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HELENA
Higher Education Leading to
ENgineering And scientific careers

HELENA Research Overview

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Introduction

Attracting more young people, particularly women, in Engineering and Technology (ET) is a major concern in Europe today. Their participation in engineering occupations appears to be a key-issue for European economic and technical development, as well as a central achievement towards gender equality and social justice. Increasing young people interest in the sciences and mathematics and underlining the importance of Engineering and Technology developments in shaping our collective future is an ongoing project in the education sector.

Many studies have identified gender-mainstreaming measures in engineering education; for example, the WOMENG project (HPSE-CT-2002-00109) has recently highlighted key-moments for action and recommendations. Yet, other studies have confirmed that successfully implementing such measures requires in each case a tailor-made overall approach to take into account the specific cultural and economical context in which they must be implemented. The aim of the HELENA project is to provide indications about how to launch such measures and monitor the obtained results. They will be intended at the same time for students, faculty and staff and consider transitions from secondary education to higher education and from higher education to academic and industrial professional spheres.

This document gives an overview and reports about the current status of the HELENA research. The project is carried out within the European Union's 7th framework programme "Science in Society" (<http://www.fp7-helena.org/>) under the coordination of Šiauliai University (Lithuania). Partners from Austria (Alpen-Adria-Universität Klagenfurt), France (Ecole Normale Supérieure de Cachan and ECEPIE – Égalité des Chances dans les Études et la Profession d'Ingénieur en Europe), Serbia (Mihailo Pupin Institute), Spain (Fundacion TECNALIA LABEIN), and the United Kingdom (Loughborough University) are involved.



Work Package 1: Coordination

The objectives of this work package are:

- to ensure a good coordination and management of the project
- organise consortium, Scientific Coordination Committee, Advisory committee, Team Leaders' Board meetings and provide respective documents (agendas and minutes)
- to provide day-to day management of the co-ordination action
- to consolidate the project planning, progress reports, and milestones reports
- to coordinate financially the project: monitor the resources of all partners, check and submit cost claims, ensure the effective resource usage, receive payments from the EC, transfer payments to the bank account, etc.
- to review the project budget and the management of project work match the budget actual spending
- to manage the technical progress of the project according to the Project Work Plan
- to co-ordinate the technical work to be developed in the project
- to liaise with the European Commission
- to provide the Consortium Agreement
- to provide Quality Manual
- to ensure efficient and sufficient dissemination activities

Deliverable D1.1

Quality Assurance Plan / Manual

The Quality Assurance Plan / Manual described in this report define the general approach to quality assurance and the procedures to be followed for partner communication, documentation and deliverable production. The document describes: communication procedures between participants; procedures for the production of reports, Financial Statements and deliverables; procedures for the review and distribution of the various types of deliverables; reports, prototypes; procedures for risk assessment and contingency strategies; a general approach to quality standards.



Work Package 2: State of the Art Review

The overall objective of this work package is to:

- to inform work package 3 (methodology), by establishing working definitions of innovative and traditional engineering courses, for example.
- to inform work packages 4, 5 and 6, by grounding the data collection stages of the research in existing studies, including trends and developments identified in existing research
- to provide a documentary analysis of existing engineering programs in higher education (HE) and their curricula.

Deliverable D2.1

State of the Art Overview and Scoping Study

Considering T2.1.1 in more detail:

- ENSC prepares a data collection sheet.
- The data sheet is then completed by each partner [before July 10] and returned to ENSC for collation and analysis [July 10-22]. This analysis will aim to ensure all relevant areas receive appropriate coverage and no duplication exists across the partners
- The results of T2.1.1 will enable work in T2.1.2, to define the overall scope of the work (research question, to be discussed further during meetings)

While the partners are completing the template, ENSC prepares the table of contents for D2.1. This will show all partners how the data being collected will fit together and show where their inputs are required. It will be available on the wiki.

Deliverable D2.2:

State of the Art on Career Choice and Gender

This deliverable provides useful background information on career choice and gender in engineering by looking in detail at statistical indicators on gender and career choice in engineering by partner country (section 2) and provides a review of research on the impact of gender on career choice and research that explores the reasons women choose to study engineering (section 3). A large amount of interesting data has been generated by partner countries, and although these are too detailed to include in the main report, we have included these in the appendices should further information be required.



Deliverable D2.3: ***State of the Art on Curriculum Research in Engineering***

This deliverable outlines work completed under Task 2.3 State of the Art Review of Curriculum Research in Engineering & Technologies in higher education by each partner country. Deliverable 2.3 consists of three parts. It provides information about existing research and statistics addressing curriculum issues in engineering HE in EU, including the demands for changes in engineering education and curriculum development, from gender perspectives, with special focus on interdisciplinary and innovative learning and teaching (section 2). Section 3 includes a review of Curriculum Research in Engineering in HELENA partner countries and research that explores research discussion of the framing of curriculum development – in gendered or non-gendered terms and how curriculum can be couched in technological-economic, technological-social, technological-humanitarian, innovative terms in HELENA project countries. Country reports from six different cultures have produced a large amount of interesting data and although these are too detailed to include in the main report, we have included these in the appendices should further information be required.

From the Engineering Curriculum Research in EU before this project were mentioned main findings during last 15 years:

Universities are exploring ways to revise the *engineering curriculum* in order to meet the changing needs of industry and society. Any restructuring of an engineering curriculum must take into account the correlation between society, engineering competencies and the changing paradigm of engineering education. The 'employability' of graduates depends on a combination of high technical knowledge, practical experience and soft skills. Decreasing student enrolment figures in engineering in many countries call for appropriate measures to be implemented including the development of attractive programmes of study and challenging learning environments.

