E4 Thematic Network:
Enhancing Engineering
Education in Europe

VOLUME A

Introductory Book

Claudio Borri, Francesco Maffioli

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1. Introduction

Prof. Claudio Borri
President & Legal Representative of E4
Deputy Rector for EU Programmes
Università degli Studi di Firenze, Italy

Entering the so-called "dissemination year", at the end of the 3-years nominal working period of the E4 TN project, time has come to strike a first provisional balance of the outcomes and revenues of such a large project. Aiming to this, let us first shortly draft the reasons why European Higher Education (HE) Institutions need to focus their attention on "Enhancing the European/International dimension".
European Universities at the dawn of the 3rd Millennium face the extraordinary task of reshaping their educational profiles and mission statement in order for their graduates to be skilled and ready to respond to the need of a "*globalised, high-technological and extremely competitive*" society, i.e. to:

- the ever faster developing scenery of the work market & environment,
- the stronger competitiveness within the education sector between public and private sector,
- the radical changes in the HE studies and curricula (and, in particular, in Engineering) that entered into force in many European countries after the well known Paris-Bologna-Prague process (initiated in 1998, and continued in 1999 and 2001),
- the need of a reliable, internationally recognised system of quality assessment,
- the introduction of a culture of "accreditation" of studies and/or Institutions,
- the progressive interfacing and convergence of the EHEA (European Higher Education Area) towards the ERA (European Research Area) (as a renewed priority for the Berlin Conference of European HE Ministers, Berlin Sept. 2003),
- the attractiveness and competitiveness world-wide of the European University system (as aimed through the new ERASMUS MUNDUS programme, which will be launched in 2004)

All items above are nowadays necessarily part of a suitable and modern development strategy/plan of a good University/HE Institution. The SOCRATES II programme (launched by the EC in 2000) and its Thematic Network projects largely contribute to the improvement and to the implementation of such new strategies and policies. This is why the University of Florence, School of Engineering, decided to launch, in September 1998, a proposal for a TN project in Engineering education. The University of Florence (UNI-FI in the following) recognised it as an opportunity for strengthening its role as strong "ERASMUS committed" Institution (in the first candidature for a

Inst. Contract in 1996 Florence was No. 1 in Europe as far as overall activity and financial contribution was concerned). In a "*generalist*" kind of University (with highest reputation in Italy and Europe in many fields of study and research and more than 55,000 students) the youngest school – Engineering, only 30 years old – was willing and fully determined to launch and run such a large project as follow-up of an intense and fruitful cooperation within previous European projects and international associations. The acting Rector (Prof. P. Blasi) fully supported this willingness, the Dean (Prof. E.A. Carnevale) and the staff of the school recognised the good chance and intended to strengthen the numerous ties and cooperation links within Europe, mainly developed within the previous 10 years of cooperation in ERASMUS and other research relationships ... and the candidature was submitted.

The commitment of the School and of the whole University has to be acknowledged primarily: due to the "hard" contracting rules of a TN project, a local sustain is normally required, both in human resources as well as in financial terms. On the global budget devoted to SOCRATES activities, the E4-TN has received a yearly lump sum, which has been negotiated with the AC of UNI-FI. Despite the very hard restrictions in the budget (these are very hard times for the University cashiers!), the TN project has been always considered and highly respected (and preserved) in front from heavy budget cuts.
Nevertheless, the only commitment of the Contracting University would not have ensured the successful accomplishment of the project: the Co-ordinator (F. Maffioli) and the 5 Promoters (the true scientific "souls" of the project) have to be gratefully acknowledged for their personal commitment and devotion: this has been also underlined by J. Levy (Senior member of the IAB, an independent and external advising body that has been created to accompany and monitor the project).

E4 could profit from the expertise gathered by many of its actors as they were involved, at different level, in the previous TN project, run by a EEIG called H3E: in fact, 3 leading European Associations that were establishing such Consortium (BEST, CESAER & SEFI) continued to strongly support the activity of E4: "Also commendable is the considerable involvement of engineering students through IAESTE and BEST and the contacts maintained with engineering education associations in Europe (SEFI) and North America (ASEE, UEF)", J. Levy, IAB Report, August 2003).

Which has actually been the impact of E4 on the EE scenery in Europe? This might be hard or pretentious to be said in such a short term: possibly, the major influences on the EE developments will become evident in a (some more) medium/long term. Unquestionably, the immediate effects on the EE environment can be measured in:

- a stronger integration effect amongst the Engineering schools, in both dimensions, a "cross-regional" one and a "cross-disciplinary" one. This has to be considered as an important factor, as normally EE institution tend to network and group mainly within restricted areas and/or a given discipline

- a very sensitive East-West integration of the Engineering schools, with an active participation of members of Technical Universities of Poland, Romania, Hungary, Bulgaria, Czech Republic and some minor participation from all other eligible countries; at least one of the dissemination events is planned to take place in Eastern Europe
- renewed synergies with some major professional associations (FEANI in first place) which has lead to the proposal of some common European projects (LEONARDO applications)
- improved links and successful cooperation with some major European/worldwide industry: as an example, the production of the final documents of E4 and the dissemination year has already received a significant contribution from SIEMENS AG, which has to be here gratefully acknowledged
- a greater visibility of the EE network by all major Education "stakeholders" (the EC, some high functionaries at the Ministries of Education of the member countries, the EUA, Rector Conferences, etc.)
- a major role played in the discussions of the so-called *"Bologna process"* as primary interlocutor within its follow-up
- again a primary role played within the "Engineering Synergy Group" contributing to the TUNING (Educational Structures in Europe) project of the EC
- a pioneering work in the field of accreditation/quality assessment, which is recognised through the set-up of the "European Standing Observatory for Engineering Profession and Education" (ESOEPE)

The outline/list of contents of the present "Introductory Book", for which these few lines could appear too modest, would made everyone proud to deliver the introduction: I am leaving to the Coordinator the merited privilege to introduce and shortly describe the Chapters/Annexes of the 2 volumes, which collect all gathered expertise and thoughts assembled during numerous meetings, seminars and simple talks. The work done by the Promoters, which I like to mention here: G. Heitmann, for Activity 1; G. Augusti & A. Soeiro, for Activity 2; P. Montesinos (supported by A. Hagström, during the first and the second year) for Activity 3; B. Mulhall and J.P. Charlot, for Activity 4; M. Pursula, for Activity 5, has to be considerably acknowledged both for the quantity and for the quality.

Nearly 110 partners involved, 5 Work Packages/Activities leaded by as many Promoting Institutions, 3 Transversal activities serving the whole project structure, 1 Project manager at the Headquarter based at the International Relations Office of the School of Engineering in Florence: these are the figures that give an overall idea on the dimension of the project and on the management effort. Such effort made it possible for E4 to become synonymous of EE in Europe, at least for the time being: after the E4 experience, the EE sector has gained a primary position in front of all relevant policy makers and stakeholders of the HE. Looking to the future, some challenging tasks are now likely to be affordable, namely:

- to define new strategies of internationalisation of curricula, leading to joint Master and/or Doctoral degrees,

- set up new lines to realise a progressive convergence of EHEA towards ERA: the EE sector could again play the role of a pioneer for running experimental projects,
- to pass to a further/advanced stage in order to establish an European accreditation system for EE,
- to enhance student mobility and mutual recognition of titles, in order to create a *free* European work area for Engineers.

But, before the future comes, let me frankly conclude these few words with a statement of full satisfaction: it has been a great honour and a privilege to serve as President of such a good group!

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2. Committed to E4: Mission and Results

Prof. Francesco Maffioli
Scientific Co-ordinator of E4
Politecnico di Milano, Italy

2.1 Foreword

I will try to give in this chapter an outline of the mission and of the results achieved by the E4 Thematic Network. Someone would think that this should be an easy task for the TN co-ordinator. I do not share this confident opinion: the life of E4 has been enriched by so many contributions, the evolution of the European scenario in Engineering Education (EE) so rapid (and still continuing!), that the risk of not being successful in giving a representative enough outline of E4 is a definite possibility.

