and the grade they expected to achieve at the end of the course in the subject of Business. Also they were asked for the reasons to choose the HAP group and vice versa for the non-HAP students.

Then, at the end of the course, we obtained the final grades of each student as a compilation of the different evaluation systems applied. Each system of evaluation meant to be a variable.

Also, the belonging to the HAP group and the gender were codified as dummy variables (HAP student: 1, non HAP student: 0; female student: 1, male student:0)

Then, we built our data bases with the previous and post course sources of information for both groups HAP and non HAP group.

-With the aim of testing our hypothesis 1,2, and 3, we applied non-parametric tests (Mann-Witney; Kolmogorov-Smirnov) to observe if there were differences between both groups.

- In order to test H4, we developed a logistic regression model, in which our dependent variable is the student who has a final grade higher than 8.5/10, and the independent variables are the gender, the group, the previous to the course sources of information.

3 Results

Firstly, as the authors assumed there was no difference between groups related to their previous knowledge.

On contrast, we found significant differences between both groups related to the interest declared by the student in the course at the beginning (pre source of information). In fact the HAP students' interest was higher on average (8.17) than the non-HAP ones. (7.86).

Also, between groups was relevant the difference related to the grade dream, (higher for the HAP group), as for the grade expected by the student at the end of the semester.

As a result of the logistic regression, we can observe how just two variables resulted significant in the analysis, the gender and the belonging group. In particular, a female student is 6.28 times more likely to achieve an excellent than a boy. Also, a HAP student are 11.3 times more likely to achieve an excellent than a non-HAP student.

4 Summary

We can state that HAP means to be a mechanism through which students group by their own attitudes toward challenges and self-motivation. Those students who chose the HAP group showed higher level of interest, and also their dreamed grade and expected grade were higher than the non-HAP students. As a result, those students whose choice was HAP group reached on average a higher performance, and as the logistic regression model showed, are over 11 times more likely to obtain an excellent than the non HAP students. Also the female students showed a higher level of achievement, even when their rate of participation on the Degree of AE is low (30%).

The HAP is not only a mechanism to favor the learning process [10] but also a human behavior process through which the individual, in this case a student learns in the teams with his closest mates with those that is more related, reinforcing the links in the group.

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Formula Student UPV

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Abstract

The student's participation from the Polytechnic University of Valencia in the international competition Formula Student and the teachers collaboration in the area of manufacturing processes has created a framework for the academic improvement. This article describes the conceptual and ideological framework of the project and also future works

1.- Introduction

Design and manufacture a racing car, acquire new skills and transversal competences, is undoubtedly one of the most exciting teaching frameworks. It is not easy to evaluate these skills in time, ECTS or curricular items, but it's not important. Students participate only for the passion of design, manufacture, compete and, of course, for pleasure. Collaborative work, coexistence and the work brings great pleasure to the team members.

The Formula Student competition has its origin in the Baja SAE competitions organized by the Society Automobile Engineers (SAE) in USA. The objective of this student's competition is to manufacture and design a car similar to a car-cross. In the year 1979, Professor Mark Marshek (University of Houston) proposes a new kind of competition, giving different freedoms of design and changing the rules in a drastic way since then both are organized in USA; Formula SAE and Baja SAE (Figure 1), and both competitions are international references for the automobile engineering industry [1].

Figure. 1. Baja SAE and Formula SAE vehicles

The first Formula SAE competition, in its current version, began in 1981, when the University of Texas and the SAE (Society of Automotive Engineers) organized the first Formula SAE event. There were 40 students and six teams. The European version began in 1998 in the UK and was given the name Formula Student to differentiate it from the American Formula SAE. Different societies and countries have been encouraged to organize this competition; like Germany, Japan, Brazil, Australia, Spain, and many other countries. The basic rules are always the same and the results are recognized worldwide, thanks to the media participation. Although there are standards rules for all competitions and they can be customized for each competition [2].

The working environment of this type of competition is closely related to the manufacturing processes area, and since the beginning the team has tried to link the activities of students with the subject contents and vice versa. This article is devoted to remark the activities undertaken by the students in collaboration with the faculty advisor. Specifically, the study focuses on the subject of Aerospace Manufacturing, Aerospace Engineering Degree (GIA) of the School of Design Engineering (ETSID) of the Universidad Politécnica de Valencia (UPV). The student group was born in the GIA, but now almost all the UPV engineering schools participates. This competition is recognized, for their technical affinity and media coverage, as the Formula 1 of the Universities (Figure 2). The project is highly multidisciplinary: Design, Mechanical, Industrial Technology, ADE, Electronic, Materials, Mechatronics, Telecommunication, and many other areas.

Figure. 2. Formula Student

2.- The team

The team consists of 36 students; 30 undergraduate students, 2 masters degree students and 4 PhD students. The mission, vision and values of the team are:

- Create a multidisciplinary team committed to train engineers
- Becoming a benchmark in the competition
- Continuous learning, motivation, innovation and development

After nearly two years working with the support of ETSID, vehicle design was completely finished and the support of the UPV governing was received in February 2014 (figure 3).

Figure. 3. Formula Student UPV

The development of this project is only possible with the involvement of the University and sponsors. A great effort was dedicated to the marketing area, visiting companies and presenting the project in different environments. In figure 4 the main schools of the UPV and company's partners are showed.

Figure. 4. Schools and company's

The technical team organization was made by disciplines; Electronics, Chassis, Powertrain, Brakes, Aerodynamics and Suspension. Also, there is a division responsible for the dissemination and uptake of sponsors called Marketing. The participation in social networks and a custom made website [3] is also an important tool that has been used to reach a higher percentage of people. In Figures 5 and 6 there are some examples of the works made in this field.

Figure. 5. Team participation in social networks

Figure 6. Direct advertising for companies and sponsors

3.- The competition

The objective of the competition is to simulate a real industrial environment. It can be said that it is a company that is hired by a racing team to build and design a formula prototype. Therefore the car must be competitive, and with the best performance in acceleration, braking, and stability, but also it should be easy to maintain (cheap, and reliable). Other factors such as aesthetic and comfort are a plus factor. The cost of the vehicle, is obviously an important fact to take into account as it is also evaluated at the competition [4]. Students have limited experience in manufacturing cars, and therefore, a substantial increase in cost and development time is acceptable.

The competition is divided into two main events; static and dynamic events. Static Events evaluate the design, manufacturing costs and corporate team presentation. And dynamic events are: Skid-pad, Acceleration, Autocross, Endurance and consumption that evaluate the dynamic behaviour of the Formula (Figure 7).

- *Skip-Pad*
- Aceleración

- *Autocross*
- *Endurance*

Figure 7. Dynamic events

4.- The “icing of the cake” FSUPV - 01

Undoubtedly the "icing of the cake" is the vehicle, designed and manufacture by the FSUPV team members. The main features of this vehicle are (Figure 8):

- Structural elements Manufacture with high performance composites materials.
- General composite materials manufacture with carbon fiber and epoxy resin (prepegs technology)
- Molds and tooling designed and manufactured by the team
- Internal combustion engine power 80hp (power to weight ratio 2.65 kg/hp)
- A total weight of 210 kg
- Additive manufacturing of engine intake manifold
- Vehicle design with strict security measures against impact. It has been used foams specifically designed to absorb energy during deformation.

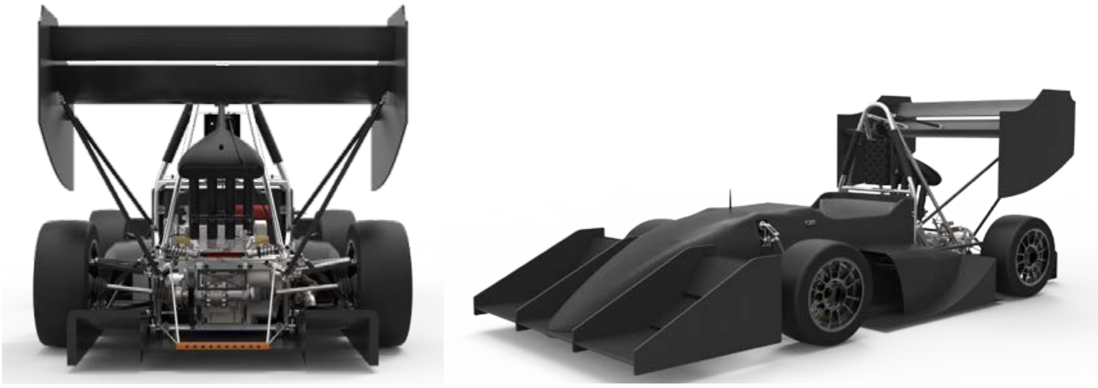

Figure 8. FSUPV-01 design

5.- Lab work and teaching collaboration

Thanks to the collaboration between students and the university, the subjects of manufacturing processes have been improved. It has also developed a lot of technical information, presentations and demonstrations. It is complex to summarize the work done in the laboratory by the students, covering many disciplines. Following, some of them are listed, especially the ones related to the manufacturing area:

Three axes CNC machining

Used for the manufacture of molds and tools for composite material parts fabrication as can be seen in figure 9. The technology selected for the manufacture of the carbon fiber parts is pre-impregnated materials.

Figure. 9 Three-axis CNC equipment and pontoon part mold [5]

Five axes CNC machining

Many parts of the vehicle have warped surfaces impossible to manufacture for a three-axis machine tool. To save time and costs, a pre-machining in three axes was made, finishing with a five axles CNC machine as ca be seen in figure 10.

Figure 10. Monocoque manufacture with 5axes CNC machine (Hertalla [6])

Universal testing machine

The structural parts of the vehicle, especially the monocoque, are sandwich fiber-Nomex-fiber. Each part of the cockpit had to be tested and pass a technical report to verify that the design is correct and complies with the rules. In figure 11, one of the test examples and machine it is seen.

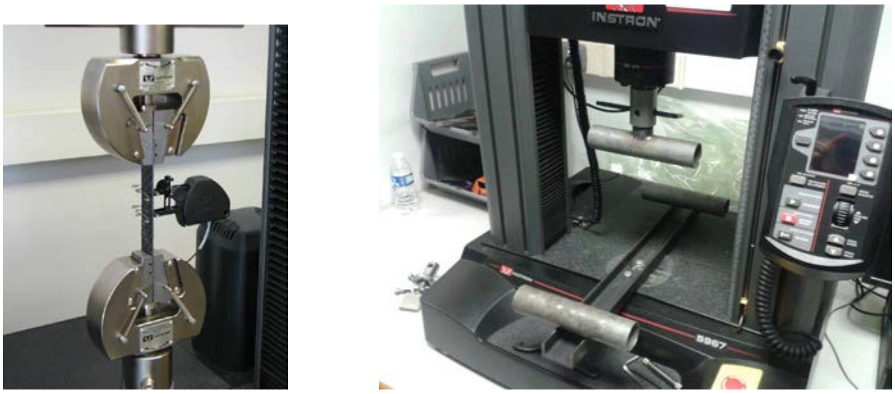

Figure 11. Universal testing machine

Oven

The manufacture of composites by prepreg needs high temperature, about 100° C depending of the used material. This equipment was not available in the UPV, it has been designed and manufactured by the students with a PID to control the temperature using a thermocouple sensor, figure 12. Both, the composite material and the mold of wood, require a careful control of heating ramps, maintenance and cooling. The technology that has been used is the "Out of Autoclave (OOA)" which, as the name suggests, avoid the use of expensive autoclave curing systems.

Figure 12. Oven for curing composite parts and mold curing part

Laser cutting machine

This equipment allows precise cutting of soft materials such as wood, cardboard and plastic. It is not possible to use it with metals because of its low operating power 60W. It has been used to cut patterns and templates as it can be seen in figure 13. Also, the manufacture of airfoils for wind tunnel testing was manufacture with the laser.

Figure 13. Laser CNC cutting machine (60 Watios) and cut airfoil ribs

Additive manufacturing

The additive manufacturing equipment's available in the UPV are essentially 3D printers that allow the fabrication of small prototypes. These machines do not provide sufficient quality for automotive parts. However, a great work of documentation and collaboration with companies has been done. The intake manifold (figure 14) was specifically designed and manufactured with the dimensions and geometries that optimize the air mass flow entering to the engine.

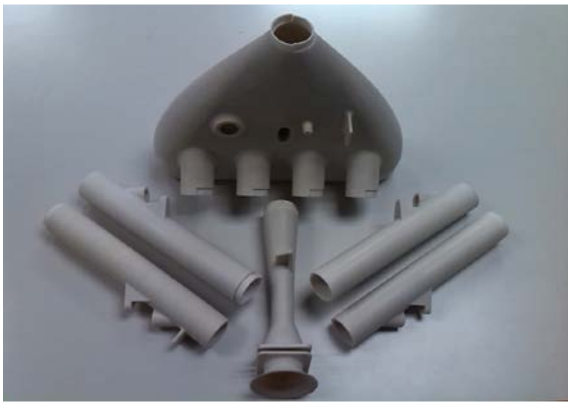

Figure 14. Manifold manufactured by Additive Manufacturing polyamide [7]

6.- Summary

A student's interdisciplinary group of people has been created to work in the manufacturing processes subjects. The student's collaboration across the activities is the perfect framework to settle down the knowledge acquired by the conventional teaching activities.