Over the last decade there have been many initiatives in the European Union and other countries to encourage girls to become engineers. Reviewed literature has shown that females have more negative attitudes toward *engineering* and technology than do males. Despite greater equality in access to higher education and employment women's participation in engineering careers does not reflect this. Higher education engineering curriculum is male based. In construction of engineering curriculum three aspects have been neglected: 1) students background in the light of formal and informal experience and interests, 2) student/student interactions, 3) teacher/student interaction. Innovation of the curriculum with regards to gender mainstreaming means broadly oriented integrated and content rich teaching material, diversity in teaching and learning methods.

As an academic discipline, engineering is continuously undergoing a process of rapid expansion and diversification that is now significantly characterized by interdisciplinary approaches. There is a rise of interest in increasing interdisciplinary studies. As a profession, engineering has to deal with scientific and technological matters, but increasingly economic, political, ethical, societal and environmental aspects are taken into account as well.

Society places many demands on an engineer; to be technicians with a human side, be adept in interdisciplinary skills that include both technical and non-technical competencies that enable them to critically analyze, solve problems, communicate effectively, and be able to learn continuously as the workplace changes. Introducing social science and other disciplines into



engineering could, ideally, help bridge the rift that exists between producers and consumers of technology. Social sciences, humanities, cultural and management studies are also as important as the traditional applied sciences for the portfolio of engineering competencies because students need to understand the financial, business, environmental, economic and social constraints in which engineers operate. Most of the studies and projects showed that interdisciplinary curriculum is one of the central elements for fighting against gender and engineering stereotypes.

Reviewing literature of engineering education and curriculum, learning and teaching methods we have found that many studies have been presented in the last decade. Past studies have shown that a change in learning environments and the methods by which learning takes place might increase number of female choosing engineering carriers. Supported by the experience of the Scandinavian, the United Kingdom and other EU countries more and more higher technical education institutes are introducing new forms of education, such as problem-based and project based education, which increases the appeal of technical education and have a positive effect on the intake, retention and output of students. Surveys and reports undertaken to document and evaluate active teaching and learning methods indicate that project and problem based learning can satisfy the demands for required knowledge, skills and attitudes of engineering graduates. But active and experiential learning is not limited only to project orientation and problem based learning. It should also use ICT environments, various extra curriculum activities and more traditional forms like labs, exercises and design activities.

However, changing teaching methods and didactical design of engineering courses are steps in the right direction but not sufficient for making education gender inclusive. Changes must be made also in content, followed by redesign of existing and design of new courses. Broadening and the repositioning of the curriculum is the challenge facing technical education for the next few years. From the perspective of larger participation of girls, the exploration of the boundaries of technology is especially interesting. Integrating more real-world concerns can also potentially reverse the declining interest in engineering.

Reviewing the Curriculum Research findings in E&T area HELENA project partners from 6 countries - Austria, France, Spain, Serbia, UK and Lithuania from the States of the Art Reviewing of Curriculum Research in E & T in Higher Education are as follows:

- *Description of pre-existing conditions* (Bologna reform impacts: standardised degree levels across Europe, more transferable and standardised; course content proscription by the professional bodies that accredit courses);
- *Interdisciplinary approach to E&T courses*. The interdisciplinary, multidisciplinary, or holistic approaches in engineering courses are a positive step and curricular transformations and research is moving towards innovations. Engineering education is adopting multi-disciplinary approaches and more innovative teaching and learning methods are applied, but these are mostly developed without gender-mainstreaming in mind.
- *Curriculum content in E&T with focus on gender*. Rapid content development asks for new teaching techniques, and this in turn requires knowledge from non-engineering disciplines, engineering programmes may become more attractive for female students. The need to make the engineering curricula more socially relevant is universally recognized.



- *Teaching techniques and demanded skill system.* Alongside the developments in course content teaching environment and assessment innovations are in use. A focus on skills may be interpreted as representing a broadening of the remit of university education and at the same time a broadening of the term skill to include aspects of knowledge and theory.
- *Projects leading to curricula innovations.* Projects are an approach to non-traditional educational schemes for engineering students and teachers. As study programmes are mostly bound with output standards that make adding optional, interdisciplinary modules to existing programmes difficult, the gender-inclusive teaching and learning methods are successfully implemented through project work.
- *Market requirements and employers' needs, marketing of E&T courses.* Innovations are mostly focused on making engineering more relevant to industry and to students themselves. Scientists as well as employers underline that there is demand for engineers who can work "outside the boundaries of their own disciplines". Engineering curriculum development and research are not usually framed within gender mainstreaming debates and rather focus upon economic and technological imperatives. As the main task is to make up curriculum to fit labour market needs, gender is just not the most important in developments in engineering curriculum during a period of widespread innovation and progress, which in itself offers a good opportunity to embed gender inclusive measures.
- *The research on traditional and non-traditional engineering study programmes, good practice in engineering education.* Only some studies have taken a gendered view of engineering curriculum developments, others have not addressed this issue at all. Generally the developments of engineering study programmes are under investigation but not in a gender dimension. The reasons for this are not clear. It may well be that the best way to develop engineering curriculum in a more inclusive vein is by the 'backdoor', as more overt attempts to address women's' position in the technical and scientific fields may be viewed as counterproductive.

In most countries few experiences and not much research have been done in relation to the impact of curricula development in engineering, neither on gender impact assessment of curriculum content.

It is evident that further research is needed to address how new, innovative teaching techniques and practices, and curriculum development impact on students and whether there is societal and gender differences concerning these initiatives.