Some 110 Institutions of Higher Education signed the bilateral agreement with the University of Florence declaring their interest in participating actively to the E4 TN, most of them during the first months of existence of it, another less numerous group, later. Three internationally recognised associations, BEST (Board of European Students of Technology), CESAER (Conference of European Schools for Advanced Engineering Education and Research) and SEFI (Société Européenne pour la Formations des Ingénieurs), have strongly supported E4 (as they did for the TN "Higher Engineering Education for Europe" (H3E for short) under SOCRATES I): it is through them that a strong active participation has been ensured as well as an effective dissemination of the results.

The structure of the project needed for achieving its objectives was implemented during the first year. In particular the *Management Committee* (MC) (see chapter 6.1 of this Volume A); the structuring of the *Headquarters* of E4 in Florence (see chapter 6.2); the *web site* of E4 (see chapter 2.5.1); the establishment of an electronic newsletter (see chapter 2.5.2); the organisation structure to support seminars/conferences, such as the International BEST Symposia (IBS), when dedicated to themes relevant to E4, and the General Conferences of the active members of E4 (as the kick-off meeting in Leuven beginning of March 2001 and the second one at the beginning of December 2001 in Florence). A self-evaluation structure was also created: the *International Advisory Board* (IAB) (see also chapter 4 of this Volume A). The IAB has been invited to the MC meetings and the general conferences of active members of E4.

E4 has aimed at influencing EE in Europe at various levels. The most important and numerous comprise all EE Institutions (students and teachers) and the many stakeholders (e.g. industries, public administrations, etc.): this level is reached mainly through the members of the associations mentioned above; another, more restricted, level is constituted by the people/institutions actively involved in the project. A comprehensive and continuously updated description of the E4 TN can be found in its web site http://www.ing.unifi.it/tne4. Since the beginning E4 was structured into five *Activities.* All five parts dedicated to the results of each one of these Activities and contained in the same box as this Volume A, begin with an introductory section aimed at illustrating the connection with the overall TN project. Two other books are contained in this box: the present one (Volume A), whose aim is to constitute a general introduction and synopsis of E4 activity, and Volume B dedicated to the *Glossary* of EE terminology and to the results of the Synergy Group on EE of the Project TUNING. Besides what already mentioned, Volume A contains a brief history of the TN (chapter 3), and some thoughts about TNs in general and about the mission(s) of a TN (if any) continuing the work of E4 (chapter 5). Volume A contains also in Appendix the complete list of the Institutions/Organisations having signed the bilateral agreement with University of Florence, pointing out the most active ones during the E4 life (chapter 6.3), the list of outputs (chapter 6.4) – which includes not only those presented in print in the volumes of this box, but also those which were not considered worth printing and remained available in the web sites – and the list of events organised in these years (chapter 6.5). Finally let me remind the reader that this set of books is also accompanied by a *CD-Rom,* containing not only what can also be found in print, but also other items coming from activities developed during the life of E4.

2.2 The Five E4 Activities

As already announced in order to ensure a smooth development of the activity, 5 working groups have been identified:

Activity 1: Employability through innovative curricula. Promoter: Günter Heitmann, Technische Universität Berlin.
Activity 2: Quality assessment and transparency for enhanced mobility and trans-European recognition. Promoter: Giuliano Augusti, Università di Roma “La Sapienza”. Co-promoter: Alfredo Soeiro, Universidade do Porto.
Activity 3: Engineering professional development for Europe. Promoter: Patricio Montesinos, Universidad Politecnica de Valencia.
Activity 4: Enhancing the European dimension. Promoter: Brian Mulhall, University of Surrey. Co-promoter: J. Pierre Charlot, Université d’Angers.
Activity 5: Innovative learning and teaching methods. Promoter: Matti Pursula, Helsinki University of Technology.

Each Activity had of course its specialised aims and objectives, which we summarise below and which have sometimes suggested to articulate each Activity Working Group into a number of *Special Interest Groups* (SIG). It must be outlined that in many cases it was felt that original aims and objectives as present in the first application for E4 to SOCRATES 2 should be actualised in order to take into account the interests of the members of each Working Group as well as recent developments and challenges in the field of EE in Europe.

2.2.1 Activity 1: Employability through Innovative Curricula

Innovation is one of the key factors not only for enhancing employability, but also for the competitiveness of European industry. This need is multifaceted: forming innovative minds must be high in the list of goals of any EE institution and many aspects contribute to the satisfaction of this need. One is the explicit outcome orientation and the continuous updating of the curricula for EE in their various aspects: basic science courses; the fundamentals of engineering; more recently introduced topics, like management and information technology; new teaching and learning arrangements promoting active learning and the acquisition of core competences and transferable skills. All these aspects are carefully considered and their respective value assessed, also comparing the degree in which different institutions have taken them into account, in particular having in mind the consequences of the Bologna Declaration. Indeed a great challenge for the European EE institutions will be the development and implementation of curricula for the two-tier system, especially the design of undergraduate courses of study (i.e. first level degrees) guaranteeing high quality, employability and international professional and academic recognition. Activity 1 has been co-ordinated by Günter Heitmann of the Berlin Technical University. It is also fair to say that some of the objectives considered at the beginning of E4 were not pursued further: the mission of Activity 1 (as well as that of other Activities) have continuously evolved according to the interests of active participants as well as to stimuli coming from the rapidly evolving European scenario in EE. Some of these objectives could be considered if another TN will follow E4, for instance: study of aspects of curricula which are likely to attract more effectively good secondary school students, in particular women, in EE; formation for entrepreneurship; synergies between EE and Research.

The book reporting the results of Activity 1 begins illustrating the criteria for curricula innovation, namely responsiveness to new demands and offers, such as the changing working environment, the new teaching and learning technologies, the need for interdisciplinary formation, the ability to work in teams, ethic and environmental responsibilities. A particular attention is given to the internationalisation of studies, to cope with global and, in particular, European dimension of modern enterprises. An ad-hoc chapter is dedicated to the overall frame in which any curriculum development must be conceived. Several innovative components are then analysed. This huge study effort has permitted to arrive in the 6^{th} chapter at a substantial set of guidelines for core profiles of new curricula for the two tier system. The limits of this exercise are presented for clarity in the first sections, then the chapter is divided into two parts: the first relevant to all engineering areas, the second outlining the peculiar requirements of each one of the major branches of EE. In Appendix the book reports the official communication of CESAER and SEFI on the Bologna Declaration and the list of active members of Activity 1 during the life of E4.

2.2.2 Activity 2: Quality Assessment and Transparency for Enhanced Mobility and Trans-European Recognition

This Activity is targeted to a key issue for the development of the European dimension of EE, from the point of view of all stakeholders (academia, enterprises, students, Society): namely, the way and means to enhance recognition throughout Europe, in order to ensure employability and (physical and virtual) mobility of engineers. The key issues tackled are how to foster the generalisation of “Quality Assurance” procedures, and how to improve the ways and means to measure (and compare) the competencies of each “type” of engineer. In many European countries, Quality Assurance procedures are already suggested (or imposed) to EE institutions in order to validate the learning opportunities they offer. They are in the majority of cases supported by Quality Assessment bodies, managed by the competent Ministry and/or by professional associations. Further development is however essential.

On the other hand, in order to facilitate Trans-European recognition of courses and degrees, E4 was among the first promoters of the development of the “European Standing Observatory for the Engineering Profession and Education” (ESOEPE), established in the very first days of activity of E4 with the participation of assessment and accreditation bodies of six European countries and now being enlarged: E4 feels that this “Observatory” may help to provide a path to a smooth form of “accreditation” through mutual trust and bilateral agreements. A web site of ESOEPE, run by FEANI (European Federation of National Engineering Associations), has been established (www.feani.org/ESOEPE).

Activity 2 working group has been co-ordinated by Giuliano Augusti of University of Rome “La Sapienza”, later joined by Alfredo Soeiro of Porto University. The book dedicated to Activity 2 is divided into 3 parts. The first on “Accreditation and recognition in EE” (by G. Augusti), the second on “Quality assurance in EE on a national and European scale” (by M. Gola of Politecnico di Torino), and a third part on “New trends in evaluation and recognition” (by A. Soeiro). The first part is devoted to a survey of the various situations with respect to these matters across European countries. The second chapter is articulated in three sections: the first presenting the overall horizon of quality assurance issues, the second dedicated to ideas for European evaluation models, and the third presenting an articulated proposal for debate on this very sensitive matter. Soeiro in the third part touches aspects which have entered the scene only in a comparatively recent past, such as accreditation of informal and prior learning, accreditation of distance learning, and transfer of accredited LLL (Life Long Learning) experiences.