7.- Acknowledgements

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Engineering as a tool for International Cooperation

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Conference Key Areas: International Cooperation Programmes, The Global Engineer, International Networking
Keywords: Engineering, Human Development Index, Cooperation.

Abstract

This paper revisits the concept of Human Development Index and tries to show how International Engineering helps quite a lot in terms of improve HDI. We decompose such a general term and try to give a solution to some of the parts. Some examples and a general International Cooperation Engineering Project structure are also given.

1 Introduction

The main objective of this article is to help those related to engineering or science in general who want to make international cooperation projects and have no previous experience. Initially shown how such a general concept as the index of human development can be improved through university cooperation projects . then some national examples that can help you get a main idea of how to help in international cooperation .

once we know the need for this type of project for international improvement (both areas and populations and institutions) a general structure of projects and some practical advice that comes from the experience at the University of Cádiz (shown for 8 years first country in international development cooperation in national programs) .

Finally projects at European level is to show that inter-university cooperation should be established between countries not only the first and third world, or between continents. From the first time that two institutions are contacted to collaborate, both derive benefit .

Of course the people who signed this work we are available for any partner who wants to ask questions or ask for help in the development or approach this type of project , highly satisfactory and necessary to meet the social work that universities have with the public.Human Development is a development paradigm that is about much more than the rise or fall of National incomes. It is about creating an environment in which people can develop their full potential and lead productive, creative lives in accord with their needs and interests. People are the real wealth of nations. In the report published in 2011 the Human Development Index fluctuated between Norway with an index of 0.943 in the first position to 0.286 Democratic Republic of Congo in the post 187

2 State the problem

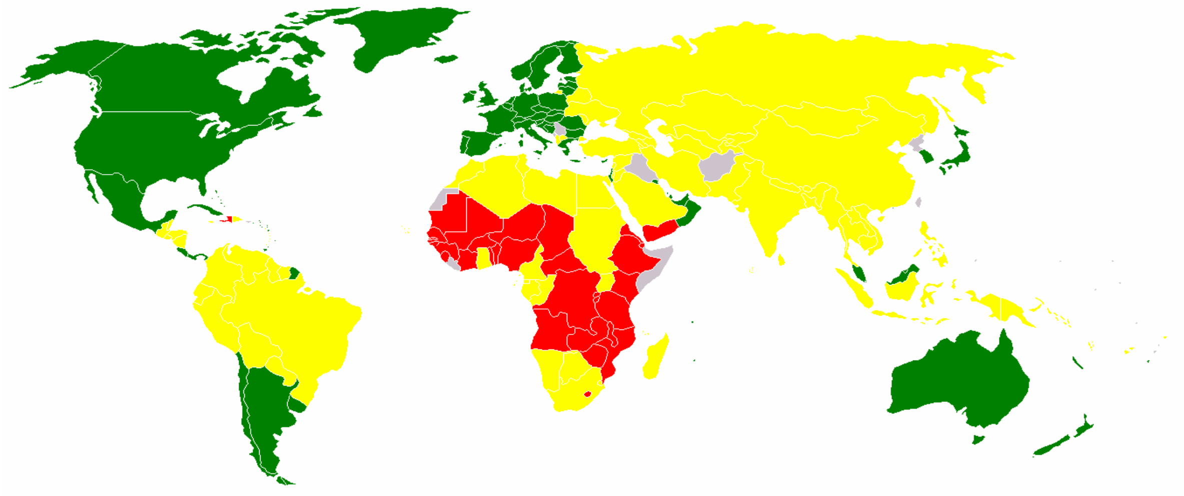

Fig 1.

The map (Fig 1) and the list of countries help us to understand the problem. The main idea is, from the point of view of engineering, to improve the human development index of the countries listed. Differentiating in high, medium, and low, we can find countries that were expected in a group but after being in another. This is because we find certain aspects of the concept of human development which we thought were so important, and they are.

So, what can we do from our Institutions? Break down the concept of Human Development and try to help in such a general term. This is the very first point for an Engineering Project.

International Human Development=

Life expectancy at birth
+
Mean years of schooling
+
Expected years of schooling
+
Gross national income (GNI) per capita
+
GNI per capita rank minus HDI rank
+
Nonincome HDI value

At this time we find the decomposition of HDI in its main terms. Now select those in which there is possibility of changes from the University Institutions. The selected and marked in red.

International Human Development=

Life expectancy at birth
+
Mean years of schooling
+
Expected years of schooling
+
Gross national income (GNI) per capita
+
GNI per capita rank minus HDI rank
+
Nonincome HDI value

And rename the items so we can have academic fields related with the parts of the HDI.

International Cooperation in Universities=

Healthy, Security
+
Educational and Academic Cooperation
+
Research, Technology, Business
+
Arts, Humanistics, Environment

Then we have found how from universities and research centers we can assist in the overall improvement of the countries through development cooperation projects in many academic areas and subjects.

3 The country working. The Spanish Example

One of the actions developed by Spain is the Interuniversity Cooperation Program and Scientific Research. With the 2003 call came as an evolution of ancient INTERCAMPUS, comprising nineteen Latin American countries that now make up the program and Tunisia and Morocco. It was with the 2008 call when they joined these two countries in the Mediterranean area and including the participation of Egypt, Jordan and Algeria. Finally, today we have a single call, which covers three geographical areas such as Latin America, Mediterranean and sub-Saharan Africa.

The Main Aims are two: Contribute to strengthening the academic and research institutions in partner countries through activities to create or improve institutional capacities, teaching, research and transfer of knowledge and technology. And contribute to the generation and application of scientific and technological knowledge in areas critical to development, according to the international agenda for cooperation, the Millennium Development Goals, objectives and horizontal and sectoral priorities of the Spanish Master Plan of Cooperation.

Focusing on Engineering actions for institutional strengthening. We can have several integrated activities. The integrated activities will involve several departments or units of the institutions of the partner country and in any case, reflect the Improvement and modernization of the academic administration, strengthening research trends and scientific innovation, or promote of IT and e-learning.

Some specific examples:

1. Development and evaluation of tools for optimizing moleculars finfish and shellfish, University of Havana (Cuba)

2. PhD and quality management - Don Bosco University (El Salvador)

3. Mediation and arbitration in resolving conflicts - Catholic University of Santiago de Guayaquil (Ecuador)

4. Change in the organizational system of economic and financial management at the University of Havana. Improved management - University of Havana

5. Food security pilot project for commercial exploitation of tilapia in rural communities. University of San Carlos (Guatemala)

All of them developed in Center America, please notice the thematic difference with these in Mediterranean Sea:

1. Study of wastewater high in heavy metals and organic compounds of economic interest with microalgae. Application to industrial wastewater from the city of Tanger. Faculté des Sciences et Techniques. (Morroco)

2. Reliability analysis and seismic design of reinforced concrete buildings. - Universite Abdelmalek Essaadi. (Morroco)

3. Studies of adaptation of European Master in Quality in analytical laboratories in the UAE - Faculté des Sciences et Techniques. (Morroco)

4. Assesment and Interaction in Teaching Skills and Units in Computer Engineering.
Princess Sumaya Universiy for Technology. (Jordan)

3 Come with us

Well now maybe you are interested in begin to walk this path, but how? You have several topics to work, but more important is the general structure of a Project. Here you are:

Coordinators Data

Action data

Adaptation of horizontal principles
- Human Rights
- Cultural diversity
- Gender
- Democratic Governance
- Environmental Sustainability

Aspects involved in the action

- Improvement and modernization of the academic management
- Strengthening research trends and scientific innovation
- Infrastructure support for general use
- Libraries and documentation
- Promotion of information technology and communication
- Other objectives of particular value for the center

Engineering area

Project Description

Integration of institutional development action counterpart

- Development and sustainability of action
- Objectives and action components
- Justification of equipment

Proposed Work Plan

Feasibility: match between objectives and means

Capacity building in partner institution

Multiplier effect of the proposal: potential beneficiaries

Estimated cost of the action

4 Some specific Hints

it is very important to use the concept of Transfer of Innovation when we want to develop an International Cooperation Engineering Project. One solution, just a service or product, used with success in a source area, can be reused in a destination area. Is the concept of adapt existing innovative practice for use in new settings, through working with national of transnational partners.

Dissemination and exploitation of results is a key feature of International Cooperation Projects. It is also important that you involve your target groups and ultimate beneficiaries in developing and delivering your project. A good application form should also clearly demonstrate the impact on target groups, systems and practices. It should also clearly explain how the sustainability of the project activities and results will be ensured.

The Work Programme is an important part of your application as it will provide information on how you and your partners plan to achieve the aims and objectives of your International Cooperation Project.

Two concepts are crucial to the work programme: consistency and relevance. The overall Work Programme (and individual work packages) must be consistent with, and relevant for, the identified objectives and the expected results of the project. At the same time, the various activities should be balanced and well planned.

The Work Programme should clearly outline the tangible outputs (including results) that will be delivered, when and in which format they will be delivered. The outcomes should stem directly from the aims and objectives of the project and should be appropriate for the aims and target groups involved. The Work Programme should provide details for developing all the outputs/results identified.

The Work Programme should be divided into work packages. Key work packages such as Project Management and Dissemination should be included. The evaluation and quality management plan should also be part of the Work Programme and should be a part of project activities from the start.

Each work package should clearly explain its aims, the role and task of each partner involved, the role and task of sub-contractors (where necessary), the working methods and techniques, and the expected outcomes/results of the work package.

To demonstrate the experience of project's partners, management of work packages should not be the sole responsibility of one partner. A good Work Programme will see project partners share the responsibility of managing work packages.

The work packages and timing of proposal activities should be realistic for the activities to be carried out and clear indicators to measure the progress should have been identified.

The first steps for International Cooperation Projects will include the following:

- Identifying and analysing targeted user requirements
- Selecting and analysing innovative content to meet these requirements and analysing the feasibility of transfer
- Integrating (or certifying) it in European, national, regional, local and/or sectoral Engineering systems and practices.

This implies:

- Adapting it to the training systems, culture, needs and requirements of targeted users (updating the product, etc.)
- Transferring it to new socio-cultural and linguistic contexts. (Don´t forget we look for improve HDI)
- Using it in new sectors or new target groups, including piloting it in public or private structures.

4 European Projects

Mixing Engineering (Industrial, Software Engineering, Management Engineering) topics. Both of them are funded by EU Comission.

Project Name: EU Women. The EU Women project aims to increase the number of women considering self employment by developing a tailored pre-enterprise learning programme and making it available online. The project involves partners from Bulgaria, Czech Republic, Italy, Lithuania, Portugal, Romania, Spain and the UK.

The EU Women project has:

□□ developed innovative pre-enterprise learning materials for women

□□ focused on the needs of women who face particular challenges (e.g. those with few formal qualifications, those experiencing socioeconomic deprivation, those who have withdrawn from the labour market to raise a family)

□□ assisted women participants across Europe to develop new pre-enterprise skills and enhance their personal growth

□□ involved the transfer of knowledge and innovation along with the sharing of best practice between partner countries

Results and Impact

The project aims to: enable women to learn about pre-enterprise; empower women to take the next step towards self employment; facilitate the transfer of knowledge, innovation and best practice between partner countries; contribute to the economic development of member states.

Project Website: www.euwomen.org/

So we can see is not necessary to leave the Continent for improving HDI in our countries.

Project Name: Pathways to Work: an Employment Upgrade Training Programme for Young Immigrants This project aims to develop a training resource to help young immigrants (aged 18 – 30) to overcome barriers and “upgrade” their employment level, as it is only through their increased skills, adaptability and insertion into higher quality jobs that they will fulfil their potential in the labour market, as well as enjoying greater personal growth and social integration.

The project aims to:

□□ Design and pilot a web-based information/training resource specifically for young immigrants looking to gain employment that more closely matches their skills, qualifications and experience.

□□ Adapt existing products by taking into account the specific needs of Immigrants and Ethnic Minorities in gaining employment across the partner countries.

The resource tool will provide interactive information/training materials for new and existing businesses consolidating current resources into one easily accessible vehicle.

Project Website: www.pathwaystowork.eu/

5 Now you have enough for a starting or turning point

So the authors only want to wish you good luck, and thanks in advance.

Team-teaching collaboration between Colombia and Spain to improve English language skills of Engineering students

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Conference Key Area: Internationalizing the engineering curriculum, Education and Research.
Keywords: CLIL (Content and Language Integrated Learning), Language Learning, Civil Engineering, international collaboration, Team-teaching.