Deliverable D2.4: State of the Art on Documentary Analysis of Higher Education Engineering & Technologies Programmes and Curricula

This deliverable provides information from specific traditional and innovative engineering courses and concludes with a working definition for identifying traditional and innovative engineering courses to be used throughout the project. It identifies existing engineering programs across European HE that incorporate interdisciplinary aspects using university websites; reviews statistical indicators measuring performance/effectiveness of engineering degree courses; identifies trends, developments, similarities and differences in interdisciplinary



programs across engineering disciplines and European countries, including for example the extent to which interdisciplinary aspects have been incorporated, and the nature of interdisciplinary aspects; and, recommends criteria for identifying traditional and innovative engineering degree courses.

Work Package 3: Methodology

The overall objective of this work package is to provide common research hypotheses, thus designing a pertinent work plan, highlighting intensive collaboration between work packages 2 to 6. Its main challenge would be to overcome cross-national comparisons difficulties due to cultural, sociological, economical contexts and impacts on any qualitative approach and methodology applied.

The object of the HELENA research is the evaluation and analysis of traditional and pilot E&T degree courses curriculum in Europe through quantitative and qualitative approaches. We will collect data concerning each national context (sociological, cultural and economical) of the current E&T curriculum, thus evaluating and analysing traditional and pilot E&T degree courses through their identifying using peculiar criteria that we have to define. Once defined, we will conduct a fieldwork qualitative analysis through interviews and focus groups aimed at female and male students in E&T degree courses, deepening our analysis through case studies, which will highlight our study subject. We will here work closely with WP4 and 5 leaders.

Deliverable D3.1 Translation Guidebook

The overall objective of work-package methodology is to provide common research hypotheses, thus designing a pertinent work plan, highlighting intensive collaboration between work-packages 3 to 6. Its main challenge would be to overcome cross-national comparisons difficulties due to cultural, sociological, economical contexts and impacts on any qualitative approach and methodology applied.

The object of the research will be the evaluation and analysis of traditional and pilot SET degree courses curriculum in Europe through quantitative and qualitative approaches. We will collect data concerning each national context (sociological, cultural and economical) of the current SET curriculum, thus evaluating and analyzing traditional and pilot SET degree courses through their identifying using peculiar criteria that we have to define. Once defined, we will conduct a fieldwork qualitative analysis through interviews and focus groups aimed at female and male students in SET degree courses, deepening our analysis through case studies, which will highlight our study subject. We will here work closely with WP4 and 5 leaders.

The work-package methodology will be divided in three steps, each of these steps will allow both a deeper understanding of national context and impact and will improve our methodological cross-national comparison approach.



Deliverable D3.2: Methodological Guidelines

This report presents the methodology used in the HELENA project. This methodology has been previously experienced successfully in former EU funded projects such as PROMETEA and WOMENG. A brief description of such a methodology has been published in: Godfroy-Genin, Anne-Sophie & Pinault, Cloé 2006. « The Benefits of Comparing Grapefruits and Tangerines: Toolbox for European Cross-Cultural Comparisons in Engineering Education. Using this Toolbox to Study Gendered Images of Engineering among Students». In: *European Journal of Engineering Education*, 2006 Vol. 31, No.1, March, pp. 23-33. Taylor and Francis.

This deliverable provides guidelines for fieldwork in WP4, WP5 and some indications for WP6. The outline follows the chronology of the research: Common design of research, fieldwork, reporting, analysing. After a description of the overall methodology and aims, data sheets for WP4 data collection are provided, as well as guidelines for interviews in WP5.

The deliverable gives technical information on samples, use of the database, coding system, and various forms (ethical agreement with interviewees, letter of introduction to interviews, recommendations for fieldwork organisation, etc.) as well as guidelines for reporting results in a database and analysing results by country and by workpackages.

Deliverable D3.3: Methodological Guidebook

This methodological guidebook complete deliverable 3.2 “Methodological Guidelines” as it is done as a tool supporting researchers on the designing/doing/analysing/reporting of interviews and focus groups, and introduce them to the methodology WP3 team will use to explore qualitative data. We will try to support WP4, WP5 and WP6’s work for main deliverables, as we will try and use CAQDAS tools on the obtained qualitative data.



Work Package 4: Data and curricula analysis from traditional and pilot E&T degree courses

The overall objective of this work package is to:

- to gather gender specific data on traditional and innovative pilot degree courses in E&T in Europe.
- to identify successful pilot degree courses in E&T in European countries.
- to analyse traditional and pilot E&T degree courses in regards to attracting and retaining female students.
- to evaluate the success of pilot projects in E&T in attracting more female engineering students.

Deliverable D4.1: Analysis of country specific case studies

This deliverable of work package 4 begins with a brief introduction giving an overview of the methodology used in work package 4, the sample description, the guidelines, and some overall results. The second part contains the individual country reports, as written by the national teams of the consortium, in alphabetical order: Austria, France, Lithuania, Macedonia (also written by the Serbian team), Serbia, Spain, and the UK.

A more in-depth analysis of country specific aspects and cross-national and cross-cultural similarities will be carried out and discussed in D.4.2. in order to evaluate 'traditional' and 'interdisciplinary' Engineering degree courses in Europe. For this deliverable, some first tendencies can be summarized.