2.2.3 Activity 3: Engineering Professional Development for Europe

Activity 3 has had from the very beginning the aim to enhance Continuous Engineering Education (CEE) in Europe, in order to help achieving a continuous professional development of European engineers. This was also the mission of the similar Working

Group of the previous TN known after the acronym H3E, which published a successful document titled “CEE: a Call to Action”, advocating the urgent need for European Universities to equip themselves in this sense. A natural consequence of this preliminary work has been to focus on tools to do so. Therefore the active members of this group considered that the first crucial step was to help having good CEE providers. This meant improving the management skill and abilities of these providers. Hence Activity 3 has had during the 3 years of life of E4 the goal to discover critical success factors and processes related to CEE management.

In the first year of E4 the focus of Activity 3 was on organisational and business models for continuing education and in the second year on competence development in continuing engineering education. A survey, two workshops and two seminars were organised in order to collect data on continuing education activities at engineering schools, the organisational structures and business models used. The information thus gathered has been used to further develop the models for data collection (benchmarking) and paradigms for describing university continuing engineering education. This work has been continued in the second year, and used as the basis for developing guidelines and description of successful practice. In the third year the main focus was on further analysis, documentation and dissemination. Further case studies were collected with the particular focus on the use of Open and Distance Learning (ODL) in CEE. This work was closely co-ordinated with Activity 5 (Innovative Learning and Teaching Methods) of E4.

One of the most important aspects to realise is that there is not a solution suitable for all cases. Moreover the CEE market appears, as other service markets, to run faster than the suppliers. Activity 3 took advantage very strongly of the CEE Working Group of SEFI, as an essential forum for inspiration and discussion. The mission of Activity 3 was itemised as follows:

- monitoring actions already established within European projects, as well as in individual universities, professional associations, companies and other organisations;
- collecting examples of good practice in the development of continuing education opportunities for engineers;
- assessing the role of research as a component of continuing engineering education;
- producing guidelines for the development of good continuing professional development initiatives in Engineering faculties;
- helping to develop a learning culture in industry.

Most of these objectives have been achieved and are presented in two parts: “Typology of CEE supplying in Europe” and “Recommendations on CEE management”. The report of Activity 3 is completed by four Annexes on benchmarking different aspects of CEE: demand analysis, product design, marketing, and ODL. Finally it must be remembered that the book from can not reflect every activity developed during the life of E4 by Activity 3: the picture is completed by visiting the web site http://www.cfp.upv.es/e4.

2.2.4 Activity 4: Enhancing the European Dimension

Despite the great success of ERASMUS Programme in increasing the mobility of graduate students in Europe, the awareness of the necessity of introducing a European Dimension for all engineering students is not yet as widely accepted and understood as it should be. Among other aspects, it is felt that this need can be satisfied only introducing elements of internationalisation culture into the formation one receives *at home*. Hence this Activity has two sides: one devoted to identify these elements and how to incorporate them into an already crowded curriculum, the other devoted to design actions to facilitate students mobility, trying to remove hindrances on it and proposing initiatives to stimulate it, like the so-called *JEEP Teams*.

Four lines of actions have been initially identified, but significantly modified in the second and third year:

- to study the structure of the European work environment, in order to assess the real needs;
- to identify tools for introducing the international component in Higher Engineering Education;
- to study current hindrances to international employability;
- to establish and study projects targeted to international teams of students, akin to the JEEP Teams.

Following this mission, the report of Activity 4 presents first a chapter on “The real needs of industry”, then a chapter on “Internationalisation of Universities” and finally a chapter devoted to “Project Teams”. Another aspect worth exploring which was identified only during the last year of E4, is the opportunity of a “Register of courses given in foreign languages” across Europe: to this need the last chapter of the Activity 4 report is dedicated. In Annex 1 the book reports the main characteristics of ECTS and in Annex 2 the enquiry form for going on constructing the Register mentioned above.
The reports of Activity 3 and Activity 4 are collected into Volume E.

2.2.5 Activity 5: Innovative Learning and Teaching Methods

New Information and Communication Technologies (ICT) continue to create new opportunities also in the learning environment. The application of ICT in education and training can help to make the learning process more effective and closer to the needs of students. However the application of ICT does not automatically lead to better education. In an Engineering environment the technology itself is usually less of a problem, but achieving the shift from teacher-driven to learner-centred education involves a complex, and inevitably slow, process of re-adaptation of minds and structures in Institutions. There is a lot of experience in applying ICT to EE across Europe, but too little of this experience has been successfully disseminated, so that positive as well as negative aspects need to be thoroughly discussed.

In the project kick-off meeting four themes were established and four people appointed to be the co-ordinators of these Special Interest Groups (SIG). Also the future plans for each of the themes were outlined. Activity 5 developed its own web site during the three years of E4 (http://virtual.hut.fi/E4_Action5/themes.htm). In the introduction to the Activity 5 book aims and working methods are presented. The second chapter discusses the themes in which Activity 5 has been articulated: study of virtual university initiatives in Europe, good practices in the use and support of new teaching and learning technologies, training for engineering teachers and facilitation of ODL-ICT in teaching and learning, and experiences of net-based and trans-national courses. Students' views on new learning challenges are summarised in chapter 3. Conclusions and recommendations are the topics of the last two chapters. The four Annexes report activities, active members-institutions, and the methodology for benchmarking national e-learning strategies. It must be emphasised that lot more can be found on the web site of Activity 5, part of it reflected in the CD-Rom attached to this full set of books of E4.

2.2.6 Transversal Actions

With reference to what already stated in the previous section introducing the 5 activities, there have been several aspects which have been common to all sub-projects and having them under the same TN obviously implied economies of scale in terms of the efforts required. Among these the networking aspect virtually encompassing all institutions of EE in Europe had been given the highest priority.
One key tool for this kind of action was the implementation and maintenance of the Internet site of the TN (Transversal Action 1, TA1).
The task of maintaining the web site of E4 in good operating conditions is under the supervision of the Departement of Electronics and Telecommunications of the Faculty of Engineering of the University of Florence.

Another Transversal Action (TA2) was in charge of the managing of the publications coming out of the various Activities This TA is the responsibility of SEFI who was also in charge of the publication of the bimonthly Electronic Newsletter of E4 in close contact with the Headquarters and the project Co-ordinator.

Finally, of paramount importance has been the organisation/participation to conferences and seminars during the life of E4, also including intensive workshops collecting teachers and students for experimenting innovative learning tools and systems as well as the IBS initiatives of BEST. In this activity all associations have been involved, identifying case by case the ad-hoc organising structure. Transversal Action 3, jointly leaded by CESAER and BEST, has been in charge for these aspects.

2.3 The TUNING Synergy Group in Engineering Education

This short section wants to provide an introduction to the Report of the Engineering Synergy Group of the project TUNING. The full text of the Report is reported in Volume B.

The European labour market is developing fast. At the same time the Bologna process is promoting fundamental changes in the Higher Education sector. The meeting of European education ministers in May 2001 in Prague has confirmed the intention of gradually arriving at a fair degree of convergence between the different educational systems in Europe by 2010. This implies the necessity of adapting curricula in terms of structures, contents, learning attributes, learning tools, assessment methods. The project "Tuning Educational Structures in Europe" (*Tuning* for short) aimed at "pooling together and capitalising on available experience and recent developments in several of the Member-states ... particularly from previous and on-going European co-operation in the context of the Socrates programme".

The Tuning project aimed initially at enabling European universities to conduct a joint debate on these issues in five areas: Mathematics, Geology, Business, History, and Educational Sciences. Many other synergy areas were soon identified on the basis of previously done and/or on-going work in the context of the ERASMUS Thematic Networks action, in particular when concerning the European Credit Transfer System (ECTS), quality assurance, definition of core curricula. Selected areas included Chemistry, Physics, Languages, Law, Medical Sciences and Engineering.