Abstract

Technical universities nowadays are seeking a high degree of internationalization. The learning of foreign languages, especially English, plays a crucial role within such an offer. This paper describes a teaching and learning cooperation project called BEELT between two universities (*Universidad Nacional de Colombia* and *Universitat Politècnica de València*, in Spain) whose principal objective is to implement the CLIL (Content and Language Integrated Learning) approach, active teaching methodologies and the approach known as Team-teaching in order to develop and improve the communicative competence in technical English of Civil Engineering students. At both institutions, two general Engineering units (Materials and Structures) that are taught within the Civil Engineering degrees, have been used for the project. It also makes use of ICTs. In the proposal, two teachers –a Civil Engineering and an English language teacher- teach some subject matter in a joint and coordinated manner. In this paper, firstly, the rationale and fundamental issues behind these two methodologies (CLIL and Team-teaching) are discussed. Secondly, the collaborative teaching project between both universities is presented. Finally, some conclusions are drawn on the advantages of the project and the feasibility of extending it to other contents and subjects in the future.

1 Introduction

In an increasingly globalized world and technological market, technical universities should ensure a high level of internationalization in the education of future engineers. This general objective, when put in practice, may be carried out at various levels, from university management to specific teaching and learning innovation approaches. This paper deals mostly with the latter, since it is through effective teaching and learning that universities will become really international. Nevertheless, in internationally-focused teaching innovation projects such as the one presented here, a high level of managerial support should be put in place by the institution's stakeholders and there should also be coordination of multiple factors so as to foster the fulfillment of the project's objectives.

The two universities involved in the project presented here, i.e. the *Universidad Nacional de Colombia* (UNAL) and the *Universitat Politècnica de València* (UPV), Spain, have a clear international dimension that may be shown in their strong interest and involvement in international cooperation programmes and projects, their support for the integration of foreign languages, especially English, and, more specifically, in the long tradition of bilateral international collaboration among these two universities, both at the teaching and the research levels. In addition, both institutions offer lectures in the English language, although in a quite different way. UPV offers Technical English subjects at the B2 level within the syllabus of its Engineering degrees, that is, integrated with official teaching, whereas UNAL offers B1- and B2-level general English courses through the International Office of its Faculty of Engineering.

In the teaching offer of a modern university world where academic, research and labour markets become increasingly international, training in second and foreign languages, especially English, plays a crucial role. English is the lingua franca of society, academia and, most importantly, of business and industry. On the other hand, Engineering students must be equipped with technical content knowledge and skills in order to carry out various fundamental aspects of a profession that nowadays is developing at a very fast pace. In this context, and given the widespread constraints of today's higher education syllabuses and courses of study, in terms of available time and resources, the integration of content and topics from different subjects and across disciplines may be considered as a coherent teaching approach in the design of modern university programmes. The project suggested here advocates such an approach, since it establishes a methodology to teach both English and a Civil Engineering subject in a joint and coordinated way. It must be said, though, from the outset, that this work is about a project that is still at the proposal stage, and has not been implemented yet.

Therefore, in this paper a proposal is put forward for a teaching and learning cooperative project to be carried out jointly by these two universities (UNAL in Colombia and UPV in Spain) whose major objective is to implement the new technologies of virtual teaching and the so-called Team-teaching approach in order to develop and improve the communicative competence in technical English of Civil Engineering students. The project has been named BEELT (which stands for Building Engineering through English Language Teaching).

Both institutions offer subjects within their Civil Engineering degrees which are related to topics of general interest for a wide range of Engineering students (not only Civil Eng.), and in both institutions these subjects share a core of broadly equivalent content matter. They will be discussed in detail below as they are the basis of the project. The aim of the collaborative teaching project proposed here is to make use of POLIFORMA-T, an online learning platform developed and used at UPV, in order to create and display interactive multimedia educational materials, in English and Spanish, which are integrated within the syllabus of the abovementioned subjects, so that they may be extensively used at both universities. Videos and other instructional materials and tasks are developed that are equivalent and usable for different subjects and are created in both languages, so they may be taught through the POLIFORMA-T platform. Another complementary proposal within the frame of this project is the implementation of the teaching methodology known as team-teaching, for common content. Through this methodology, in the selected modules, two teachers –a Civil Engineering and an English language teacher- jointly teach some of the subject matter in a coordinated manner. In this way, Engineering students learn technical content in English as a vehicular language, thus developing and improving their knowledge and communicative skills in this foreign language. This in turn implies the implementation of another major active teaching methodology called CLIL (Content and Language Integrated Learning), which has proved to be highly effective in developing the communicative competence of foreign language students. In this paper, firstly, the rationale and fundamental issues behind these two active methodologies (CLIL and Team-teaching) are discussed. Secondly, the collaborative teaching project between UNAL and UPV is presented. Finally, some conclusions are drawn about the advantages of the project and the feasibility of extending it to other contents and subjects in the future.

2 Rationale and theoretical framework of the project

BEELT is based on three ideas or approaches which together form the foundation of the project. It is through their synergy that the teaching and learning processes in the project can be developed. These three major pillars of the project are:

a) *CLIL* (Content and Language Integrated Learning): a teaching methodology that integrates specific subject matter and language teaching.

b) *Team-teaching*, i.e. the coordination of two lecturers from different background disciplines to teach both disciplines in a joint educational endeavour.

c) *TEL* (Technology-Enhanced Learning), which makes a pedagogically sound use of technology (in this case, Information and Communication Technologies, or ICTs) as an integral part of the teaching and learning process.

These three fundamental aspects of the project provide the theoretical framework that supports and helps to fulfill the primary objective of the project, that is, the teaching of an Engineering specific subject through the English language with the support of new ICTs, thus improving the students' knowledge and skills in three crucial facets of their academic curriculum: the Engineering subject content, the communicative competence in English and the proper use of ICT-based tools and resources to enable autonomous learning. Each of these three basic pedagogical features of the BEELT Project are discussed next.

2.1 Content and Language Integrated Learning (CLIL)

The term CLIL was coined in the 1990s and was adopted by the European Network of Administrators, Researchers and Practitioners, i.e. EUROCLIC, soon afterwards [6] to refer to an innovative language learning methodology that implies the teaching of a subject matter of the curriculum -i.e. a specific content- through the use of a language different from the students' native language, and therefore provides the teaching process with the added value of a dual aim [15]. We also agree with this researcher when, more recently, he points out the motivational factors promoted by CLIL, in connection with the learning-by-doing philosophy [16].

The CLIL approach is based on a two-fold assumption. First, language is a complex set of skills and competences that is primarily void of subject matter, and, therefore, language can be taught by using the context of any given subject matter, which is normally referred to as content. Second, the joint teaching of language and a specific content in a coordinated manner enhances the acquisition of both the foreign language and the content. Although the research literature does not seem to draw sound conclusive results on the benefits of CLIL in terms of students' learning outcomes and performance [2] [3], positive reports from practitioners and recommendations from prestigious institutions, such as the EU [5], provide strong justification for the implementation of the CLIL approach and pint point at its pedagogical advantages.

Although CLIL has sometimes been compared with language immersion, there are major differences [12], but both approaches are said to be beneficial for effective ad-hoc language acquisition. Moreover, when CLIL is implemented in a pedagogically coherent way and with the appropriate resources, it goes far beyond the mere sum of its components, namely content and language [21]. It is this didactic potential brought about by the synergy of the different CLIL components which has been so appealing to researchers and practitioners alike. This is also an added educational value that the BEELT Project wishes to attain, through the teaching of Civil Engineering content through English.

The adoption of CLIL is a multidisciplinary and multifaceted approach, for several reasons, related to CLIL's goals, its pedagogical features and its principles [17]. In the first place, this methodology has a threefold focus and its goals are the jointly development of three groups of skills: content, language and learning skills. Secondly, the 30 core features of CLIL have been divided by these researchers into six groups (multiple focus, safe and enriching learning environment, authenticity, active learning, scaffolding and co-operation), corresponding to the cognitive dimensions of the methodology. Thirdly, the driving principles of CLIL, which also act as reference for lesson planning and task design, are the following: cognition, community, content and communication. All of these aspects of CLIL must be taken into account throughout its implementation process [17].

The CLIL methodology has been institutionally supported both in Bogotá, Colombia and in Valencia, Spain, most extensively (and almost entirely) at the primary and secondary education levels. In the Colombian capital city, the programme known as *Bogotá Bilingüe* [18] aims at implementing bilingualism and the CLIL teaching methodology in English in a series of economically disadvantaged schools in Bogota, as a way of social and educational development. In Valencia, in turn, the regional government is also involved in a plan for supporting the progressive implementation of CLIL within primary and secondary education curricula[1]. Nevertheless, this methodology is not yet

[1] For further information on the programme in Valencia, the following institutional website may be consulted: http://www.cece.gva.es/per/es/sfp_81_plan.asp

a mainstream teaching approach in Spanish universities, although it is becoming increasingly widespread. There is no reason why CLIL should not be an integrated methodology within higher education institutions, especially when there are strong links between CLIL, ICT-based teaching and LSP (Language for Specific Purposes), which could be somehow regarded as a previous step leading towards the more integrative CLIL approach [9]. The BEELT Project aims at bridging the gap between those methodologies at the tertiary level. It should be noted, though, that, in this project, CLIL will only be applied to the actual teaching of part of the selected Engineering subjects and topics, due to the constraints related to the international nature of the project.

2.2 Team-teaching and teaching cooperation

Team-teaching is a much more general term than CLIL. Generally speaking, team-teaching refers to the co-presence of two or more tutors or teachers to teach the same subject matter, or content. Nevertheless, examples of best practice suggest that such an approach should not be simply an addition of teachers, but it must ideally provide the teaching process with a pedagogical added value, since each individual teacher brings about his or her own expertise, background knowledge and skills, thus enriching the learning experience of students. Team-teaching or collaborative teaching involves collaboration among the teachers on the planning and execution of the course work for their group of students, typically including a number of "classes". This type of teacher collaboration, like in the case of CLIL, also provides the teaching process with the power of synergy, since the learning experience is enhanced by the coordinated efforts of a team of specialist teachers, as reported in some studies where significant gains in student achievements have been observed [4].

The team-teaching approach, therefore, offers a series of pedagogical advantages, but, on the other hand, it also requires a high degree of commitment and coordination, which at times can make it difficult to manage in practice. As Melissa Leavitt put it,

> "*Team teaching boasts many pedagogical and intellectual advantages: it can help create a dynamic and interactive learning environment, provide instructors with a useful way of modeling thinking within or across disciplines, and also inspire new research ideas and intellectual partnerships among faculty. To experience the full benefits of team teaching, however, instructors must adjust their course planning and classroom management strategies to accommodate a collaborative approach*". [13]

There is a lot of flexibility in the way team-teaching may actually take place in a given educational context. In English Language Teaching, Maria Dove and Andrea Honigsfeld identify six models in which collaborative teaching may occur, depending on the number of student groups and the roles of the teachers [7]. In the BEELT Project, there is one student group (at each university) and two teachers for each selected subject, i.e. one English teacher and one Civil Engineering teacher, teaching the same content cooperatively. But again, the team-teaching configuration is not implemented for the whole subject, for the same reasons explained in the case of CLIL.

2.3 The implementation of ICTs in teaching and learning

The third tenet in the rationale of the BEELT Project is the pedagogical use of the Information and Communication Technologies (ICTs). Universities nowadays make a widespread use of these technologies, most commonly through specific online tools that assist the management and delivery of courseware, such as subject websites or Online Learning Environments (OLEs). The most usual approach to the implementation of ICTs in higher education is blended learning. According to some researchers, this is the most appropriate format of instruction, at least from the point of view of the students and in the context of Computer Assisted Language Learning [8].

When technology is used to enhance the learning experience, it is convenient to bear in mind that the ICTs, or any other technology, should not be used for its own sake, simply because it is new or trendy, but because it is driven by pedagogical criteria, rather than by simply technical ones. According to Jordi Adell, technology should help us either to do something we could not do without the technology, or to do something we could already do before in a better way [1]. Thus, in order to take full advantage of the technology for teaching and learning, it is crucial to know what the technology can do better and what it can do worse than more traditional methods. In this way, the teaching can be efficiently devised accordingly.

At a general level, the ICTs represent a change of paradigm in the way both information and communication are dealt with. Internet and the Web, for instance, have radically transformed three basic aspects in information, namely its access, distribution and design. Regarding communication, Computer Mediated Communication (CMC) has arguably become the most important functionality of the Web and Internet nowadays, in the broadest sense. CMC is at present the predominant feature of the Web [20], integrating the most significant innovations of this environment. These important changes affecting information and communication have substantial implications in teaching and learning. In fact, ICTs in general and the Web in particular, help us to successfully perform fundamental verbs (actions) in our life, such as learning and teaching [19].