- The hypothesis that 'interdisciplinary' study programmes have more female students is supported by results in Austria, Spain and Lithuania.
- Hypothesis two, that the female success rate is higher in interdisciplinary study programmes, is supported by results in Spain, Lithuania, and the UK, where the women graduates' share in study programme with 25% or more non-engineering subjects is higher than in those with less than 25 %.
- For Austria, there is a tendency that women in interdisciplinary degree courses have a higher success rate than in mono-disciplinary study programmes. To test the significance of this result, more statistical data are needed.
- In Austria, Spain, Macedonia and Serbia 'interdisciplinary' study programmes have their nonengineering subjects predominantly in the fields of Business and Management whereas the nonengineering subjects of 'interdisciplinary' study programmes in the UK and Lithuania are in more various fields like History, Philosophy, Design, Sociology.



- There is a tendency that new study programmes which are established after the Bologna process have more non-engineering subjects and are more 'interdisciplinary' (Spain, Austria).
- Some results indicate considerable country specific distinctions. In France, for example, it seems that students base their study choice on other criteria like the prestige of the university. For the UK, factors like socio-economic or cultural networks around a university, its image, cultural and sports resources influence students' choices of where to study.
- Degree courses in the case studies that present and promote interdisciplinary course contents, plurality in teaching and learning styles and methods, gender equality, attract more female students.

Deliverable D.4.2: Evaluation of traditional and pilot E&T degree courses

In this deliverable the 'traditional' and 'interdisciplinary' Engineering degree courses in seven European countries were evaluated. The work was carried out in the project "HELENA - Higher Education Leading to ENgineering And scientific careers" within the European Union's 7 framework programme "Science in Society" (<http://www.fp7-helena.org/>) under the coordination of Šiauliai University (Lithuania). Partners from Austria (Alpen-Adria-Universität Klagenfurt), France (Ecole Normale Supérieure de Cachan and ECEPIE - Égalité des Chances dans les Études et la Profession d'Ingénieur en Europe), Serbia (Mihailo Pupin Institute), Spain (Fundacion TECNALIA LABEIN), and the United Kingdom (Loughborough University) were involved.

For several years now, various stakeholders have argued for more interdisciplinarity in engineering education. However, what exactly is meant by that is still debatable. Beginning in the 1970s, a number of schemes have been set up in engineering faculties to practice multi-disciplinary or cross-disciplinary approaches and yet engineering programmes today retain the aura of a purely technical domain. The social content and context of engineering is still not integrated enough and hardly promoted. The majority of study programmes analyzed in the course of the HELENA project have less than 25% non-engineering subjects and the scope of these is mainly limited to management skills.

The curriculum analyses of the case studies shows that the list of non-engineering subjects comes predominantly from fields like management, business, economics, and languages. Some cases in Lithuania, Spain, and Serbia also cover philosophy, sociology, humanities, environmental aspects. Case studies in Austria and the UK show the biggest number of non-engineering subjects in the fields of history, philosophy, design, sustainability, sociology. Gender Studies courses are only offered in the two Austrian interdisciplinary case studies: at Klagenfurt University as "compulsory optional subject" and at Linz University as "compulsory subject".

This report explores some aspects of how mono-disciplinary engineering has been in the past, what has since changed, some likely reasons for the slow rate of change, and what more can be done to make engineering education more inclusive, diverse and sustainable. Interdisciplinarity not only means bringing non-engineering subjects into engineering education but it also calls for an inclusion of some science and engineering competencies in humanities, social sciences, etc.



to enable citizens in general to critically reflect developments in our technological society, to empower them to assess technologies, get engaged, involved and participate in discussions and debates about socio-technological issues. The plea for more informed citizens leads to the necessity of including techno-literacy into non-engineering education as well.

Work Package 5: Analysis of students' perception of societal impacts of E&T and their study choices

The overall objective of this work package is to:

- to collect data about the background of the current E&T education and the cultural context of E&T in Europe
- to analyse female and male student's perception of E&T in general and of interdisciplinary E&T fields in particular
- to analyse female and male traditional E&T student's study choices from a retrospective point of view
- to analyse female and male interdisciplinary (pilot project) E&T student's study choices from a retrospective point of view
- to evaluate the success of pilot projects which integrate societal impacts of E&T in the curricula (analysing interviews of traditional and interdisciplinary E&T students) against the background of the European context

Deliverable D5.1: Gender and context analysis of traditional / interdisciplinary degree courses

The main aim of this deliverable is to collect state of the art data and references about the background of the current engineering and technology education against the country-specific backgrounds and context of engineering and technology education in Europe, and to present findings, which are relevant for upcoming empirical fieldwork for HELENA in a concise way.

This deliverable consists of three major parts. First, it discusses engineering and technology education in Europe, presents important stakeholders (engineering education associations), illuminates the role of the Bologna process for engineering education and presents data about the students' perspectives of Bologna reforms in Europe. Second, gender issues in engineering and technology are presented in a nutshell, in order to understand the ratio of HELENA and especially WP5 about "Analysis of students' perception of societal impacts of E&T and their study choices".

Third, existing studies and data about traditional and/or interdisciplinary engineering and technology education are presented, to emphasize the possibility of attracting more or different



students with different foci in engineering and technology curricula. A special emphasis in this third part lies in the discussion of gender-specific and country-specific results to the question whether interdisciplinary study programmes in engineering and technology could attract a more diverse students' population and especially attract more female students.

Deliverable D5.2: Analysis of interviews with E&T students

This report consists of nine chapters written by different authors. The first chapter introduces the topic of engineering and technology (E&T) students' perceptions of their study choices and experiences from the point of view of the editor of this report, the leader of the work package 5. The following eight chapters are country reports from each team of the HELENA consortium. In alphabetical order the country-specific interpretations of E&T students are described, starting with Austria followed by France, Lithuania, Macedonia (covered by the Serbian team), Serbia, Spain and UK. One additional report especially addresses issues of a cross-comparison between Macedonia and Serbia.