The Engineering Synergy Group (SG) of the Tuning project included:

Giuliano Augusti	Università "La Sapienza" di Roma
Anselmo Del Moral	Universidad de Deusto, Bilbao
Anders Hagström	ETH Zürich
Günter Heitmann	TU Berlin
Francesco Maffioli	Politecnico di Milano (co-ordinator)
Iacint Manoliu	TU of Civil Engineering, Bucharest
Brian Mulhall	University of Surrey
Matti Pursula	Helsinki University of Technology
Reinhardt Schmidt	Università di Firenze
Valeria Bricola	European Society for Engineering Education (SEFI) (secretary)

The Engineering SG was formed with the declared goal of taking advantage of the experience being obtained within the Thematic Network (TN) "Enhancing Engineering Education in Europe" (E4) (and of the experience gained within previous TN's in the field of Engineering Education such as H3E (Higher Engineering Education for Europe, 1996-99) and EUCEET (European Civil Engineering Education and Training, 1998-2001). This implied some differences in methodology with respect to other areas of Tuning for arriving at recommendations, in particular the Engineering SG decided not to use the questionnaire approach of other Groups of Tuning, but rather to rely on recently done surveys of similar characteristics. Another difference immediately apparent is the relatively small number of members of the Engineering SG, which may cast doubts on how representative it is of the European Engineering Education world. However it must be pointed out that GA, GH, AH, BM and MP are Promoters of the five Activities of E4 and that FM is its co-ordinator, whereas JM is the General Secretary of EUCEET. It is through these links to Thematic Networks in the engineering field that the representativeness of the Engineering SG was ensured together with the active role that engineering education societies such as SEFI and CESAER, and professional organisations such as FEANI, have been playing within E4.

The main objectives of the Bologna Declaration are:

- Adoption of a common framework of readable and comparable degrees, "also with the implementation of the Diploma Supplement";
- Adoption of a system of higher education based on two cycles, undergraduate or first cycle studies, lasting a minimum of 3 years and a maximum of 4, and postgraduate or second cycle studies following successful completion of first cycle studies and leading to a master and/or doctorate degree;
- Implementation of the European Credit Transfer System (ECTS);
- Elimination of obstacles to free movement of students and teachers;
- Inclusion of a European dimension to quality assurance in higher education.

The objective to promote the adoption of a two-cycle system of higher education is the one that poses the greatest challenge. The European Universities in March 2001 in Salamanca, accepting this challenge, endorsed the move towards a compatible qualifications framework and pointed out that "There is broad agreement that first degrees should require 180 to 240 ECTS points but need to be diverse leading to employment or mainly preparing for further postgraduate studies". Arriving at a good level of convergence in higher education in engineering may well be easier than in other fields, because of the fact that Engineering Education (EE) institutions have always been keen to respond to the requests coming from the labour market, nevertheless the diverse scenarios existing in different countries suggest the necessity of a long phase of gradual modification.

This enhances the importance of initiatives like Tuning (and E4) aiming at identifying the instruments, which can help in this delicate phase. However the EE world resents the fact that technical universities and faculties are not yet properly represented in the Bologna process, which has lead to the specific needs of EE not being taken sufficiently into account.

The Report of the Engineering SG of Tuning is organised as follows. After having summarised the European scenario in EE, some current important trends are surveyed. Then the four lines of Tuning are considered as far as EE is concerned: this may be considered as the core of the Report. After some brief consideration about the doctorate level in Europe, a sizable part is devoted to life-long learning issues. A number of recommendations and tools for arriving at a certain degree of convergence within EE in Europe are presented in the final section of the Report. While the reader is invited to refer to the full text for all details, it is felt useful to report here the essential parts of the final recommendations.

General aspects

The creation of the "European Higher Education Space", strongly supported by the policies and efforts of the European Commission and the "Declarations" of the Education Ministers (Sorbonne, Bologna, Prague), favour an increased "harmonisation" of the European educational structures, in engineering as in other disciplines.

To pursue this "harmonisation" while avoiding to turn it into a "cage", the means to follow are not strict rules for educational programmes, but rather appropriate procedures for quality assurance and accreditation of courses of studies: in this way, engineering education will be improved, academic degrees and professional qualifications granted in one country will be easily recognised in other countries, and the trans-national mobility of engineers will be ensured.

In working towards the creation of a European Higher Education Area, it is crucial to recognise that specific characteristics of engineering education, which reflect, on one hand, the needs of European industry, and on the other hand, the special nature of scientific and technological studies.

Providing highly qualified engineers able to contribute to the technological progress through their leadership in research and development activities is vital for the economic competitiveness of Europe. The education of these engineers needs to be based on a scientific oriented curriculum. The first degree qualifying for this kind of professional activity should correspond to the second-cycle (Masters) level. The economy also demands graduates from practically oriented engineering studies lasting for three to four years with a first-cycle (Bachelors) degree, the specific qualities of which must be appropriately recognised.

Attributes and Qualification Profiles

It is essential that each "type" (i.e. "short" and "long-cycle") and "branch" of engineering qualification can be easily recognised, including its appropriate differences. This requirement is not satisfied by most existing national systems nor by the FEANI Register, which set only minimum standards.

To further this goal, the emphasis in the programme requirements need to be shifted from the way in which the programme is structured and delivered, i.e. from prescriptions concerning the curriculum, to requirements on its "final product", i.e. on the "competencies" acquired by its graduates. This shift will also turn the great diversity of educational systems throughout Europe into an asset of, instead of being an obstacle to, mutual recognition.

The maximum *transparency* of objectives and contents of the course of studies is a prerequisite for pursuing this objective: each educational institution must provide complete information about itself and its degree programmes. In other words, the type qualification profile produced by each engineering degree programme must be articulated. Each engineering education provider will have to demonstrate which qualification profiles of engineers they have defined and which they produce.

Both academic and professional recognition will benefit from this increased transparency, covering not only structures and input data but also concentrating outcomes and qualification profiles achieved through initial and continuing education as well as professional experience.

The tools to pursue this aims might be differentiated lists of "qualification attributes" for engineering education and professional practice, including a categorisation of "types" and "branches" (specialisations) and specifications of levels at which certain attributes must be achieved. These lists should be based on descriptions of aims and objectives of the various programmes and profiles of engineering education, performance records, outcome-oriented criteria and standards of accreditation procedures and competence-oriented assessment approaches. These lists should form a *two-dimensional grid* of Engineering Qualifications, taking into account both academic (and non-academic) *education* (and where relevant, including *continuing education*) and professional *experience and training*. The columns of the grid should correspond to different "*types*" of qualifications, and lines to the different *branches* of engineering.

It worth noting that, in order to be accepted by a British Chartered Institution, i.e. before full professional qualification, a period of acceptable engineering experience after the achievement of the academic requirements is necessary. Although this requirement appears logical (some experience "on the field" is normally required for the legal, medical and other professions, before the licence to practice a profession in full autonomy is granted), for engineers this seems to happen only in the British system and for the FEANI Eur Ing Register: even ABET accredits only educational programmes and completely neglects external training and professional experience. Also in the examinations required by some European countries for granting professional qualification, field experience does not appear to play any significant role. A study and a definite proposal on this point might be another appropriate tuning tool. Finally we should distinguish general employability from professional employability. The Bachelors level needs not necessarily qualify for professional employability.

Quality Assessment and Recognition

A pre-requisite for mutual recognition of engineering degrees across Europe is undoubtedly the "accreditation" of the courses of study. It is, however, unrealistic to suggest any form of overall European accreditation system, at least for the time being. The best way forward is a bottom-up approach to promote and facilitate increasing contacts and agreements between national bodies, in order to build up gradually a consensus, perhaps starting with mutual recognition of accreditation bodies, and agreements between countries of similar systems and cultural background. In the end, the system might look more like a European "Washington Accord" than a "European ABET".

A step in this direction has been the establishment of the "European Standing Observatory for the Engineering Education and Profession" (ESOEPE), which "*is intended to build confidence in systems of accreditation of engineering degree programmes within Europe*" and not *"to harmonise engineering programmes nor accreditation procedures, but simply to assist national agencies and other bodies in planning and developing such systems"* and to *"facilitate systematic exchange of know-how in accreditation and permanent monitoring of the educational requirements in engineering formation"*. An effort to enlarge ESOEPE to all European countries is suggested as a significant tuning tool.

It should be underlined that accreditation is useless, even counterproductive, if based only on formal requirements and not strictly connected with a process of quality assessment and quality assurance. In many European countries this is ensured by a quality assurance procedure, allowing higher education institutions to validate the learning opportunities they offer; and supported by a quality assessment body, managed either by the competent government body, by professional associations, or by both. A significant tuning tool would be to introduce functional evaluation structures in the few remaining countries that do not yet have such systems. Whatever the future steps in this matter, the engineering leadership organisations of Europe, both educational and professional, must play a role in the development of accreditation, quality assurance and recognition at a European level.