Heimans [10] notes that when ICTs are used for teaching and learning purposes, they entail a modification in the roles of learners and teachers Thus, the learner moves towards the centre of the learning process, playing a much more active and multidisciplinary role, whereas the teacher becomes a less central figure, acting as a facilitator and an experience designer, rather than a knowledge provider. In the context of this paradigm shift, there is a series of roles and functions carried out by the ICTs when used in teaching and learning, which may be summarized in the following ones: (1) facilitate the learner's independence and autonomy; (2) promote interactive work; (3) provide direct feedback; (4) enable the change in roles between learners and teachers; (5) easy and continuous content update; (6) quicker access to materials; (7) opportunities for individualized learning formats; and (8) facilitate a more social type of learning. [11]

In the specific context of language learning, and also in the implementation of the CLIL approach, ICTs can be used in a variety of ways, including, among others:

- As an environment to present learning materials
- As a resource for language practice
- As a tool for learners to become real authors (easy publication and authorship)
- As a way of carrying out computer-assisted assessment
- As a place to find and retrieve reference information
- As a communication tool
- As a facilitator of collaborative work
- As a simulation tool

The online platform POLIFORMA-T, through which the BEELT Project will be carried out, incorporates tools and resources to enable all of these possibilities. In practice, this implies a new learning culture, which goes far beyond simple language (or content) learning. The language/content teaching/learning process assisted by ICTs, as implemented in the project, promotes a series of active methodologies, in addition to the added value of an enhanced transmission of information and instructional content and the possibility of establishing professional cooperative networks among language and content teachers. These active methodologies are:

a) *Co-operative and Communicative Language Learning*: the language is taught through authentic communication and interaction, rather than theoretically.

b) *Learner-centred approach*: a high degree of flexibility is allowed for the student to choose learning paths to accommodate their individual learning styles.

c) *Task-based learning*: learning takes place by doing or carrying out authentic activities which are meaningful for the learners' purposes.

d) *Constructivist learning*: instead of merely receiving content in a passive way, learners use the new environments of the ICTs to build up the learning content by themselves, with the help of the teacher(s) and the learning materials. There is a significant shift from "instruction" to "construction".

e) *Skill-based learning*: learning is not fully based on knowledge, as was the case in traditional approaches, but draws on the development and acquisition by learners of skills or competences, i.e. complex know-how.

From the particular standpoint of language learning, which is a central component of the project, the implementation of ICTs has five major pedagogical and methodological advantages. The first one is the improvement of the contact of the learner with the target language (English) through the provision of a rich linguistic input. The second advantage is the positive impact of CMC (i.e. technology-based communication tools) in language learning methodology, since it enables authentic communication and bridges the traditional gap between dynamic interaction and reflection, which means that students can engage in fluent communication while attending to linguistic form. The third benefit lays in the fact that Computer Assisted Language Learning multiplies the types of tasks and the possibilities of interaction, with materials, people and environments [14]. The fourth advantage is the promotion of social and cultural knowledge and skills through ICTs. The fifth strong point has to do with the potential of ICTs to improve traditional learning materials and environments in a variety of ways, for instance through the functionality of hyperlinks that establish a wealth of information connections.

The BEELT Project will use a specific Online Learning Environment called POLIFORMA-T (based on Sakai and customised for the *Universitat Politècnica de València*). This online platform consists of a series of learning, management and communication tools which enable CLIL to be implemented within the project.

3 The proposal of the BEELT Project

3.1 Brief description of the project. Aim and context.

The BEELT Project (Building Engineering through English Language Teaching) is a collaborative and innovative teaching project between two universities (UNAL and UPV) involving the use of an online learning platform and the team-teaching approach, through the co-operation of a content and a language specialist teacher, with the aim of improving the English language skills and competence of Civil Engineering students, by means of the teaching of specific units within Engineering subjects in the English language, i.e. the CLIL approach. The project will take place at both universities, to benefit from the synergies of international co-operation among teachers (and students). The online platform allows communicative exchanges among the participants at both sides of the ocean, thus promoting collaborative teaching, learning and feedback.

The online platform which has been selected for the experience is POLIFORMA-T, a Sakai-based online learning environment (OLE) which has been developed at UPV and has extensively been used for long at this institution to deliver courseware both for online and for blended learning. The platform is rich in tools to assist teaching in various ways. Among other functionalities, some POLIFORMA-T features that are used in the project are listed below (capital letters indicate the name of the platform section in Spanish):

- A general section for uploading and downloading content (called RECURSOS) for the whole group of students, as well as a personal folder (ESPACIO COMPARTIDO), identified with the student's name, to do the same for every individual student.
- CMC capabilities: A CHAT tool, an internal e-mail system (CORREO INTERNO) and a discussion list (FORO) through which students and teachers can carry out discussion work (both in a synchronous and asynchronous way).
- A dynamic tool (TAREAS) to upload tasks and manage their configuration (when they start and finish, how they are assessed and how feedback is provided, etc.).
- An online test-developing tool (EXÁMENES) to create and administer tests.
- A WIKI section to allow for collaborative work on the subject content.
- A calendar to organize the teaching and learning process (CALENDARIO).

The project uses POLIFORMA-T as an environment to deliver courseware and related learning materials, as well as to help managing the CLIL-based teaching process. In order to create the CLIL teaching materials that will later be located in the POLIFORMA-T platform, two tools are used within the frame of the project. The first one is called POLIMEDIA, a system developed at UPV that allows teachers to record their own Learning Objects (LOs) in the form of instructional videos supported by multimedia presentations and to host them in an institutional LO repository for later use. There is the possibility of linking LOs from POLIMEDIA to the online teaching platform POLIFORMA-T. The second tool is called CLILSTORE, a Web-based resource that allows the authors of learning materials to pedagogically exploit instructional videos from the Internet by attaching their transcript and directly linking this text to an online set of over 100 multilingual and monolingual dictionaries. CLILSTORE, as its name suggests, is also a repository of reusable video-based multimedia units or tasks that can be linked to and used by POLIFORMA-T. These two specific authoring tools (POLIMEDIA and CLILSTORE) have been used to develop the project's CLIL materials that will be delivered and managed through the POLIFORMA-T platform.

During the early stages of the project, two topics from Civil Engineering subjects offered by the Department of Civil and Agricultural Engineering (*Departamento de Ingeniería Civil y Agrícola*) at the Faculty of Engineering of UNAL are selected to start the experience. These two topics, which are taught as part of the curriculum of the Civil Engineering degree, are the following: (1) Engineering Materials and (2) Building Structures. The reason for this choice is the fact that these units somehow cover topics which are more general than other units in the degree, and, consequently, could be later re-used in other similar subjects, or even to teach Technical English to students of other branches, such as Architecture or Mechanical Engineering. The teaching of each one of these units is scheduled for approximately 10 hours of face-to-face lectures plus 15 hour of student's work.

After the teaching materials of these units have been developed in the English language, which is a requirement of the adopted CLIL methodology, the units are jointly taught by two teachers (Team-teaching methodology), i.e. the content and the language teacher, with the assistance of the online platform POLIFORMA-T and with the help of other ICT tools, such as translators, glossaries, dictionaries, websites including exercises, etc. Both teachers perform their teaching tasks in a coordinated manner, and at least 50% of the time with the co-presence of both teachers in the same class and to the same group of students. The content teacher uses the English language to cover the Engineering content, and the language teacher deals with language-related work, such as vocabulary and grammar practice, skill-based tasks and communicative activities. It is very important to emphasize that both the Engineering-based content and the language components of the teaching process are closely intertwined, meaning that the language used (by the content teacher) and taught (by the language teacher) in the sessions is exactly the same. In this way, in line with the CLIL approach, the acquisition of content is enriched by the learning of specific and authentic language, and, in turn, the practice of the English language is completely authentic and fully contextualized. It is also worth pointing out that both teachers have to evaluate the students independently: the content teacher assesses technical knowledge and skills and the language teacher focuses on the improvement of language competence.

3.2 Stages in the project and methodology

The project will be carried out for a period of approximately 6 weeks, including the CLIL team-teaching and student assessment and evaluation. But it is actually longer, comprising 4 phases:

1. Development of the CLIL teaching materials in the English language.
2. Team-teaching period (classroom teaching).
3. Students' assessment.
4. Feedback and evaluation of the project.

In the first stage (materials development), the two teachers develop their teaching materials in a quite independent, though totally coordinated way. That means the content teacher creates teaching materials to deal with the technical and specific (content) matter of the subject, while the language teacher prepares materials to reinforce the language skills and content related to the material that the Engineering teacher has developed. Since a high level of reusability of the materials needs to be guaranteed in the future, both teachers could ask for the assistance of other colleagues, for instance in the form of feedback. The two CLIL teachers will make an extensive use of ICT tools when developing the materials for the project (websites, CMC tools, blogs, wikis, video, audio, authoring tools, CLILSTORE, POLIMEDIA, etc.) and they will also upload their materials onto the POLIFORMA-T online platform, so that they become available for the students. Two requirements are fundamental at this materials development stage, namely materials must be as authentic as possible, and they will be updated. They should also be highly motivating and take advantage of the pedagogical possibilities of multimedia.

The second stage of the project is probably the most complicated one to implement, since it implies the co-presence of two teachers in the same classroom, and with the same group of students. Future versions of this project could include blended-learning, i.e. online learning combined with face-to-face teaching in a variety of ways. It is also the most international part of the experience, because the language teacher comes from the Spanish institution (where technical English is taught as a subject) and the content teacher is from Colombia, where the actual team-teaching classes will take place. This collaborative face-to-face teaching period covers approximately 10 hours for each unit (which could be distributed in two and a half weeks or be shortened into an more intensive period of, say, one week, to facilitate the attendance of the teacher coming from abroad). It must be noted that this period also includes about 15 hours of study that the learners must undertake individually and/or in groups.

After the team-teaching period comes the next stage of the project, namely the assessment of the students. It has a dual nature, since the Engineering topics will be evaluated by the content teacher and the language aspects will be assessed by the language teacher. The assessment process must be carried out in accordance with the content and the tasks that have been covered during the teaching. And it will include formative assessment (with short review tasks throughout the teaching stage), and summative assessment (at the end of the teaching period). Assessment of students can also (and should) be assisted by the use of ICT.

The fourth and last phase of the project is the evaluation of the project itself, including all of its parts. Feedback to inform such evaluation will come from different sources. Primarily, from the content and the language teachers that are involved in the team-teaching. Feedback will also come from a questionnaire administered to the students that take part in the project, focused on their degree of satisfaction with respect to the different component of the learning experience, both on the content and the language sides. Finally, other teachers and stakeholders of the institution will be given the opportunity to have their say in this evaluation process. The objective of this final stage is to inform possible ways of improvement in any aspect of the project, which can be implemented in future editions of the project.

Throughout the project, the use of ICT will be of prime importance, especially, but not exclusively, in phases 1 and 2. A central role will also be played by the so-called active teaching (and learning) active methodologies, such as communicative language learning, learning by doing, task-based learning, among other constructivist approaches.

3.3 Implementation possibilities and future developments

This is a pilot project, and thus, only a small part of the chosen technical subjects, i.e. two units will be the focus of the team-teaching CLIL approach. As mentioned earlier, the choice of the 2 technical units is based on their somehow generic nature of the topics, to enable the materials' reusability potential. The project needs careful preparation and implies certain logistic issues, such as close teacher coordination, the simultaneous presence of two teachers from two distant institutions, and, last but not least, the proper integration within the study programme of the subject and ultimately of the whole Civil Engineering degree, including the students' dual evaluation issue. Therefore, it is justified to choose a small part of the subjects to start the project. Having said so, if the experience proves positive, the whole subjects, or a larger part of them, could be taught through the methodology of the BEELT Project.

A further extension of the project and its methodology could also feasibly be applied to other subjects of the Civil Engineering degree, and even to degrees offered in other faculties. A highly recommendable extension of the project would include equivalent subjects that are being offered at the UPV, within the Civil Engineering degree. This would increase the international and collaborative nature of the project. Collaboration with other universities, especially English-speaking institutions, would also strengthen the international component of the BEELT Project in the future, while adding value to its language-based part of the teaching.

Apart from the abovementioned extensions in the scope of its application regarding teaching and learning methodology, the flexible framework of the project would also allow other modifications to its general structure, to make it easily adaptable to a variety of different higher education contexts. For example, in cases where the combination of team-teaching and CLIL proves impractical for some reason, the project might only imply CLIL, which is the core component of the project, without necessarily excluding its collaborative essence, because, for instance, there could be collaboration between teachers from different departments or universities to work jointly in the application of the CLIL methodology.

To sum up, the methodology advocated and applied in the BEELT Project could be extended in scope and adapted to different situations, as a way to apply the widespread integration of CLIL and the teaching of technical subjects in the English language, which is a trend nowadays in many Spanish-speaking universities and higher education institutions all over the world. This would increase the internationalization of subjects, degrees and universities, which is also at present a general priority in higher education.

4 Conclusions

The BEELT Project presented here implies collaborative work mainly at two levels. On the one hand, there is teacher co-operation across disciplines (Civil Engineering and English as a Second Language); on the other, these teachers belong to universities from different countries and educational contexts, so this also means international collaboration. Such a co-operative framework is very interesting to get full advantage of the expertise and background knowledge of the teachers, thus creating a kind of synergy which is difficult to find in other more traditional and isolated educational environments.

Moreover, the project, from a methodological point of view, proposes the implementation of three basic principles, namely the pedagogical use of ICTs, CLIL and team-teaching. These are the foundations upon which the active learning and teaching methodologies (collaborative learning, communicative language learning, learner-centred approaches, task-based methodology, constructivist approach and skill-based training) build upon throughout the project phases.

Apart from the benefits that this project can yield from the point of view of students (and teachers) when the CLIL team-teaching approach is actually implemented, the CLIL teaching materials that will have been developed represent another valuable outcome of this project, since they may be re-used in the future within the same or different educational contexts.