At the end of this report a detailed table of content lists all relevant headings of all chapters, in order to find special information more easily.

Deliverable D5.3: Evaluation of interdisciplinary E&T degree courses from students' perspectives

This report presents a secondary analysis of research done for work package 5 "Analysis of students' perception of societal impacts of E&T and their study choices" from the EUproject "HELENA – Higher Education Leading to ENgineering And scientific careers". The project is carried out within the European Union's 7th framework programme "Science in Society" (<http://www.fp7-helena.org/>) under the coordination of Šiauliai University (Lithuania). Partners from Austria (Alpen-Adria-Universität Klagenfurt), France (Ecole Normale Supérieure de Cachan and ECEPIE – Égalité des Chances dans les Études et la Profession d'Ingénieur en Europe), Serbia (Mihailo Pupin Institute), Spain (Fundacion TECNALIA LABEIN), and the United Kingdom (Loughborough University) are involved.

The secondary analysis presented in this report uses data base entries from HELENA research as well as country reports (Thaler 2011) in order to compare interview results on a European level to gain new information about students' perception of interdisciplinarity in engineering study programmes.

As one result it can be stated that quite many of the interviewed E&T students are in favour of interdisciplinarity, but they do not always name it that way. They would like to add non-technical (or to be precise non-SET) subjects to their E&T study programme, especially those obviously and closely connected to future job fields, like languages (e.g. English), management skills and business contents.



In another work package of HELENA (WP4) statistical data showed that in Austria, Lithuania and Spain interdisciplinary E&T study programmes have significantly more women students than rather mono-disciplinary study programmes. But this is just one way of looking at interdisciplinarity. Another more qualitative point of view is taken into account in this report and therefore the result chapter is dedicated to the students voices, using an interview analysis type called 'core sentence method' (in German "Kernsatzmethode", cf. Löchel 1997).

The last chapter summarises how interdisciplinarity could make a successful difference in engineering education and points out that it is not enough to only add some nontechnical subjects to an E&T study programme to make it interdisciplinary, but rather answers the questions what 'true interdisciplinary engineering education' could look like.

Work Package 6: Evaluation and definition of indicators

WP6 takes as a basis the research work undertaken along the HELENA project within the previous work packages, mainly WP4 and WP5, to define specific indicators for measuring the attractiveness towards girls of E&T study programmes and to explore new possibilities in high education. We can understand WP6 as a summary of the main conclusions of the HELENA project providing recommendations for European Policy makers and Educational actors related with E&T education which will enable the Higher Education Institutions to evaluate the effectiveness of their educational policies and study programmes in attracting more female students to engineering disciplines.

The overall objective of this work package is to:

- to collect and analyse the existing indicators, specifying the methodology to measure the societal impact on the perception of science on study choice.
- to define the assessment methodology and indicators to measure the societal impact on the perception of science on study choice.
- to make policy recommendations.

Deliverable D6.1: Comparison of case studies and student perceptions

Deliverable D6.1 provides a synthetic review of current E&T education and the cultural context of E&T in Europe, a brief explanation about how the HELENA hypotheses (that greater interdisciplinary course content can encourage a more equal gender balance in E&T courses in Higher Education) have been supported and the main conclusions of the analysis of female and male students' perception of E&T in general and of interdisciplinary E&T fields in particular and whether this differs for students of traditional and innovative courses. Finally, this report identifies some interesting preliminary conclusions after exploring the impact of other factors on career choice and gender in engineering by partner country.



Deliverable D6.2: Indicators to measure overall effectiveness of E&T pilot degree courses

The European Commission has set far-reaching gender equality in the Engineering & Technology (E&T) fields. HELENA project contributes to these initiatives by examining the presence of women in E&T higher education and exploring the impact of interdisciplinary E&T study programmes in attracting more female engineering students.

The research done in HELENA project aims to explore the students' perception and personal reasons for the E&T study choice and the influence of the cultural or social context in their decision, HELENA identifies which are the subtle processes and mechanisms operating in E&T education that contribute to sustain gender inequality, and to analyse the success of "innovative" degree courses in comparison with the "traditional" ones in attracting more female engineering students.

The work carried out under the previous work packages of the HELENA project, mainly WP2, WP4 and WP5, together with the work done in WP6 have given a judgement on the needs, to provide new ways of measure the relationship between students' perception of E&T, in general and of interdisciplinary E&T fields in particular, and study choice. In task 6.1 some interesting preliminary conclusions have been identified after exploring the impact of other factors on career choice and gender in engineering by partner country. Other related existence studies have been also explored.

In Task 6.2 the TECNALIA research group intended to taking into account the different dimensions involved to attractiveness potential of E&T high education disciplines, analyze and identify opportunities for improvement. The objective of Task 6.2 is to define indicators to measure overall effectiveness, by means of the collection of relevant factors and gender sensitive indicators related to E&T high education programmes attractiveness. As result of Task 6.2, this D6.2 report presents a five dimensions' model with set of quantitative and qualitative indicators to measure E&T study programmes and their impact assessing the attractiveness of female students which are specific to E&T higher education. The model tries to afford an answer to the following key question: Which would be the relevant aspects measuring performance in effectiveness of E&T study programmes on attracting female students? The combination of five dimensions - study programme performance, university structure, personal background, national educational governance, and social & cultural context – is expected to give more comprehensive view on E&T high education programmes attractiveness potential and it reveals the diversity of aspects that could influence the study choice of young students, females in particular.