Credits and Quality Level

If the system ECTS should become a system ECAS (for European Credit Accumulation System) then there are two essential additional descriptors which are needed. One should introduce a label to describe the "level" of the course unit, such as: B for basic or introductory course (e.g. Fundamental of Computers or Calculus), A for advanced or intermediate course (such as Electrical Network Theory or Automatic Control), S for specialised course (such as Software Engineering). The other label should describe the "type" of relation of the course unit to the discipline itself, for instance: C for core or major course unit (i.e. belonging to the discipline), R for (closely) related course unit (e.g. some fundamental mathematics course for engineering), M for minor/ optional. With these additional descriptors a course such as Automatic Control offered for students in Electronic Engineering would be labelled having perhaps 7AC credits, meaning that it is advanced and belonging to the core of the curriculum.

Another element to add is the measure of the success with which the student has satisfied the requirements of the examination procedure. A system similar to the GAP adopted in many U.S. Universities could be considered satisfactory. A more sophisticated way to measure learning results would obviously be welcomed, and in some occasions considered necessary, however it appears difficult to arrive at this result without augmenting substantially the cumbersomeness of the procedure. This is not meant to discourage from using, say, something similar to the Diploma Supplement in order to provide further information. It only suggests that its use will probably be limited to those cases where deeper analysis is mandatory.

The full report of the Engineering SG of Tuning is reported in Volume B. After having summarised the European scenario in EE in chapter 2, some current important trends are surveyed in chapter 3, in chapter 4 the four lines of Tuning are considered as far as EE is concerned, chapter 5 presents briefly some consideration about the doctorate level in Europe. Chapter 6 is devoted to life-long learning issues. Based on this analysis a number of recommendations and tools for arriving at a certain degree of convergence within EE in Europe are presented in chapter 6.

2.4 The Task Force on the Glossary of EE

During one of the early meetings of the MC it was highlighted, especially by the Promoters of Activities 1 and 2, that the creation of a "Glossary of terms on Engineering Education" would have constituted a valuable tool for E4 and by and large for EE in Europe in general. The idea of such a common tool useful in each Activity was well accepted and it was decided to create an ad-hoc group to work on it: the final draft of the Glossary was made available on the E4 web site in order to be dynamically updated with the contributions of all E4 partners throughout the third year of E4. What is presented in Volume B is the most recent version of this Glossary. It was decided to leave it on the E4 web site during the dissemination year and continue getting suggestions for its improvement.
It is common observation that, much too frequently, in international meetings and report writing, confusions arise as to correct meaning and the choice of terms, due to several factors: an improper translation from the original language into English (which remains the most used idiom in international activity) and the variety of the European educational structures. E4 has therefore undertaken the preparation of such a Glossary with the aim, besides the traditional one of explaining the meaning of the quoted terms, of unifying the terms applied in the context of Engineering Education. Therefore, whenever possible we have indicated for each meaning what we think is the most appropriate word or phrase among possible alternatives. Further comments are in *italic*. The body of the Glossary is in English, and so is Annex 1, that describes the different structures of European Engineering Education in relation with the reform started with the Bologna Declaration.

This Glossary has been prepared within Transversal Action 2 of E4, by an *ad hoc* working group under the responsibility of the European Society of Engineering Education (SEFI). The group was co-ordinated by Valeria Bricola, with the supervision of Professor Giuliano Augusti, of the University "La Sapienza" of Rome, Promoter of E4 Activity 2, and Dr.-Ing. Günter Heitmann, of the Technical University of Berlin, Promoter of Activity 1. Anders Hagström, Kruno Hernaut, Horst Hodel, Jack Levy, Francesco Maffioli, Iacint Manoliu, Jean Michel and Alfredo Soeiro actively and effectively contributed to the preparation of the Glossary.

2.5 Dissemination Activity

From the beginning the leadership and the whole E4 team have undertaken huge information efforts (brochures, website, reports) targeted to disseminate the awareness of E4 activity. Furthermore this awareness has been stimulated by means of convening meetings and special sessions devoted to E4 at major conferences, like the Annual Conf. of SEFI, the ASEE-SEFI, the ECI meetings, the International BEST Symposia (IBS), and some CESAER events. It has been current practice to repeatedly communicate with all active partners, keeping them informed (electronic newsletter, circular mails, periodic information by the Headquarter). The first results reached have been:

- important networking and strengthening of the large partnership focused on burning issues of EE, such as internationalisation, quality assurance/assessment/accreditation, mobility, tuning of educational systems, etc.;
- initiating of some good practices, like the continuous support given to ESOEPE, grouping some 7 (and hopefully more in the future) different national accreditation bodies for Engineering Curricula;
- linking and bridging to other transversal projects, such as EUCEET, TUNING, etc., ensuring information exchange and mutual cross-fertilisation.

Dissemination has been achieved through several Transversal Actions (TA), itemised below.

2.5.1 TA 1 – Web Site Conception & Management

Perhaps the most important tool for making the TN visible is its web site. The good experience which characterised the life of H3E in this respect, when the web site was conceived and maintained by the students of BEST, suggested since the beginning to follow a similar path. This did not prove to be however as effective as it had been hoped. Despite good will from all those involved, it was realised that the commitments of more standard nature which all students have to face constituted an obstacle for the efficient handling and maintaining of the web site. The MC therefore decided to thank BEST for the effort spent in designing the site and moved its responsibility to the Department of Electronics and Telecommunication (DET) of the University of Florence. The web site is fully operational since July 2001. Its structure has still undergone some improvements under the close supervision of the Bureau and, from a more technical point of view, of Dr. M.C. Pettenati of DET. Activities 3 and 5 have also implemented their own web sites (see previous Sections), linking them directly to the general web site of E4 (www.ing.unifi.it/tne4).

Report by Dr. M.C. Pettenati
Department of Electronics and Telecommunication (DET)
Università degli Studi di Firenze

As stated in the E4 Thematic Network objectives, one of the main goal of the project is to "favour a mutual exchange of skills and competences and providing a platform for communication between academics and professionals". To attain this, which is considered to be one of the most important enabling condition for the success of the project, we developed a web site since the very beginning of the Thematic Network.

The web site is located by the University of Florence main server and is retrievable at the URL www.unifi,it/tne4 ot www.ing.unifi/tne4.

The web site was initially conceived and developed by the students of BEST (Board of European Students of Technology) as project partner. Since August 2001, when BEST technicians successfully migrated the site on the University of Florence server, the development and maintenance of the site are under the responsibility of the Electronics and Telecommunications Department of the same University.
During its life, the web site has been partially re-designed three times and a Private Area restricted to project partners has been added. At present the site is implemented using standard HTML, Javascript, and Apache web server. The web site is regularly maintained on a weekly basis.

Currently the site is structured to provide quick information (Home Page) on:

- the synthetic major goal of the project (Project Abstract);
- the project context and type (European project, Socrates II Thematic Network);
- the 5 Thematic Activities in which the project is organised;
- Project President and Legal representative, Project scientific coordinator;
- Headquarters and contact information.

Trough a simple navigation bar, the access is provided to the following areas:

- About E4 (General information, Organisation, Partners and Contacts)
- Activities (Activity 1, 2, 3, 4, 5)
- Events (Meetings, Conference Activities)
- Outcomes (Publications, Products, Archives, Glossary, E4 Bulletins)
- Resources (Links, Financial Aspects)
- Private Area (restricted access)

The introduction of the Private Area – a site area accessible only by the Management Committee and the International Advisory Board – has been decided in the course of

year 2001, when the Management Committee of the project hoped for the realisation of a telematic platform for communication among the persons more involved in the project.
To implement the Private Area functionalities, the MC decided to use BSCW (Basic Support for Cooperative Work, www.bscw.de), a shared web-based workspace system with document management facilities, role based access rights, and other organizational facilities.

2.5.2 TA 2 – Electronic Bulletin, Publications of E4, Glossary

It was also decided quite early that E4 should be provided with an Electronic Newsletter or Bulletin in order to inform timely all interested institutions/organisations of the advancements of the project. This TA is the responsibility of SEFI in close contact with the Headquarters and the project Co-ordinator. SEFI has also collaborated strongly with the Headquarters in order to edit the publications resulting from E4 activity, in particular those collected into this box of volumes.