The BEELT Project, therefore, will provide a framework for the application of CLIL in higher education. Such a framework not only involves team-teaching, but also team-learning, and it has three fundamental characteristics: (1) it is flexible, since it may incorporate modifications to be adapted to different contexts; (2) it is didactic, since it has been devised to improve the acquisition of both specific content and the English language; and (3) it beneficial for the students, the teachers and the institution as a whole, since it meets the demands of modern and dynamic higher education. And the pedagogical potential and power of this project to a great extent lies in the fact that it involves international co-operation too.

It must be remembered though that, as stated at the beginning of this paper, the project, is presently in the development stage. Therefore this paper describes work in progress, rather than results of a case study. The BEELT needs to be put into practice, so that its results and learning outcomes may be evaluated properly and the project improved in the future.

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THE CAREER & EMPLOYABILITY SERVICE OF THE UPV AND THE INTERNATIONAL WORK PLACEMENT EXPERIENCE

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Conference Key Areas: International Networking, Cooperation with industry & international placements, Employability across borders, International Cooperation Programmes.
Keywords: international work placements employability career

Abstract

At the end of 2006 the Careers and Employment Service of the Polytechnic University of Valencia (Spain) was given the responsibility of managing Work Placements Abroad for recently graduated students through different programmes: The Bancaja – Blasco Ibáñez Programme, the Leonardo da Vinci Programe and, since 2010, the Free Mover Programme. During these 7 years our service has organized **1.150 international work placements** for our recently graduated students worldwide. Over the years we have gained much experience which we would like to share with you through this report.

1 INTRODUCTION

Nowadays when our recent graduated students are looking for their first job, they need even more knowledge and skills: the knowledge of a foreign language and the skill of adapting towards working in an international context amongst others. These skills bring the need for fundamental support in the acquisition and development of linguistic and intercultural competences. For this to happen, work placements abroad seem to be the most efficient way in reaching these goals, whilst also bringing an important possibility of a future contract.

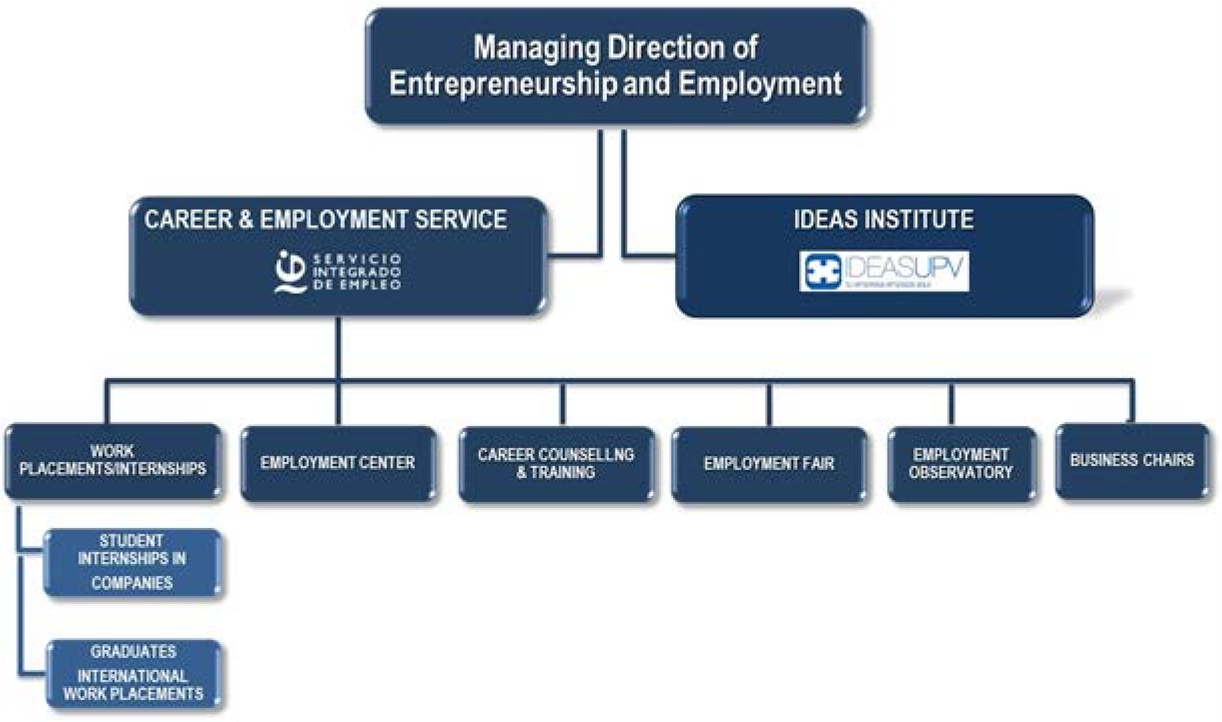
2 THE CAREER & EMPLOYMENT SERVICE of the POLYTECHNIC UNIVERSITY OF VALENCIA

The UPV is a university which orientates itself towards the employment of its graduates and has the firm commitment to contributing to their first job and supporting them in job searches when needed, as one of its strategic objectives. With this objective in the past few years the governing bodies of the university have taken out multiple initiatives in order to make services available to the students which benefit their employability and contribute to a better and faster entrance into the labour market.

In March 2000 the UPV was the first university to create a Vice Rectorate of Employment, which is now known as the Delegated Direction of Entrepreneurship and Employment. In October 2000, to give new impetus to all student employment related activities which had been developing since 1982, the Vice Rectorate of Employment created the Careers and Employment Service (SIE). Since then the university and the SIE have had a decisive contribution to the development of new initiatives and activities in order to increase relations with companies and therefore help set into motion the first employment of their graduates.

The Careers and Employment Service (SIE) of the Polytechnic University of Valencia (Spain), under the management of the Delegated Direction of Entrepreneurship and Employment, has the jurisdiction over all employment related activities. The SIE is the driving body which manages many initiatives adopted by the university in terms of employment, and its main objective is to better the employability of its graduates (Figure 1. Managing Direction of Entrepreneurship and Employment).

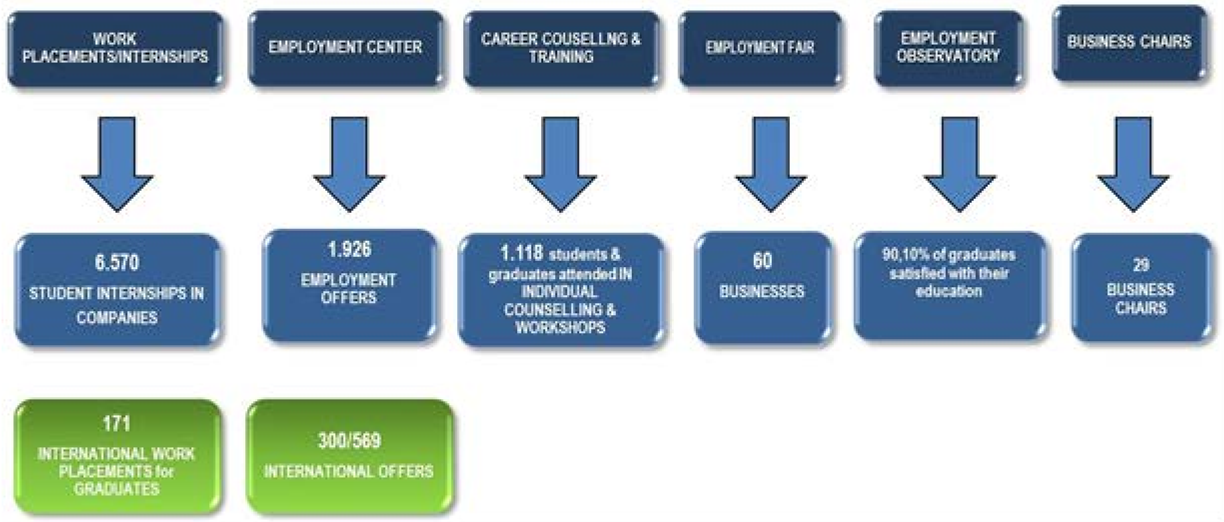
Figure 1.



The Careers and Employment Service encourages and manages the execution of placements and final year projects in companies and institutions both in Spain and abroad; offers students guidance and training to prepare them for employment; develops active employment policies as an intermediary through offers and job vacancies (employment centre) and carries out the monitoring of employability and career paths of the graduates through the Employment Observatory. The SIE is also responsible for the promotion and coordination of the Business Chairs in order to establish a large, highly qualified relationship between the UPV and businesses that have chosen to collaborate with the university in training activities, research and knowledge dissemination. Alongside these, each year since 2000, the department has organised an Employment Fair which has become one of the most successful nationwide.

In order to develop these activities the SIE establishes relations and collaboration agreements with an important number of companies and institutions, which along with work placements (internships) contribute to completing the training of our students, and with the job offers for graduated students help towards securing their first job and better employment. Every year, despite the current crisis, new companies begin their collaboration with the UPV so to offer work placements in Spain and abroad, job vacancies to graduates, to become a patron of a Business Chair and/or participate in our Employment Fair.

Figure 2. FACTS and FIGURES 2013



During 2013, a total of **6.570** students carried out a **work placement (internship)** in Spain through the educational cooperation programmes and **171** graduates took part in **international work placements** through the two mobility programmes managed by the SIE – Leonardo da Vinci and Free Mover. (Figure 2.)

1.926 job posts were managed through the web registration during the same year. Dirempleo, the UPV's job portal, as an objective seeks to act as an intermediary between job-seeking UPV graduates and companies that need qualified personnel. Alongside this during this year the SIE has continued to offer the service of job intermediation as an employment agency authorised by the National System of Employment with the ID number 1000000017-T (01/04/2011). (Figure 2)

Furthermore, in 2013 the Employment Observatory added a new programme (to the existing graduate and employer surveys programmes) which surveys teaching staff at the university. All of this gives a better insight into all of the people who contribute towards educative processes and entrance into the labour market.

During 2013, three Business Chairs were created. Some Chairs have temporarily terminated their activities due to economic difficulty, maintaining **29 Chairs**. The initiatives developed by the Chairs have served as a complementing factor to the education of UPV students and bring to their attention important companies who have a highly developed relationship with the UPV.

In April the 2013 Employment Fair took place, designed as an employment fair and direct meeting point between companies, students and graduates, with an attendance of **60 companies** and institutions. The realisation of the forum is of great value to the UPV as it serves as an indicator of the trust that both the companies and job-seekers have in the university despite the current economic climate.

3 INTERNATIONAL PLACEMENTS FOR RECENT GRADUATED STUDENTS AT THE CAREER & EMPLOYMENT SERVICE of the POLYTECHNIC UNIVERSITY OF VALENCIA

Our University is conscious of the labour market's needs and the need of our recent graduated students for fundamental support in the acquisition and development of linguistic and intercultural competences; and agree that work placements abroad seem to be the most efficient way in reaching these goals whilst also bringing an important possibility of a future contract. Work placements abroad allow a recent graduate to get to know business culture, values and ways of working in a host country, as well as how to become fluent in a foreign language; all of this without forgetting that any placement offers them training and indispensable work experience which helps with their transition into the labour market.

Therefore, at the end of 2006, the Careers and Employment Service of our university was given the responsibility of managing International Work Placements through different programmes. This started with the introduction of the **UPV Blasco Ibáñez programme (financed by a national Bank called Bancaja)** which continued until 2012. This programme gave grants to UPV recently graduated students to carry out a work experience placement in any country of the world outside of Europe. During the 6 years in which this programme was active, the Careers & Employment Service awarded **141 grants** for placements in a wide range of countries, such as the USA, Chile, Mexico, Brazil, Peru, Argentina, China, Japan, Canada, Australia, New Zealand, amongst others. (Figure 3. & 4.)

Around the same time we also introduced the European Union Programme for graduates called *Leonardo da Vinci*. Twinned with the *UPV Blasco Ibáñez programme* scheme this ensured that any placement possibility was able to receive a grant: The work placements in Europe have been granted through the *Leonardo da Vinci* Programme, whilst the work placements out of Europe were granted through the *UPV Blasco Ibáñez programme*. Since the end of 2006 until 2014 the Careers and Employment Service of the UPV has awarded **469 Leonardo da Vinci grants** to recently graduated students. These *Leonardo da Vinci* placements have been carried out in almost all of the 27 Countries within the European Union, however the biggest percentage of graduates went to Germany, Italy, the Netherlands, United Kingdom and France. (Figure 3. & 4.)