The model proposed is an attempt for structuring the factors that may influence the decision of pursuing a career in engineering. It suggests a set of assessment criteria and the setting of indicators to clarify the performance of attracting female students into E&T study programmes. The HELENA model has been contrasted against the case studies of the partners' countries in Task 6.3 (a total of 24 selected cases studies, traditional and innovative, in seven countries - Austria, France, Lithuania, Macedonia, Serbia, Spain and United Kingdom) in order to understand where the E&T study programmes stand and where our higher educational system may look for improvement. The conclusions of the research of HELENA project will permit to propose a set of recommendations to improve the effectiveness of educational policies and study programmes in attracting more female students to engineering disciplines.



The HELENA model is constructed on the basis of the results of tasks in previous work packages of the research project HELENA, Higher Education Leading to ENgineering And scientific careers. The project is funded by the European Commission under the 7th Framework Program (FP7), DG Research - Science in Society. It is coordinated by Siauliai University (Lithuania) and partners from Austria (Alpen-Adria Universität Klagenfurt), France (Ecole Normale Supérieure de Cachan and Egalité des Chances dans les Etudes et la Profession d'Ingénieur en Europe), Serbia (Mihailo Pupin Institute), Spain (Fundación Tecnalia Research & Innovation) and United Kingdom (Loughborough University) are involved.

Deliverable D6.3: Benchmarking and Promising Practice for HE

The European Commission has set far-reaching gender equality in the Engineering & Technology (E&T) fields. HELENA project contributes to these initiatives by examining the presence of women in E&T higher education and exploring the impact of interdisciplinary E&T study programmes in attracting more female engineering students.

The research done in HELENA project aims to explore the students' perception and personal reasons for the E&T study choice and the influence of the cultural or social context in their decision, HELENA identifies which are the subtle processes and mechanisms operating in E&T education that contribute to sustain gender inequality, and to analyze the success of "innovative" degree courses in comparison with the "traditional" ones in attracting more female engineering students.

The work carried out under the previous work packages of the HELENA project, mainly WP2, WP4 and WP5, together with the work done in WP6 have given a judgment on the needs, to provide new ways of measure the relationship between students' perception of E&T, in general and of interdisciplinary E&T fields in particular, and study choice. In task 6.1 some interesting preliminary conclusions have been identified after exploring the impact of other factors on career choice and gender in engineering by partner country. Other related studies have been also explored.

In Task 6.2, TECNALIA research group intended to take into account the different dimensions involved to attractiveness potential of E&T high education disciplines, analyze and identify opportunities for improvement. As a result, a five dimensions' model was proposed with a set of quantitative and qualitative indicators to measure E&T study programmes and their impact assessing the attractiveness of female students which are specific to E&T higher education. The combination of the five dimensions - study programme performance, university structure, personal background, national educational governance, and social & cultural context – is expected to give more comprehensive view on E&T high education programmes attractiveness potential and it reveals the diversity of aspects that could influence the study choice of young students, females in particular (Arrizabalaga et al., 2011b). The model proposed is an attempt for structuring the factors that may influence the decision of pursuing a career in engineering.

The HELENA model has been contrasted against the case studies of the partners' countries in Task 6.3. The research group intended to explore if some common pattern was appreciated in



the E&T study programmes of the case studies, regarding their attractiveness and to benchmark them taking into account the different dimensions involved in the assessment model. The goal is to understand where these E&T study programmes stand and where our higher educational system may look for improvement. The results are summarized in this report.

It is needed to note that it has not been possible to gather the complete information and data demanded by the model from the case studies (that goes beyond the objective of HELENA project). Thus, the results of the analysis done in Task 6.3 should be considered as a very preliminary approach where further research would be needed. It could only be suggested which influencing factors are important for E&T students' interests.

The HELENA model was constructed on the basis of the results of the different tasks in previous work packages of the research project HELENA, Higher Education Leading to ENgineering And scientific careers². The project is funded by the European Commission under the 7th Framework Program (FP7), DG Research - Science in Society. It is coordinated by Siauliai University (Lithuania) and partners from Austria (Alpen-Adria Universität Klagenfurt), France (Ecole Normale Supérieure de Cachan and Egalité des Chances dans les Etudes et la Profession d'Ingénieur en Europe), Serbia (Mihailo Pupin Institute), Spain (Fundación Tecnalia Research & Innovation) and United Kingdom (Loughborough University) are involved.

Deliverable D6.4: Policy recommendations

More girls than boys now complete their secondary education in 32 of the 34 countries that are members of the OECD, according to the recent report (OECD 2011). Moreover, female graduates greatly outnumber male graduates. Overall they account for 58% of graduates within OECD member states in 2009, the most recent year for which data are available, up from 54% in 2000. Men, however, continue to dominate the sciences: some 60% of science graduates are male. This proportion oversteps 75% in engineering and technology.

Europe presents a similar behaviour. The statistical indicators on engineering education demonstrate that in most European countries women now make up over half of the higher education student population, but make up a much smaller proportion in engineering and technology, ranging from 18% of students in the UK, to 35% in Serbia. Despite the fact that the greater proportion of higher education students is women, engineering is far from reaching parity with regards to numbers. It seems that the attractiveness towards engineering and technology sectors differs from male to female, where the women's share remains very low. Thus, equal participation of women and men in engineering occupations is still a major challenge for the European Union. Women presence in engineering appears as a key-issue for European economical and technical development, as well as a central achievement towards gender equality and social justice.

The history of engineering education in Europe may impact upon current developments; in particular tensions felt between theories and practice in the curriculum, and between the profession and Higher Education Institutions (HEIs). In this context, interdisciplinary degrees are



argued to offer attractiveness to a bigger and diverse student population than single, traditional engineering degrees. The HELENA project¹, “Higher Education Leading to ENgineering And scientific careers”, has been established to address the under-representation of women in engineering and technology higher education with the aim of exploring the students’ perception and personal reasons for study choice and the influence of the cultural or social context in their decision and to analyse the success of “innovative” study programmes -which include interdisciplinarity- in comparison with the “traditional” ones in attracting more female engineering students.