2.5.3 TA 3 – General Conferences

The organisation of General Conferences is of obvious importance for the target of disseminating knowledge about the work of the TN. The first event of this kind was organised at the beginning of March 2001 (as soon as definitive data about the financial situation of E4 were made available from the EC). It took place at Arenberg Castle, a very prestigious site own by the Catholic Univ. of Leuven and also the site of CESAER General Secretariat. CESAER is in fact the organisation in charge of TA 3 and its Secretary General Mr. Jan Graafmans is one of the members of the MC of E4.
This event was quite successful (63 partners attending), giving the opportunity not only of fully presenting E4 to representatives of most of the Institutions having signed the bilateral agreement with University of Florence, but also of making an important step further in the formation of the working groups of each Activity of E4.

During the life of E4 other events targeted to wider dissemination of results have been organised. A second General Conference has been held on 7 and 8 December 2001 in Florence. This second General Conference has allowed to put the activity of the second year of the TN in the best of conditions, through a collegial assessment of what has been done and an effort in making the future activity as focused as possible. During the conference one half day has been devoted to the consequences of the Bologna Declaration, an issue of growing interest for all European Higher Education Institutions, which presents very special characteristics in the field of Engineering Education. During the Annual SEFI Conferences of September 2001 in Copenhagen and of September 2002 in Florence Poster Sessions presenting the E4 TN have been organised.

At the present moment (end 2003) several events are foreseen during the dissemination year. Their main purpose is that one of disseminating effectively the outcomes of

the 5 working group throughout Europe via regional events each time targeted to a specific interest group.
All the information concerning these events can be found on www.ing.unifi.it/tne4.

2.5.4 Other Contacts

Other contacts that have allowed to disseminate awareness of the activity of E4 have been:

- ESOEPE (European Standing Observatory for the Engineering Profession and Education);
- SEFI Working Group on Continuing Engineering Education (CEE) – E4 Activity 3;
- SEFI Working Groups on Curriculum Development (CD) and Information and Communication Technologies (ICT);
- BEST – IBS (International BEST Symposia);
- other TN's such as EUCEET-ECCE, EUPEN, USAEE, EEGECS and ECTN2;
- the meeting of the continuing education TN THENUCE in Brussels end of 2001;
- ECI (Engineering Conferences International, USA) for organising a joint conference on European soil (Portugal) in April 2003;
- the so-called Follow-up Committee (Bologna process) envisaging to organise a joint event in preparation of the Graz Conference for the Berlin Council meeting;
- the meetings of the Steering Committee of the TUNING project.

2.5.5 The Dissemination Year

The year 2003-2004 is the dissemination year for E4. At the time of writing of this introductory chapter it is not possible to foresee if this dissemination activity will be successful. It is the intention of E4 to organise 4-5 *regional* events in geographically scattered locations in Europe in order to facilitate the attendance from representatives of Institutions not having actively participated, but willing to consider what has been produced. Each one of these events will have a general presentation of E4 activity, and therefore of the volumes of this box, followed by a more targeted part devoted to one or two key issues, emerging from the work of E4 Activities. It is intended to leave ample space to discussion.

A *closing event* is also foreseen and will be organised in Brussels around the end of June 2004. At this event E4 will make efforts to attract representatives of all stakeholders, European commissioners among them. A possible structure of this event could see the presentation of the work done by the Promoters of each Activity, a plenary discussion on the future of TNs, in particular those with technologically oriented interests.

A strongly related event is a Workshop of technological TNs, foreseen by mid February 2004, indicated up to now as *TechnoTN-2004*. In this workshop several TNs will nominate experts in order to compare opinions on key issues of transversal interest, already present among those studied by E4.

2.6 A Set of Recommendations

It has been considered advisable to report in full at the end of this chapter 3 of Volume A the recommendations of the Activity working groups of this TN. Although repetitive with respect to what already contained in Volumes C to F, it is hoped that this will stimulate the curiosity of the reader inducing him/her to go more deeply into each volume, in order to find out about the rationale behind these recommendations.

2.6.1 From Activity 1 – Guidelines for Core Profiles of Two Tier Curricula

These guidelines or reference points for core profiles of EE in Europe are referring to two already elaborated main factors of influence:

- the implication of the Bologna Declaration with an expressed policy of shaping the education systems in a such a way that increased student migration, cooperation and interchanges will become a natural aspect of European integration;
- the increasing complexity of the engineering world with rapid technical development, new emerging branches and internationalisation of research, development, business and production.

These factors have already had some influence on the education systems. University planners may benefit from analysing current processes and estimate which changes or improvements that will or should take place over the coming years. With such an approach in mind, these proposals are trying to display some common factors and criteria that should be considered when shaping European engineers of the future – typically year 2010.

European integration (Bologna Declaration)
The 3 + 2 tier system appears to be generally recognised, even though there are differences and exceptions. It is reasonable to assume that the 3 + 2 system will be the dominant engineering course structure, and that student migration should be adapted to such a system. For the purpose of this paper a 3 + 2 tier system will be assumed for the Bachelor and Master level courses. The Ph.D. level as such is not included in the discussions.

One agreed aim is to facilitate student movement. In recognition of practical obstacles to such movement some basic requirements must be met: (i) the academic levels of courses must correspond to each other; (ii) the knowledge base must cover identical or corresponding areas; (iii) students must be able to communicate in their environment; (iv) institutions must remove formal obstacles to student migration; (v) degrees awarded must be recognised in all European countries.

Internet Education
The Internet will increase in importance and will form the base for new and enhanced teaching methods as well as new types of courses and new ways of obtaining degrees. This proposals do not analyse these trends in depth, but recognise the importance of considering the possibilities and effects that Internet will have in the future. Students and institutions will be required to master the challenges of Internet.

Language Communication
Language discussions are sometimes difficult, and have a tendency to trigger national feelings, historical attitudes, and policies. Internationally there is, however, a very clear trend of accepting English as the universal language of education. Developments in the computer world, the world of publications, international conferences, international industry and business also show a factor common to all of them: English is accepted as the only common world language. Recognising this as a fact, educators should evaluate which consequence this will have for engineering education. One obvious conclusion is that all engineers must be able to use English as a working language. Another question is whether all engineering courses should be conducted using English as a common language.

New Areas of Education
Industry and companies require an increasing degree of specialisation. The traditional engineering fields have given birth to a multitude of new areas such as: environmental engineering, micro system engineering, bioengineering, product development engineering, marine engineering, nuclear engineering, etc. Another trend is to combine and/or supplement engineering education with other fields of study like business, product development, export engineering, human resource development, and international relations. These trends will most likely continue, and will represent new challenges and possibilities for the educational systems.

Purpose of the Core Profile Guidelines
In order to form a common basis for European engineering this proposal presents "*guidelines for engineering core profiles*". The profiles describe the qualities that we expect a European engineer of 2010 to represent, and the requirements that his or her educators should use as a base for the formation. The profile does NOT give a detailed list of subjects, hours, etcetera in the traditional way of describing a curriculum, but try to follow an learning outcomes approach by stating which qualities and academic abilities the student should possess at the end of certain courses respectively the degree programme. The student is at the centre of the discussions. How courses are organised and conducted is left to each institution, as long as the student fulfils the requirements at the end. The core profile forms a basis for improved awareness and a reference, but it is also a recommendation. The following factors are considered.

University Planning
The core profile is a reference for university planners. The acceptance of the core profile will contribute to shape the curricula in accordance with the intentions of

the Bologna Declaration. There will, however, still be ample room for different approaches and national differences, which are still desired. The aim is to create a path for student migration with as few obstacles as possible.

Life-long Learning
Engineers of tomorrow will face an increasing demand on their ability to adjust to new technology, new environments, and new types of jobs. This could be described as an ability and an acceptance that life long learning is a natural course of events. Hence the core profile must prepare the student for this aspect of his future career.

Accreditation of the Curricula
Accreditation will be carried out by different bodies, and in different ways. The core profile is intended to form a common reference for accreditation bodies. Even though it does not cover any full course program, it should be used as a basic reference that must be met by all courses. Accreditation should be carried out by the national education and engineering authorities, but international agreement should be reached as a basis to the recognition of university degrees in all countries.