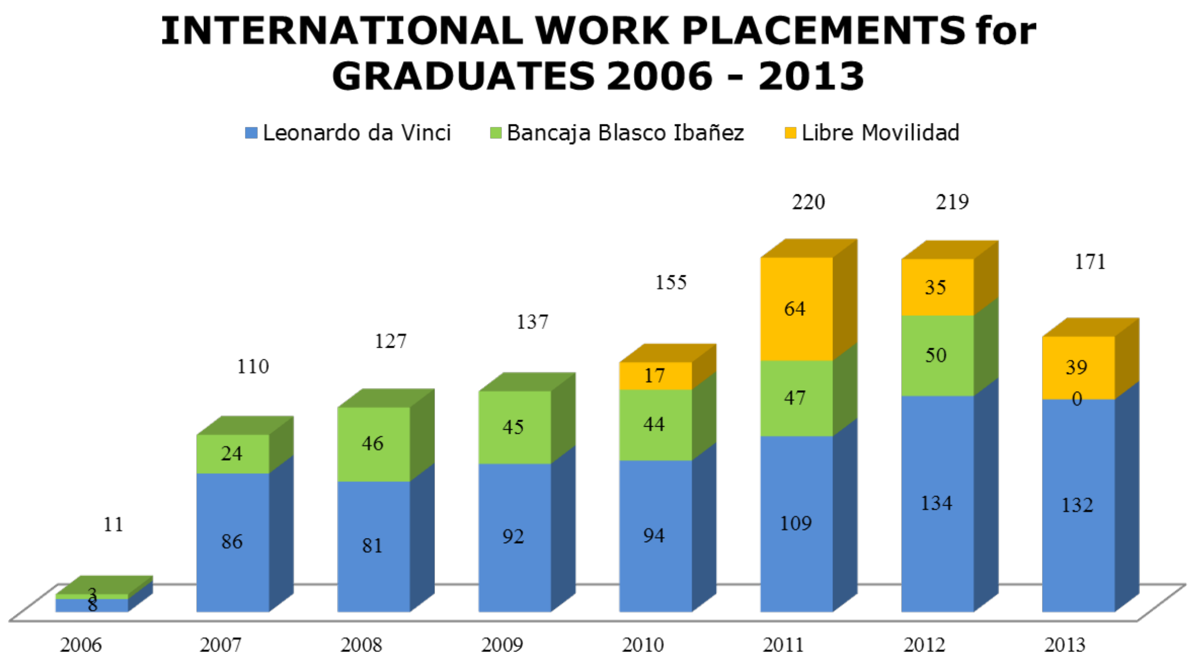
In February 2010, with the aim of addressing the need for internationalisation of our graduates, the UPV created the **Free Mover programme** for work placements in any country outside of Spain. The programme was made as a complementary scheme to run alongside the *UPV Blasco Ibáñez* and *Leonardo da Vinci* programmes so that all graduates that fit the stated requirements and find themselves a host company are able to carry out a placement, even without a grant. Since its creation, **155** work placements have been carried out through this programme. (Figure 3. & 4)

Figure 3.

PROGRAMMES & PARTICIPANTS IN UPV INTERNATIONAL WORK PLACEMENTS FOR GRADUATES

	Leonardo da Vinci	Bancaja Blasco Ibañez	Libre Movilidad	Total
2006	8	3		11
2007	86	24		110
2008	81	46		127
2009	92	45		137
2010	94	44	17	155
2011	109	47	64	220
2012	134	50	35	219
2013	132	0	39	171
	469	141	155	1150

Figure 4.

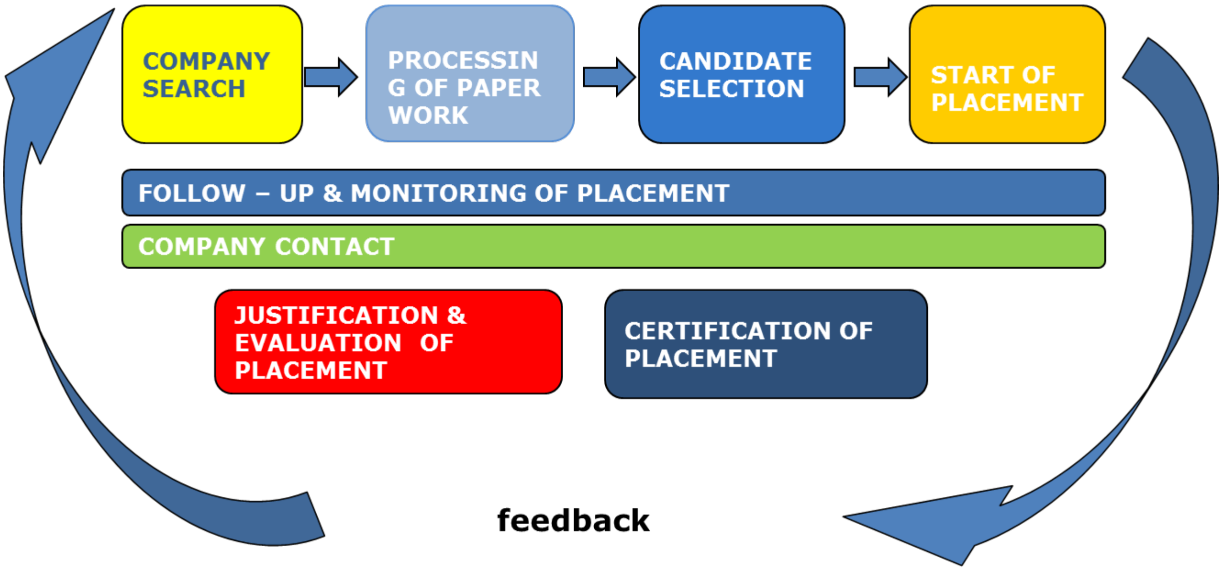


4: KEY TASKS IN THE PROCESS OF MANAGING INTERNATIONAL PLACEMENTS FOR RECENT GRADUATED STUDENTS

The present study is based on my extensive personal experience in the managing of international placements for graduates.

It is important to note that the background of the following process is the “training agreement”.

Figure 5. Key tasks



4.1 COMPANY SEARCH

There are two different ways of carrying out the company search:

- Model A. Sending Institution offer the candidate the placement.
- Model B. Sending Institution offer the candidate the framework to carry out the placement.

The former, model A, is when the university or sending institution searches for companies on behalf of their students and informs them where to do the placement. Related to my extensive experience, I have seen this model better suited to smaller institutions with a set number of students who are more likely to need more guidance (for example younger students in vocational education), or faculties where the placements are for students within the same area of study.

The latter, Model B, is when the student carries out the search themselves. This is better suited to larger institutions with a diverse range of students who have already completed their studies and are likely to want to specialise in a particular area of work. This is complemented by the higher level of maturity attributed to the graduates, given that they have completed several years of university education. But above all, the most important factor in this type of process is that the graduates learn for themselves the job-seeking skills that will benefit them in the future.

Our university uses both models in different quantities. In each case, Model B makes up around 90% of the process with Model A representing around 10%, thus, we have established initiatives such as guidance services which ensure that the graduates are not alone in this process. These services consist of tools such as a Curriculum Vitae model and guides on how to write a cover letter or a letter of intent in English; alongside maintaining company relations with the objective of securing placement offers for them and facilitating lists of potential host companies.

4.2 CANDIDATE SELECTION

In order to run an efficient service and give a guarantee of quality to all our participants, there must be some kind of pre-set requisites put in place by the managing institution and therefore a process of selection is necessary.

These requisites depend on the needs of the programme and/or the sending institution.

It is a hard task to design a programme. To do that in the best way, there are very important factors that we have to take into account, such as:

- Whether the programme has an external source of funding or not
- The human resources available to our service
- The internal policies of our university
- The period of time available to design the programme.
- The calendar established to carry out the programme, amongst others.

In order to provide transparency and objectivity to this process, the candidates' requirements and the application process have to be published with enough time beforehand, so that all potential applicants know exactly what is required of them and how to carry out the process.

4.3 PROCESSING OF PAPER WORK. DOCUMENTATION

Each institution managing international placements for graduates will require a number of different documents according to their own internal policy, however, in any case there are some which are essential in order to manage the placement correctly and efficiently:

- ✓ Completed application form alongside the relevant identification documents on part of the graduated student.
- ✓ Completed application form detailing the host company or institution and details of the work placement to be carried out.
- ✓ Cooperation agreement made between the host company or institution, the university or sending institution and the graduate.

- ✓ Insurance Policy: It is vital that the graduate is covered by an insurance policy which covers all eventualities that may occur in the host country.
- ✓ Visa, if required by the host country, and/or any other required travel documents.

4.4 COMPANY CONTACT

We understand that it is highly important to solicit and maintain a high level of direct contact with the host companies or institutions in which our graduates will carry out their placements. Above all this is due to the company search process that our University has chosen whereby the graduated student finds the placement for themselves and therefore we have often had no previous relations with the host company.

This is done through a number of ways throughout the placement procedure. Firstly, before approving a placement application by signing a collaboration agreement, we carry out research on the company through the internet to ensure that it exists and that it suits the professional needs and previous studies of the graduate. This research is carried out as soon as we receive the joint application from the graduate and company.

Once the candidates have been selected and the placement has been provisionally awarded, the successful companies will receive an e-mail asking them to confirm the details of the placement, as well as personally introducing ourselves as those who are responsible for the management of the placement; as it is important for companies to know that we are available to cater for their needs.

4.5 FOLLOW-UP & MONITORING OF PLACEMENT

Once that the graduate has arrived in the host country and has begun their placement, it is very important to follow-up their progress. This can be done by e-mail, but in case of urgency telephone contact is desired.

Our philosophy is to act in ways similar to a doctor – whereby we don't maintain daily contact with them, but we ensure that they are aware that they can contact us in any situation and we will support and help them to the best of our ability.

Nevertheless, in order to maintain said relation with the graduate and carry out the follow-up process we require that they send us their updated personal details and their confirmation of safe arrival and integration into the host company. Regarding the company, we contact them for a second time in order to confirm the arrival of our graduate and details of the integration into their team.

In specific programs towards the end of the placement we contact the graduates once more in order to inform them how to complete the documentation needed to finalise and justify the placement.

4.6 JUSTIFICATION & EVALUATION OF PLACEMENT

On behalf of the graduate this is an important part of the process. Due to the nature of international placements it is much more necessary to check that the placement has been carried out in the correct manner in accordance with the placement agreement. For this reason it is essential that the graduated student presents certification of their placement as emitted to them by the host company.

In regards to the evaluation of the placement, as a university and sending institution, it is necessary to gain feedback from the graduated student, as well as from the company. Therefore, we request that the graduate completes a feedback report detailing the students experience within the company. By part of the company evaluation, we receive this feedback through the aforementioned certificate of completion of the placement.

Through these reports we are able to obtain a lot of useful information that helps us improve our service. Besides the assurance that the placement has been carried out correctly on both parts, for example, through the company's certificate we ask whether or not they would be interested in hosting another placement student from our university; and through the graduate's report we ask them to provide information on local companies within the same sector; which we are able to contact in order to offer them our services and improve our range of placements offers.

4.7 Feedback

This is received throughout the experience. We receive three kinds of feedback:

- Student Feedback
- Company Feedback
- Tutor Feedback

All of these help us to improve our process and relationships with our participants. In addition it provides us with information which we can use to collaborate with other activities in our service.

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Higher Technical School of Geodetic, Cartographic and Surveying Engineering

Geomatic Engineering-our compromise with internationalization

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Conference Key Areas: Mobility Programs, Quality, Education and Research.
Keywords: Geomatic, EEGCS, TEMPUS, double degree

Abstract

In this paper we explain three main international activities carried out at the ETSIGCT of the UPV and their impact on the internationalization of the Geomatic Engineering: The EEGCS thematic network focused on the deployment of the Bologna Process among more than 115 partners coordinated by ETSIGCT, the TEMPUS-GIDEC aimed to implement new study plans in Armenia, Moldavia and Ucrania and some of the Double Degree agreements currently in force: ESTP (France), Hochschule Karlsruhe (Germany) and Cranfield University (United Kingdom).

1 Introduction

We are one of the newest Schools of the Universitat Politècnica de Valencia. (20 years), we are rooted in a deep and long history of cartography that goes till the XVI Century, and among many other achievements, helped to plot the very first maps of the New World.

Fig. 1 - A map of Valencia created in the early 16th century

Nowadays, we are a modern engineering which, in cooperation with many other branches of science and engineering, has proved to be an essential discipline for the progress of mankind.

Fig. 2 - Smartphone with mapping app

It is in our very nature to develop our research and work in an international environment. Cartographers had to travel with well-known prominent explorers: Columbus, Magellan, Elcano, Cook, La Pérouse, etc. For this reason, and from our beginnings, we have implemented a strong international co-operation policy. We are going to describe three of the main international activities carried out during the last years:

1st. The EEGECS thematic network focused on the implementation of the Bologna Process for Geomatic Engineering in Europe

2nd: The TEMPUS GIDEC, aimed to implement new study plans on Geographic Information Technologies in Armenia, Moldavia and Ucrania

3rd: Three double degree programs with France, Germany and United Kingdom.