As result of task 6.4 of HELENA project, this report will provide a synthesis of the main conclusions of HELENA and a set of recommendations for stakeholders in higher educational at national and European levels related with of E&T. The results and recommendations shown in this report have been built on the analysis of the findings of WP4, WP5 and previous tasks of WP6 of HELENA project, which offer a detailed picture of the engineering and technology higher education in Europe and cover a wide range of issues to contribute to enhancing the knowledge of women and their presence in every stage of E&T higher education; strengthening female participation in E&T higher education in Europe and thus in the related professions; supporting female presence in E&T degrees and professional careers; identifying gender-specific needs of engineering professions and emerging fields attractive from women's perspective.

Even though HELENA’s hypotheses could not be fully proved in all covered countries and case studies, enough evidence has been found in the empirical work and complementary literature studies to propose recommendations with respect to gaining more quantitative and qualitative data and challenging HEIs and educational policy to contribute to an equal participation in E&T and a more equal society.

Content redesigning has been recommended for attracting more female students to E&T education but the atmosphere and new teaching and learning formulas in engineering are also seen as encouraging factors for students, for females but also for males. Thus it is needed to make appropriate both, the curricula content and the methods and the climate of teaching and learning, to attract and satisfy the needs and interests of both women and men.

The proposed recommendations cover a wide range of issues and they have been grouped to be addressed to:

- Policy (additional efforts for updating surveys, databases, studies, etc. on a regular basis, Measures to progress towards gender equality in E&T fields, ..).
- Higher Education Institutions (Open the E&T curricula to a more interdisciplinary dimension; establishing new rules for increasing women’s presence in E&T higher education; collaboration across academic communities).
- Women themselves.

The HELENA project recommendations could be used and integrated within new policies to improve gender equality for European higher education. Different key groups could benefit from them: policy-makers and educational actors related with E&T education at European and



national level, and in particular for HEIs, to help them to improve the effectiveness of their educational policies and study programmes in attracting more female students to engineering disciplines. This approach will allow every group to make suitable decisions about their strategy for gender mainstreaming and educational management and policy.

Work Package 7: Dissemination

The overall objective of this work package is to disseminate the project itself and project results to all relevant users and other stakeholders, and to raise awareness by:

- Establishing, updating and developing a website.
- Establishing a dialogue with the stakeholder.
- Disseminating project existence and objectives; disseminating project results and reports widely.
- Contributing to the awareness raising in the gender issues.
- Publishing major reports and studies on gender and scientific and technological education.
- Publishing results with specifically design documents for the general public.

Deliverable D7.1a Dissemination Plan

The aim of this project HELENA is to collect and analyze literature and data from traditional and pilot confirmed European Higher Education SET curriculum in order to question or confirm traditional statements about reason why women do not choice Science and Technology. HELENA wants to provide indications about how to launch such measures and monitor the obtained results. The study will be then grounded on empirical research about traditional SET curriculum in Europe and will compare them to selected pilot degree courses, which successfully integrated societal impacts in their science, engineering and technology (SET) degree course all over Europe.

Considering these objectives, it is essential to have contacts with carefully selected stakeholders since the beginning of the project in order to have as much information as possible about existing pilot curriculum. Among those stakeholders we will contact developers of such curriculum, and possible users of new curriculum which could attract more women in ST. At the same time it is important for the success of the project to inform numerous stakeholders of the existence of the project and its aims. Then, later on, we will have to disseminate as widely as possible the results of the study in order to convince as many stakeholders as possible that other types of curriculum are possible, that they can attract more young people into Science and Technology and particularly women.



Deliverable D7.1b

Revised Dissemination Plan

This report presents a revised dissemination plan for the HELENA project (D7.1b), it is a complement of the report presented last year in July (D7.1a). Basically, it is a confirmation of the plan established with all the partners at the beginning of the project. We use in this report the same structure and, for the most part of it, the same content as the D7.1a (July 2009). Indeed, no major difference appeared in the past 14 months neither on the methodology of dissemination, nor on the strategy which should be used, nor on the different types of actions which seem necessary for disseminating the HELENA project on an efficient way. Of course those different points have been discussed with our partners and received the agreement of the coordinator of the project, Pr Dr Virginija Sildauskiene.

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Deliverable D7.2:

HELENA Website launching

HELENA website was launched immediately after HELENA project had started. Besides coordination support, this website aimed at facilitating the dissemination of the project results. To establish this website, the Mihajlo Pupin Institute undertook both website design and interactive portal functionality support. From the functionality aspect, the web portal comprised two main sections: a public section (accessible to everyone) with a view to dissemination and gathering general information about the project and a private section (accessible to the consortium members only) for collaborative work used for sharing and exchanging information between project partners.



**Deliverable D7.3:
Material(brochure/leaflet)**



**Deliverable D7.4a
Dissemination Report**

The aim of this project HELENA is to collect and analyze literature and data from traditional and pilot confirmed European Higher Education SET curriculum in order to question or confirm traditional statements about reason why women do not choice Science and Technology. HELENA wants to provide indications about how to launch such measures and monitor the obtained results. The study will be then grounded on empirical research about traditional SET curriculum in Europe and will compare them to selected pilot degree courses, which successfully integrated societal impacts in their science, engineering and technology (SET) degree course all over Europe.