Engineering Profiles
Traditionally different types of engineers have received their education in institutions giving them different profiles. One such clear distinction can be drawn between the "Fachhochschule" and Universities in Germany, and between previous "Polytechnics" and Universities in the UK. Other countries have similar arrangements.
This proposal does not address the differences inherent in such profiles. A true core must be common for all profiles, but must leave space for the diversity that will be and should be part of the institutional characteristics. The core is a reference for a threshold or minimum level which should be fulfilled by all profiles of engineering education.
Some institutions incorporate periods of practical training as part of the university courses. One may question for example if a 4 year course is really a full 4 years, if several months or even one year are allocated to practical training or internship. However, it may contribute in a significant way to the outcomes and the profile of a degree. This document does not define the workload, duration or contents of a university year of study. With reference to the 3 + 2 years used in the text, these are years of study defined as such by any university in accordance with the Bologna declaration. According to the proposals specified in the Bologna process this would encompass a minimum of 180 ECTS credits for the first cycle degree and additional 120 ECTS credits for the achievement of a second cycle degree.

Core Requirements
Specifications in this document are outcomes oriented, and focus on the skills, abilities, potentials and personality of the graduate. Teaching/Learning arrangements and methods provided to generate these kind of outcomes are the responsibility of the university institution and can be based on an increasing range of innovative approaches as already described in previous parts of this volume.

The proposed core does therefore not contain:

- a detailed list of subjects and topics which must be taught
- a specification of how many hours must be devoted to different subjects
- a specification of how the university should arrange its inputs to the students

(The reader is invited to consult Volume C for details on the specific examples of curricula).

2.6.2 From Activity 2 – Statements Regarding Evaluation: a Proposal for the Debate

Universities can be very different, not only from one country to the next, but also among different scientific sectors within the same country.
Also the needs of the three levels of higher education are different. The three levels of higher education call for evaluation models based on different approaches.
Level I (bachelor or equivalent), which is the entry level for a large number of students, requires a strong emphasis on the legibility of the curriculum (in terms of basic, characterising culture, knowledge and skills target levels, areas of competence and professional roles envisaged, national and international benchmarking, if applicable) and on organisational aspects.
The evaluation of Level II (Master or equivalent) must take into account the fact that learning contents are geared to the highly specific (professional or research) goals of the reference Departments. A sizeable majority of international student exchange activities should be concentrated at this level.
The evaluation of Level III (Doctorate) should be based on the ability to provide a markedly research-oriented learning environment. It is closely interconnected with the evaluation of the research activities of the Departments.
This means: evaluation objectives and criteria which are well diversified but share a common requirement: formulating a final judgement on each Course of Study based on a very narrow final set of key quality aspects.
The latter should be selected so that, in a clear and readily recognisable manner, they go to the very "heart" of the quality of educational activities, which is not limited to the quality of individual teachers, but rather is the overall quality of a an organised collective effort encompassing several fronts.

(omissis)

Identifying the "minimum set" of evaluation requirements suitable for Programmes of the first and second level, common to all countries and to all scientific sectors, appears to be a reasonable and achievable objective. Such "minimum set" could stimulate discussion about what constitutes good quality within higher education and support the development of a common methodological framework and common quality criteria for comparative international evaluations within higher education programmes.

For the sake of clarity and to stimulate a lively debate, we make statements strictly geared to the needs of the learning process, i.e., not inclusive of all the many and various requirements mentioned in the literature on quality and evaluation of higher education.

Basic Policy of a Programme
A Programme should be evaluated on the basis of its ability to put into effect a policy focusing – clearly and distinctly – on the external and internal "efficacy" of the learning process:

- specify worthwhile learning goals,
- enable most students to achieve the established objectives.

According to a policy of this sort, quality must be interpreted in terms of:

- relevance of the purpose (fitness of purpose)
- fitness for purpose

with a special accent on "transformation" (see Ch. 1, 1.2 – Quality of Volume D).
The "efficiency" criterion or, in other words, the cost awareness, should be seen as a constraint affecting the implementation of the policy, not as a policy in itself.

The Mandate of the Evaluation
The first and foremost purpose of the evaluation is to reflect the design and management of a Programme: the evaluation checklist should express the set of minimum aspects, and the main factors thereof, that the Programme should use in a stable manner before it is submitted to an external evaluation. The latter shall be conducted on the basis of the same checklist.
The self-evaluation document, as reviewed and commented on by external evaluators, shall be used by:

- the management of the Programme, with an educational function relating to the all the individual actions that put the policy into effect;
- the university that has entrusted the Programme with the task of bestowing on its behalf qualifications corresponding to the academic degree;
- government bodies or third parties for the correspondence between the qualification and the academic degree;
- partner universities, in our particular case those included in the European circuit, for purposes of mutual recognition; in particular within the countries signatories of the Bologna declaration.

Vision is needed: policies for evaluation and accreditation should not remain scaled down to local perspectives and to threshold requirements.

The Focus of the Judgement
The instruments of the external evaluation are:

- indicators with summative functions: in particular: indicators of intake, progression, success of the student and of the graduate,
- experts' judgements: with both summative and formative functions, on the aspects and factors required by the model.

The organisational system, which is highly variable from one case to another and is always developed over several levels (Programme, Faculty, University), should be left in a free format and should be evaluated ex-post, in terms of its suitability to support those actions having a bearing on the internal and external efficacy of the Programme.
Thus, it is sufficient to ensure that the following indications are provided for each aspect/factor envisaged by the model:

- it must be absolutely clear which person or committee is responsible for the policy, the quality and the execution of all educational matters relating to a given study programme,
- that those responsible discharge their duties competently and on time,
- that each action is documented in a pertinent and accessible manner.

In other words, that the effectiveness of an organisational system is evidenced by the description of the actions and their documented effects, factor by factor.

Changing the Philosophy of the Self-evaluation Report
Our proposal is to discard the logic and practice of periodic "evaluation reports" and adopt a logic of on-going monitoring: it is desirable that each Programme be required to maintain an "information model" that collects and updates the quantitative parameters and the qualitative descriptions enabling the external examiners (with special regard to: academic authorities, third parties, external evaluators ...) to formulate an informed judgement.
This "information model", which preferably should be made known to the public, can be flanked by a "self-evaluation supplement" discussing the strengths and weaknesses; in many documents it is claimed that this analysis is a necessary preliminary condition for external evaluation.

The Structure of the Information Model
A comparative examination of the evaluation checklists has shown that the different items to be considered can be grouped into four key "aspects" or "dimensions" of the evaluation:

- Requirements and objectives
- Teaching and learning
- Learning resources
- Monitoring, analysis, review

An appropriate quality assurance mechanism will be present if these four aspects are kept under control in an effective manner by the Programme.
Each "aspect" is clarified through a certain number of "factors" to be treated separately (even though it would be very helpful to consider their interconnections).
The "factors" listed in Tab. I together with their "key aspects" represent the "minimum set" needed for the evaluation model.

The Contents of the Information Model
Let us examine the most critical factors.

Requirements
The first aspect of the model is "Requirements and objectives" instead of "Aims and objectives" to underscore the fact that in order to determine the occupational roles for which students are being trained it is also necessary to investigate the needs of the external parties concerned.
In some instances, it is possible to stipulate a veritable alliance with the world outside the university as a valuable aid to overcome deep-seated habits and to increase public awareness of the logic underlying the Programme.
In order to determine the requirements, expressed in *market language*, it is therefore necessary to identify clearly the parties concerned. Needless to say, it would be a mistake to push this attempt beyond reasonable limits for the sake of formal compliance.
A traditional Programme that refers to well consolidated professional roles needs not be motivated by specific market surveys; the opposite is true for a Programme relating to new, evolving professions.

Educational Objectives
The translation of the "requirements" factor into "educational objectives" is performed by the university; it uses the know-how and the *language of training specialists*; it consists essentially of harmonising the knowledge building processes and learning outcomes that meet the requirements.
This is the point at which it is necessary to reflect critically on the strategies, make choices, clearly express justifications for the chosen priorities.
The best guide currently available for the formulation of learning outcomes is provided in the "Benchmarking Statements" by the QAA. This document could be adopted as the starting point for the definition of educational objectives, in terms of contents and levels.