2 Internationalization Actions

2.1 EEGECS Thematic Network

OBJECTIVES: Facing the challenge of implementing the Bologna Process for the Geomatics engineering

- To achieve a European Qualification
- To improve the academic aspects in the EU
- To create a European Degree
- To encourage students and professors mobility in the EU
- To increase the quality of education
- To extend and create more post-graduate programs
- To strengthen links between students and private sector
- To radiate and promote the **divulgation** of the **EEGECS results** through activities planified by the Working Groups (WGs)
- To promote specific **co-operation** among partners, facilitating the creation of **new agreements** in the frame of EU projects (Erasmus Mundus, Tempus, Socrates, ...)
- Ensuring long time **sustainability** of the Network
- Evolution of number of partners

Evolution of number of partners

- 1st year: 75 members
- 2nd year: 90 members
- 3rd: 115 members
- 4th year: 134 members
  - 114 EC countries (elegible)
  - 20 Other continents (non-elegible)

- Austria
- Belgium
- Bulgaria
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- lithuania
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- Turkey
- United Kingdom

Fig. 3 - Evolution of number of partners

Nature of members

- Universities
- Public institutions
- Private institutions
- Associations

ORGANIZATION of the WGs

WG1: UNDERGRADUATE EDUCATION

1-. Analysis of the study plans in each country

2-. Adoption of the ECTS, and Diploma Supplement, to promote transparency and facilitate mobility and recognition of study periods abroad.

3-. Elaborate a core curriculum of the discipline, with a European dimension. Move towards the adoption of a 2-tier degree system.

WG2: RESEARCH

1-. Analysis of existing PhD programmes, thesis, organisation of doctoral studies, existing programmes in collaboration with industry…

2-. Create a European Research Area: promoting joint research programmes, promoting the mobility of researchers.

3-. Promote the inclusion of the results of research into undergraduate education.

WG3: CONTINUOUS EDUCATION

1-. Assure a lasting employability of graduates

2-.Promote the use of innovation in teaching methods, and collaboration between higher education institutions

3-. Creation of international modules, courses, joint-masters programmes…, involving institutions from different countries

WG4: ENTERPRISES

1-. Strengthen links with enterprises and the private sector

2-. Analyse the needs of the economic and private sector

3-. Analyse the types of industry in which graduates can work: survey of the applications of the studies within Europe

4-. Create a network of enterprises willing to accept students under practical training.

WG5: MOBILITY

1-. Increase the mobility of undergraduate students, lecturers, researchers and administrative staff in Europe

2-. Promote scientific studies among young people

3-. Promote language learning among the whole academic community.

WG6: QUALITY ASSURANCE

1-. Increase the quality of teaching (methods and materials, identifying best practices).

2-. Move towards a common accreditation system, to improve mutual trust and facilitate comparability and recognition of degrees. Cooperation with existing quality assurance organisations and groups: Enqa, Naric etc..

GENERAL ACTIVITIES

- Steering Committee Meetings
- WG's Meetings
- Participation in Conferences
- Dissemination Events (WG's)
- 4th General Assembly
- Tuning activities

OUTCOMES

- Printed and digital materials (*brochures, reports, CD's, books, minutes, papers, interactive material, databases,...*)
- Conference presentations (*articles, papers, posters,...*)
- Dissemination events (*proceedings, reports,...)*
- EEGECS and Techno TN websites
    - www.top.upv.es/eegecs
    - www.upv.es/TechnoTN2004
- (Frame agreement for doctorate consortium)

2.2 TEMPUS GIDEC

This joint project was funded by the European Union's Tempus Programme. The objective of the project was to reform higher education in geodesy and geoinformatics in Ukraine, Armenia and Moldova in order to support sustainable development in these countries.

The project activities included modernization of existing geodesy curricula, development of new curricula and new teaching materials, establishment of 6 new GIS Laboratories in partner countries and re-training of partner country staff through intensive training courses.

The project focused also in the implementation new pedagogical methods and quality assurance mechanism in geodesy/GIS education. Finally, web-based e-learning platforms were established in the three partner countries.

The project consortium consisted of 10 universities and 1 government agency, with Royal Institute of Technology (KTH) as the coordinating institution (grant holder). The project lasted for three years, from 15/10/2010 to 14/10/2013.

Table 1. Project activities

2010.12	Project start-up meeting in Yerevan, Armenia, December 16-19, 2010
2011.01	English language training courses for partner country staff
2011.02	Creation of a National Advisory Board in each partner country
2011.02	Survey among geodesy/GIS stakeholders in partner countries
2011.04	Intensive training course on basic GIS concepts, Valencia, Spain, April 04-17, 2011
2011.05	Intensive training course on modern geodetic equipment, Stockholm, Sweden, May 2011
2011.05	Project management meeting in Stockholm, May 2011
2011.10	Opening of new GIS Laboratory at UST, October 2011
2011.11	Intensive training course on advanced GIS applications, Yerevan, November 2011
2011.11	Opening of three new GIS Laboratories in Armenia, November 2011
2011.12	Opening of new GIS Laboratories at KNUCA and LPNU, December 2011
2012.04	Curirculum development
2012.09	E-learning workshop in Stuttgart, September 17-23, 2012
2012.10	Workshop on pedagogical methods and quality assurance, Stockholm, October 23-26.
2012.12	External evaluation of the project by independent experts, December 10-16.
2013.04	Workshop on modern geodetic concepts in Lviv, Ukraine, April 15-23.
2013.09	Final dissemination conference in Alushta, Ukraine, September 9-13.

2.3 Double degree programs with France, Germany and United Kingdom

The ETSIGCT has several agreements with prestigious European universities to study double degree that provides the student with the title of Engineer in Geodesy and Cartography from both home and host university.

We currently hold Double Degree programs with:

FRANCE

Ecole Spéciale des Travaux Publics, du Bâtiment et de l'Industrie: Students studying a double degree in this school may validate so much 4th and 5th course, as well as the MSc Degree Thesis, obtaining the title from both Schools.

GERMANY

Hochschule Karlsruhe: This college offers the students of ETSIGCT the possibility to obtain a double degree: the title of Geodesy and Mapping by UPV and the Master of Science in Geomatics at HK university.

UNITED KINGDOM

Cranfield University: Students studying a double degree in university obtain the MSc in Geomatics Degree from both Schools.

The Bologna Puzzle: the Italian and Spanish pieces

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Keywords: Bologna process, EHEA

Abstract

Bologna process has been a lengthy one born with the idea of facilitating the comparison of standards and degrees throughout Europe. After almost 20 years since its first steps were given there are more differences in the different national systems than many people are aware of. In this paper we may a short review of this process and nowadays situation.

1 Introduction

European Higher Education Area (EHEA) has been involved in the Bologna Process since 1989, when an agreement was signed by the European Ministers of Education: the Bologna Declaration [1]. Its aim was indeed creating the European Higher Education Area itself, by promoting comparability and compatibility between the different European higher education systems and institutions.

The final goal of such process would be to facilitate mobility, improve employability and reinforce Europe's international competitiveness.

And clearly, quality and accreditation of higher education have proven to be at the heart of the setting up of a European Higher Education Area (EHEA); they are considered as an international determinant factor of the European competitiveness and mobility. The principal idea - repeated persistently as slogan- is that the European educative and training become a "world quality reference by 2010" [1]. That year has passed and many reforms in the higher education systems across Europe have been undertaken.

One of the main objectives of the Bologna Process was to structure higher education according to a three cycle system, with degree programmes based on profile, learning outcomes, competences and student workload, [2]. Such educational systems should provide the necessary competences for preparation for the labour market at all levels. Let us recall that, competences are defined as "a complex know-act based on the effective integration, mobilization and adaptation of knowledge, attitudes and skills within similar situations".

Thus university degree programmes should have been defined in terms of professional competences that comprise both generic competences (common to any degree) and subject-specific competences (related to a field of study) [3].

The implementation of a competences approach for the design of educational programmes involved the review of teaching, learning and assessment strategies to be used in many universities, in order to guarantee the development of the required competences.

This necessarily implied a change of paradigm: from teacher-centred to student-centred teaching, learning and assessment, in which teachers act as facilitators and guides, and students, in turn, play an active role and take the responsibility for their learning.

After four years of all these efforts in search of some convergent goals the Bologna process is fully implemented throughout Europe, However the paths followed have different lengths and there is a debate in some countries on whether their chosen path is the right one, [4-8].

In fact some countries some universities keep merging or some degrees are transferred to other universities by a number of different reasons and focusses all which brings out that the common European Higher Education Area is far from being a single one.

This work is focused on the analysing the Bologna process itself and how it has been understood and applied in general and specially in Italy and Spain.

2 The successive declarations in the Bologna process

The initial Bologna Declaration was signed in 1999 by ministers from 29 European countries. Fig. 1 collects the successive declarations in the so called Bologna process and is taken from 'Eurydice network' (2102), [9].

Mobility of students and teachers	Mobility of students, teachers, researchers and administrative staff	Social dimension of mobility	Portability of loans and grants Improvement of mobility data	Attention to visa and work permits	Challenges of visa and work permits, pension systems and recognition	**Benchmark of 20 % by 2020 for student mobility**
A common two-cycle degree system	Easily readable and comparable degrees	Fair recognition Development of recognised Joint degrees	Inclusion of doctoral level as third cycle	QF-EHEA adopted National Qualifications Frameworks launched	National Qualifications Frameworks by 2010	**National Qualifications Frameworks by 2012**
		Social dimension	Equal access	Reinforcement of the social dimension	Commitment to produce national action plans with effective monitoring	**National targets for the social dimension to be measured by 2020**
		Lifelong learning (LLL)	Alignment of national LLL policies Recognition of Prior Learning (RPL)	Flexible learning paths in higher education	Role of higher education in LLL Partnerships to improve employability	**LLL as a public responsibility requiring strong partnerships Call to work on employability**
Use of credits	A system of credits (ECTS)	ECTS and Diploma Supplement (DS)	ECTS for credit accumulation		Need for coherent use of tools and recognition practices	**Continuing implementation of Bologna tools**
	European cooperation in quality assurance	Cooperation between quality assurance and recognition professionals	Quality assurance at institutional, national and European level	European Standards and Guidelines for quality assurance adopted	Creation of the European Quality Assurance Register (EQAR)	**Quality as an overarching focus for EHEA**
Europe of Knowledge	European dimensions in higher education	Attractiveness of the European Higher Education Area	Links between higher education and research areas	International cooperation on the basis of values and sustainable development	Strategy to improve the global dimension of the Bologna process adopted	**Enhance global policy dialogue through Bologna Policy Fora**
1998 Sorbonne Declaration	**1999 Bologna Declaration**	**2001 Prague Communiqué**	**2003 Berlin Communiqué**	**2005 Bergen Communiqué**	**2007 London Communiqué**	**2009 Leuven/ Louvain-la-Neuve Communiqué**

Fig. 1. Timeline of the Bologna Process

The number of countries has been increasing and nowadays there are 47 countries participating:

Albania, Andorra, Armenia, Austria, Azerbaijan, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Holy See, Hungary, Iceland, Ireland, Italy, Kazakhstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, "the former Yugoslav Republic of Macedonia", Turkey, Ukraine, United Kingdom.

In addition to the participating countries the European Commission is also considered an additional member and there are a number of consultative members namely the Council of Europe, UNESCO European Centre for Higher Education, European University Association, European Association of Institutions in Higher Education, European Students' Union, European Association for Quality Assurance in Higher Education, Education International Pan-European Structure and BUSINESSEUROPE, the last one being a corporate and advisory group of 41 members from 35 countries.

3 The Bologna path in Italy

Italy was one of the first countries adapting its university system to the new system outlined in the Bologna process. In fact the reform started in some universities with a limited adaptation to certain courses of study in the academic year 1998/1999, while other universities started in the year 1999/2000 and the latest ones initiated it in the year 2000/2001.

The new perspectives of the suddenly coming European integration, with an increasing mobility of universities students and workers pushed the Italian universities towards an international challenge. Because of this, Italian Governments and universities had to urgently face the problem of internationalization. Indeed, Italian universities, and university professors were already used to international exchanges, but this was limited mainly to scientific research and not extended to University students and education.

In the 80s, at a very early stage, the Italian government with the DPR 382/1980 (DPR, *"Decreto Presidente della Republica"*) set the guidelines of a renewed University system, by clearly defining the roles and professional skills of University research fellows, professors, scholars and by fixing the tasks and activities at universities, (mainly) in research and education. This was considered the "big reformation of the Italian System" (La "*grande riforma*" di Craxi, G. Acquaviva, L. Covatta, Marsilio Ed., 2010).

After many years with limited actions, because of weak political coalitions and policies, there appears the big reformation of the State and this one was starting from the most appropriate environment, i.e. universities. This reformation went into practice, but since then there was no comparable revolution in the Italian cultural system. In fact, after the DPR 382/1980, there were other two (less) significant laws, dealing more specifically with the Educational system of Universities, where also the Bologna Process was taken into account. Indeed the main aim of the following laws was also to renew the entire scholastic system starting from the primary school, in order to adapt the University degrees and (mostly) the professional skills of the Italian graduates to the International challenges.

In fact prior to the University education reformations, the Italian graduates had some nonflexible curricula and scheduled plans which obliged Italian students to face hard studies without any intermediate achievements, only a small percentage of students were able to get the final master degree, very often after many year delays with respect to the scheduled time. This was considered a terrible waste of public money and mostly a useless task for the qualification of the Italian laureates. At that time, in other University systems, like in the U.K. an Engineer could get a bachelor degree after three years, while in Italy it took at least 6 years of hard studies.