Considering these objectives, it is essential to have contacts with carefully selected stakeholders since the beginning of the project in order to have as much information as possible about existing pilot curriculum. Among those stakeholders we will contact developers of such curriculum, and possible users of new curriculum which could attract more women in ST. At the same time it is important for the success of the project to inform numerous stakeholders of the existence of the project and its aims. Then, later on, we will have to disseminate as widely as possible the results of the study in order to convince as many stakeholders as possible that other types of curriculum are possible, that they can attract more young people into Science and Technology and particularly women. The object of this report is to present the state of the work; it is an overview of the dissemination work in progress. In a first chapter we present the objectives of the dissemination policy as it has been established by the consortium, defined in the contract and revised when it seemed necessary to do so. In a second chapter we present the dissemination which has already been done by partners at the national and international level through conferences, seminars, workshops. In the last part (chapter 3) we present the preparation of the International Conference which will be the main effort for disseminating the results of the HELENA project.

Deliverable D 7.4b ***Revised Dissemination Report***

This deliverable presents the dissemination which has already been done by partners at the national and international level through conferences, seminars, workshops. Additionally, this deliverable reports on the *Gender and Interdisciplinary Education for Engineers (GIEE)* conference held in Paris, June 23th and 24th, 2011. The conference was organized by the HELENA consortium with the aim to present the results of the HELENA project to the community of researchers involved in women participation in engineering, as well as to confront the HELENA results to the other studies in the field.

Deliverable D7.5: ***Final version of Web Portal***

The main objectives of the EU FP7 project HELENA (“Higher Education Leading to ENgineering And scientific careers”) is the analysis and evaluation of traditional and pilot E&T degree courses curriculum across Europe through quantitative and qualitative approaches. In order to make the work of HELENA researchers coming from different EU partner institutions more efficient, to support data collection and processing and facilitate public dissemination of results, the HELENA portal as an e-collaboration platform was established and problem-specific tools for curricula analysis were developed.

The HELENA portal (see <http://www.fp7-helena.org/>) is a generic platform built using the latest Internet technologies. The public part of the portal presents the HELENA project, the accomplished results, acquired awards, and the HELENA related events (project meetings, conferences, seminars, etc). The private part of the portal consists of the Wiki that facilitates the project administration and is used for storing the HELENA deliverables, working papers, the HELENA methodology guidelines, etc., and the HELENA database that stores data collected by HELENA researchers and serves for analysis of higher education engineering programmes.

The HELENA database is a unique repository of three different types of data including collected data about 109 European universities and 189 E&T study programmes, collected gender specific data on enrolled and graduated students, and 156 interviews with female and male



students of traditional and interdisciplinary degree courses. The study programme analysis tools can be applied for analysing complete or parts of tree-cycle curricula offered in different countries and engineering disciplines such as Civil engineering, Environmental engineering, Information and communication technologies, Industrial data processing, Industrial management engineering and Mechanical engineering. The interview analysis tools can be customized for collecting and retrieving different types of common and/or country specific questions, as well as for different types of interviewees (students or teachers).

In addition, the HELENA portal hosts the web site of the HELENA International conference “Gender and Interdisciplinary Education for Engineers - GIEE 2011” (see <http://www.fp7-helena.org/conference2011/>).

Deliverable D7.6

Summary Report for Stakeholders

Since women’s presence in engineering appears to be a key-issue for European economic and technical development, as well as a central achievement towards gender equality and social justice, it is important to understand why there are so few women in E&T. There are traditionally two reasons put forward:

- Technology has a very clear gendered representation, which is a masculine one culturally, symbolically and professionally.
- The lack of interdisciplinary subjects in E&T curricula is acting as a foil to potential E&T students, males and females.

The first one has been extensively studied over the last twenty years. Hence, HELENA focused on the second one. The HELENA methodology is based on comparisons between “traditional” and “innovative” European Higher Education E&T curricula (see below Section 4, p. 7, for the definition of what is called in this study “traditional” and “innovative” courses). Then, 24 of these study programmes (case studies) were analyzed. Finally, a field work was conducted through 162 individual interviews with female and male students from the selected case studies.

The results:

- Engineering study programmes with more than 25% of non-engineering subjects are more attractive to women than traditional engineering study programmes: interdisciplinary study programmes have about 12% more women than the average of all the study programmes analyzed.
- Women have a higher success rate in interdisciplinary programmes (about 16% more) than in traditional ones.

It was very clear that success depends on the cultural context, on the kind of relation which is built between subjects in a curriculum, and how the teaching is organized, e.g. project-based pedagogy is a positive factor.

**Deliverable D7.7:
GIEE International Conference, Paris, 23rd-24th June 2011**

This deliverable reports on the Gender and Interdisciplinary Education for Engineers (GIEE) conference held in Paris, June 23th and 24th, 2011. The conference was organized by the HELENA consortium with the aim to present the results of the HELENA project to the community of researchers involved in women participation in engineering, as well as to confront the HELENA results to the other studies in the field.

The deliverable is divided into several sections. Firstly, a synthetic report covering a detailed view on the conference organizational structure, numbers of papers presented, numbers of conference participants, and key note speakers is given. The next section gives the scientific report by Pr Jean Michel, the chairperson of the Scientific Committee. The section 3 presents the programme of the conference (timetable), while the section 4 introduces the abstracts of conference papers and key note speeches. The dissemination of the conference is the topic of the last section.

The Call for papers, the List of conference participants, and the Abstracts of conference papers and posters are given in the appendices.

The importance of the conference topic and the interest of researchers in the field were confirmed by the large number of conference participants. More than one hundred of people attended the conference and participated in the very interesting discussions on 21 research papers that were presented in the two conference days.

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