In order to avoid this gap between the same professional possibilities, the Bologna process came into practice and Italian Governments immediately took this chance to reform not only University Education, but the whole educational system. However, as quite often happens during sudden changes, these reforms were concerned by the steady bureaucracy and tendencies, thus implying disgraceful delays in the reformation. The Italian system was very skilful and quick in setting the “big reform” of 80-ies, but the subsequent reform of University was not regulated until 2000 (D.P.R. 30/2000), 2003 (D.P.R. 53/2003) and 2010 (D.P.R. 240/2010) and they came into practice very slowly.

In 2000 with the D.P.R. 30/2000 the “3 plus 2” system (3 year bachelor plus 2 year master) was settled thus equating the value of Italian university degrees with equivalent European studies. This law also established the Educational system based on credits and the most important it was stated and enforced the autonomy of educational choices of each single University. From then on, each university could define a particular and suitable curricula for obtaining a university degree, somehow more flexible with respect the national fixed rules.

However the application of this law was quite problematic and ineffective. Sometime because of laziness and lack of common sense, this law was applied by simply segmenting the previous university courses into short modules. However, very often the contents of these short modules was the same of the longer prior courses, so that, because of this the student had to study much more in a shorter period of time! Luckily the progressive awareness and consciousness of the University staff and teachers regulated this initial drawback and moved toward a more modern University system.

In the year 2003, the political changes in the Italian Governments implied also a counter-revolution in the University system. With the D.P.R. 53/2003, some changes owing to the previous 2000 law were rejected but this law was also characterized by the awareness that the University system should strengthen its links with productive society and labor. The main structure of the Bologna process was kept in the University system. It was clear that the Italian university system would never go back and it was ready for innovation and international competition.

By fully accepting the ECTS (European Credit Transfer System), the Italian university System had to accept also the idea of quality control system should not apply only to students but also to university staff (professors). The last fence of the undiscussed authority of Professors was falling as a consequence of Bologna process, so that also the teaching activity of instructors should be evaluated by a suitable certification system.

The European quality system and control in Education was further discussed and taken into consideration by means of the University reform of 2010. The main task was to define a quality system for the University not only in education but also in research activity. For the first time the Italian University system had to face the idea that the research quality should be certified with achieving goals and quantified parameters.

In this way it started a lengthy debate about which parameters should be used in this and what research topics were adequate for them. This lead to sometimes sterile discussions and bureaucratic directives from Education Ministry kept unchanged the previous rules, thus avoiding a true and deep modern reform. Nevertheless this 2010 law started a fruitful debate on the urgent need to certify the research activity of university professors and opened the eyes in front of a stronger and stronger international competition. It should be noticed, that although the Bologna process was motivated by the need of a European homogenization, this discussion in the Universities was going beyond the original tasks, so that in 2010 with the last University reform, the Italian system was preparing the future University system to international competitiveness.

The simple scheme that came into practice in Italy in Education, as a consequence of the Bologna process was to follow the so-called 3 plus 2 structure as mentioned which is intended to empower the student to enter immediately into work. A goal of the process was in fact a better link with the labour market in each cycle, resulting in a change in hiring mode for public administrations. The inclusion of the third cycle, on the other hand, allows students to participate more easily to increase the competitiveness of the European Union in the world.

The names used for degrees in Italy differ from most other European countries which makes it unclear interpretation often, in Europe, for qualifications obtained in Italy and vice-versa. This question was discussed and clarified in the D.P.R. 53/2003.

The Bachelor's degree in many European countries is defined as "diploma", while in Italy that term refers to the degree awarded at the end of Secondary School.

The second level of university studies is worldwide known as master studies/degree whereas in Italy they are called *specialistiche/magistrali*.

Finally the third level university studies are the only ones that coincide with the worldwide name of doctorate studies or graduate school and entitle to whoever holds the degree as doctor.

However there is a slight difference in the social, cultural and economic meaning of this word in Italy where on many occasions people that have reached only the Bachelor's degree are referred as doctor, which is far from the actual meaning of this title in other countries.

4 The Bologna path in Spain

In exchange to the Italian situation, Spain has opted to move to the 4 plus 1 structure in general. All degrees in Spain are 240 ECTS (4 years) but there are cases of masters in the range of 60-120 ECTS.

A number of royal decrees have been published at the Spanish Official Bulletin (Boletin Oficial del Estado BOE) in order to fix the general rules that all degrees should follow with the aim of adhering the Bologna process.

It has been a lengthy period, with many norms and additions in subsequent regulations. In fact we may cluster the different regulations related to:

- The three level structures of Bachelor, Master and Doctorate (Grado, Master and Doctorado) in the Royal Decree 1393/2007, of 29th October, were published on 30/10/2007 and modified by successive laws published in BOE on 03/07/2010, 10/02/2011, 13/07/2013 and 05/03/2014 in which the general official university degrees were settled.

- The Doctoral studies in the Royal Decree 99/2011, of 28th January, published on 10/02/2011 and modified by law published in BOE on 13/07/2013 in which the official PhD regulations were settled.

- The Spanish Qualifications for Higher Education was set up in the Royal Decree 1027/2011, of 15th July 2011, published on 03/08/2011 and modified by law published in BOE on 05/03/2014.

- The conditions required to enter the Spanish public universities and the Spanish degrees were fixed in the Royal Decree 1892/2008, of 14th November, published on 24/11/2008 and modified by successive laws published in BOE on 04/06/2009, 08/05/2010, 17/12/2010, 03/07/2012, and 13/07/2013. Very recently, on 6th June the Spanish Government has introduced new changes to be effective on 2017/18 and a transition period is foreseen until then.

- The recognition of EHEA studies, namely University Bachelor degrees, artistic degrees, design and plastic arts professional degrees and sports professional degrees, in the Royal Decree 1618/2011, of 14th November, published on 16/12/2011 and modified by law published in BOE on 12/03/2012.

- The external academic internships were ruled by Royal Decree 1707/2011, of 18th November, published on 10/12/2011 and subsequently annulled by Sentence of Third Court of the Spanish Supreme Tribunal of 21st May 2013, published in BOE on 28/06/2013.

- The rights and duties of students were settled in the University Student Statute Bylaw established by Real Decree 1791/2010, of 30th December, published on 31/12/2010.

- Expedition of official Spanish degrees was settled by Royal Decree 1002/2010, of 5th August, published on 06/08/2010 and modified by successive laws published in BOE on 10/02/2011 and 07/05/2013.

Just to finish the picture in Spain we must also mention;

- The Organic Law of Universities 6/2001, of 21st December, published on 24/12/2001 and modified by the Organic Law 4/2007, of 12th April, published on 13/4/2007.

- The Law 14/2011, of 1st June, of Science, Technology and Innovation, published on 2/6/2011.

- The Royal Decree 14/2012, of 20th April, published on 21/4/2012, in order to take urgent measures for rationalization of public expense in educational environment, owing to the critical economic situation in Spain.

In addition to the above we find that each of the seventeen Spanish regional communities have established their respective regulations and registration fees since each region is competent to establish them and in fact there are differences in the fees for the same degree between the different Spanish autonomous regions.

Because of the continuous modifications explained above, administrators and instructors in Spain have suffered several adaptations to the Bologna process as understood in Spain.

This process was fully implemented in Spain in 2010, some universities starting one year earlier. Thus it took quite a lot to start but in addition to the obvious planning, some features such as the use of ECTS was initiated in parallel before its enforced application.

5 A glimpse of the situation in Europe

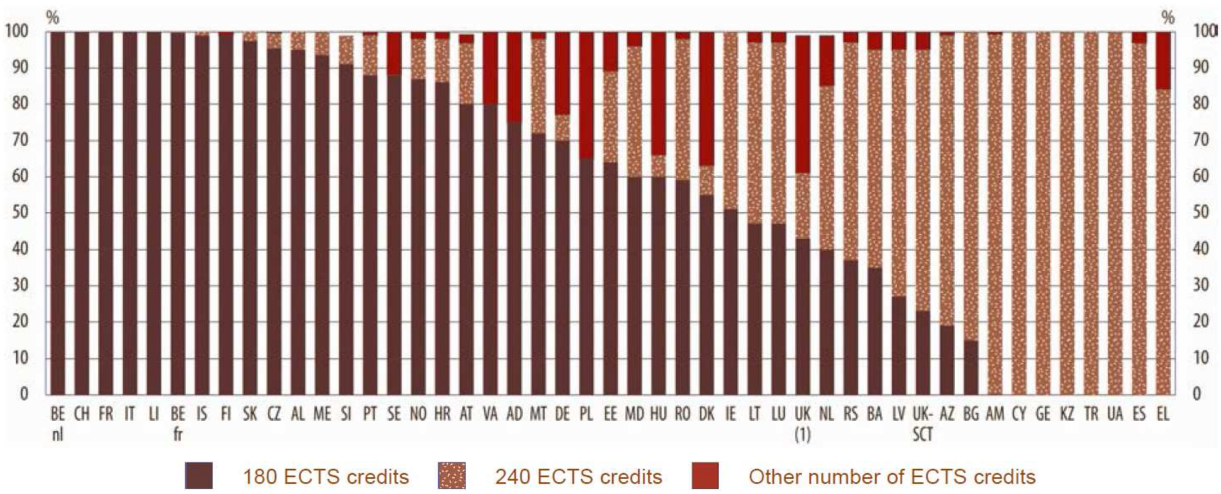

Fig. 2. Number of ECTS in EHEA countries at Bachelor level

The implementation of the Bologna process in each country is far of being homogeneous. As an example we may see how the length of studies is quite diverse with more than half of the Bachelor degrees run in 3 years but some few countries where all Bachelor degrees are run in four year time.

The results shown in Fig 2 come from the 'Eurydice network' (2102), [9], as well as those shown in Fig. 3, the latter being referred to Master studies, therein showing that most of the EHEA Master programs are run in 2 years and programs run with 60 ECTS are a clear minority.

Let us mention that recognition of professional degrees is another issue on which in a next future should be worked on.

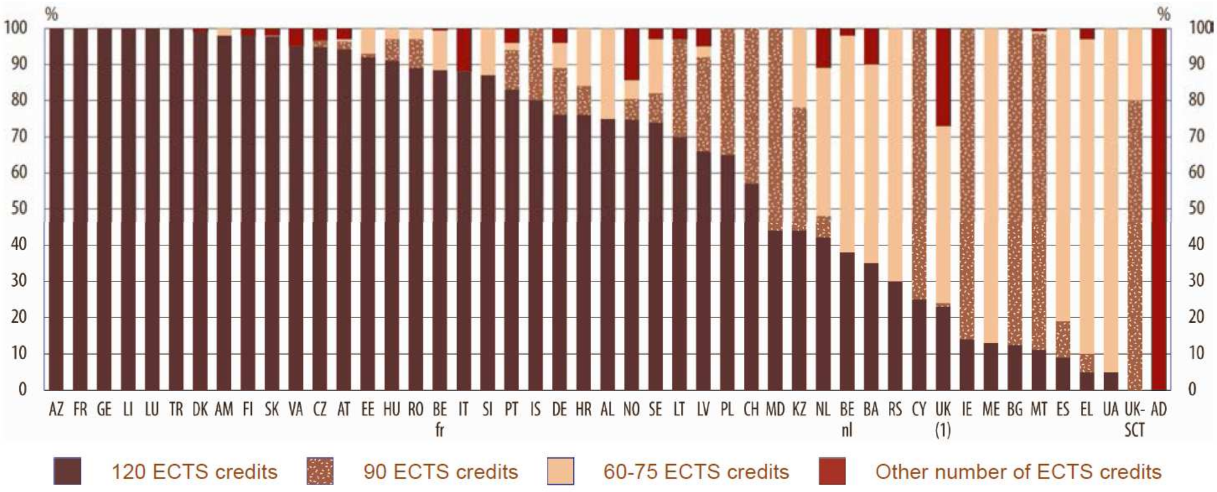

Fig. 3. Number of ECTS in EHEA countries at Master level

The Directive 2005/36/CE of the European Parliament and Council, of 7th September, and Directive 2006/100/CE of the Council, of 20th November, established the basis concerning recognition of professional qualifications as well as some aspects of the lawyer profession and were incorporated into the Spanish regulations by Spanish Royal Decree 1837/2008, of 8th November.

Nevertheless the Spanish Ministry of Education asks for consultation to [10] in order to keep continuously updated on recognition of foreign degrees.

6 Conclusion

It is quite amazing how often Instructors and administrators explain that the new changes are because of the Bologna implementation when in fact the puzzle is so complex and so many different situations do happen throughout EHEA.

Some countries are still updating and restructuring their university organization. Faculty and staff should be aware of such different environments and be ready to upcoming new changes. Diversity in general is desirable and studies are easier to compare after the Bologna process.

However it is unclear if such a divergence should keep in the long run as there are some features such as students exchange or double degree that are more complicated to handle when the length of studies is different in the involved universities.

There are new processes on the way related to European accreditation that will be relevant as well as recognition of professional degrees throughout Europe so that professional mobility and competitiveness of Europe is favored.

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