Teaching, Assessment Methods
Once the educational objectives of the Programme have been identified and deployed as specific objectives of the individual courses of study, the teacher is provided with great freedom of action as to the methods to be employed in order to achieve them and to ascertain whether they have been achieved.
Nor could it be otherwise, considering that the teacher is by definition the professional possessing the competencies that qualify him/her for this function.

The teacher and his/her course of study represent a complex system, whose management requires competencies of a technical-scientific nature as well as pedagogic and social competencies.
Effective system operation hinges on a diffused propensity to reflect, i.e., the ability of each teacher to observe the effects of his/her actions and to make appropriate corrections, as necessary.
The actual behaviour of a teacher can hardly be controlled effectively from the outside other than at the stage of apprenticeship, when the young teacher receives hands-on training in the field flanking, in a subordinate position, more expert teachers.
People are the fundamental element in the quality of services, especially those like formation involving a high content of expertise and behaviours. But assessing people using objective criteria is by definition very difficult, and this is especially true for professionals in higher education.
It is advisable, however, to prevent teachers from proceeding by trial and error. This can be done through specialist training programmes for newly-hired teachers, to enhance the pedagogic and teaching skills they need to manage the classroom and apply the assessment techniques in a competent manner.
An effective way to assess the behaviour of a teacher ex-post is to examine the contents of the examinations in order to determine the knowledge/skills they are designed to assess, and the evaluation criteria adopted. In other words, to determine whether the tests ascertain the presence of the knowledge/skills required (and made known beforehand), avoiding both false negative and false positive results.
The collection of student opinions by means of questionnaires or other equally effective means is a complementary method that can supply useful indications.

Breaking down the "Factors" into their Constituent "Elements"
A working description of the factors is provided by breaking them down into their "elements"; an overview of the evaluation modes, such as those mentioned in chapter 2 supplies many interesting indications.
An example: the "examination and assessment methods" factors can be broken down into elements such as (QAA, doc. E, Annex E Volume D, page 95):

- Does the assessment process enable learners to demonstrate achievement of the intended outcomes?
- Are there criteria that enable internal and external examiners to distinguish between different categories of achievement?
- Can there be full confidence in the security and integrity of assessment procedures?
- Does the assessment strategy have an adequate formative function in developing student abilities?

A list of common elements helps to make the evaluation reports more comparable; however, it is advisable to leave freedom of choice in the selection of the elements making up a factor.

The first two "aspects/factors" levels, in fact, reflect an analytical approach, with a list to be obligatorily exhausted.
The "elements" should have an underlying structure that can be composed in a variable manner from one Programme to another; moreover, at this level, a holistic approach stressing the interdependence between the elements and their complementarity should be encouraged.
A vision, that is, which is diametrically opposed to the "molecular" approach: the elements must be addressed and then evaluated in a context of mutual relationships.
Accordingly, while, as a rule, it will not be possible to accept compensations between the factors of an aspect, it is reasonable to consider the possibility of compensations between the elements that, taken together, add up to a factor.
Thus, the information model will reveal that the Programme is much more than a static configuration of components or a mere list of actions. Indeed, it is a self-organised structure, susceptible of evolution and development, to be assessed on the basis of efficiency criteria.

External Judgement
The external examiners shall formulate their judgement based on the contents of the "information model" and, if made available, also on those of the "self-evaluation supplement". Their judgement shall take into account the indicators and the documents mentioned in the information model and, finally, shall use meetings and discussions.
Final judgement will be expressed by factors, and shall be expressed, in a "summative" manner, by selecting an ordinal category from a set. It is a good idea to add comments or statements with a "formative" function.
Of great interest for its conciseness is the approach adopted in Estonia, where the individual requirements are articulated in statements expressing a desirable treatment of each factor or element. Example: "Responsibilities for each area are formulated clearly". The external evaluators, on the basis of the provided description and evidence, choose one of three categories:

- Not Met
- Concerns
- Met

Alternatively, in the approach of QAA, the examiners identify/comment strengths and weaknesses by aspects, and place them into one of three categories:

- failing
- approved
- commendable

QAA recommends:
Within the 'commendable' category, reviewers will identify any specific features of the aspect of provision that are exemplary. To be deemed 'exemplary', a feature must:

- represent sector-leading best practice; and
- be worthy of dissemination to, and emulation by, other providers of comparable programmes; and
- make a significant contribution to the success of the provision being assessed. Incidental or marginal features do not qualify for designation.

A combination of the two approaches is probably the best choice. The evaluation of each factor will be made on a scale of four categories, supplemented by a brief explanatory statement or comment, as follows:

☆☆☆ best practice (state why, max 5 lines)
☆☆ approved (optional comments, max 5 lines)
☆ concerns (describe concerns, max 20 lines)
– not approved (state why, max 5 lines)

This establishes a reasonable scale for the treatment of factors, distinguishing between those in need of being re-examined because of some reservations (concerns) and those to be approved or not approved on the basis of explicitly or implicitly shared standards. At the same time, space is allowed for above standard (excellent/exemplary) treatments.

2.6.3 From Activity 3 – Recommendations on Continuing Engineering Education Management

Recommendations on "Demand Analysis"

Understanding Business Processes and Strategy of your Customers
Most of the members of the group deliver courses to companies. Therefore understanding what they do and what they want to achieve is a good beginning for a demand analysis. Going deeply, it would be a good idea if we:

- *Talk to your customers continuously* .We should build a permanent relationship with our good clients, by including them in advisory boards or inviting them to events, for example.
- *Collect information about the company*, by reading company literature, visiting its web sites, etc.
- *Know the whole value chain of your customer*, what the company knows which it is important for its business.
- *Network: use alumni's professional associations.* These associations have relationships with the university, so it is easier to contact them, and are potential customers of our products.
- *Employ people with business experience.* It is a way to reduce the gap between the University and the company market.

Get to Know your Customers
This point deals with the individuals that attend to courses. The results are similar to the previous point:

- *Personal contact (Face to face).* In this case through interviews to representative individuals, or former students.
- *Organise events (conferences …).* This is a good way to know if the people are interested in some themes.
- *Contact with professional Associations.* They usually represent groups of individuals and know them quite well.
- *Smart customer databases.* Designing them and collecting data can help us in the demand analysis.

Knowledge of Technical Trends
In the engineering fields, knowing the latest technological trends is essential. Therefore, if we could see what trends are going to be important for engineering, probably we would find a gap in the market, wherein we could develop our courses.
To do so, we recommend:

- *Contact professional bodies*, again.
- *Prediction of the trends by scientists.* This is a source that can be found inside the University. Reading scientific journals or other sources can also help.
- *Create an expert group.* This means join different experts in one area to foresee trends. You can use Delphos methods; for instance, ask them for reports, mining, etc.
- *Localising the leading markets.* When the MIT bet for the Information Systems, it became a milestone for this market.

What the Competitors do not Deliver
This is the last part of “See what all the others see, think what little think and do what nobody does”. Finding a market gap is good, as long as there is a market (customers in this gap). Always try to find out why the others do not deliver it. Some good ideas:

- *Analyse the information: advertising, course programs, webs, etc.*
- *Ask the customer.* This part can be done in the first and second point of these recommendations (customers).
- *Look at the international market.* Sometimes there are successful products in other countries that nobody in ours has implemented. But always remember the differences between the markets in different countries.
- *Use your imagination. Look at the future.* If you are looking for something new, sometimes you have to take the risk and invent it.
- *Talk to researchers or experts of the field,* as commented above.

Competences to be Developed

That means that, a way to do a demand analysis is using competences. To do so:

- *Curriculum negotiations,* with the target groups.
- *Identify the goals of the company and derive the competence goals.* The employees must be prepared enough to help the company to reach their aims. A good idea would be to interview your clients' customers.
- *Recruit or mobilise experts.* Again,
- *Use a defined methodology to define competences.* There are experts who have development maps for competences. Do not re-invent the wheel, just use it.
- *Identify prerequisite knowledge (background).* To achieve some competences sometimes you need previous competences.

Recommendations on "Product Design"

It was decided in the group of experts, that to do a good design of a group, you should do the following:

Precisely Identify the Competence Needs of the Client

This means, in short, to do a good demand analysis (benchmarking done before). The ideas in this point were quite similar to the benchmarking in demand analysis: *understand your client's business* (for example, by finding the right people in the companies for interviews), interviews with *professional bodies*, and *test your clients' knowledge.*

Choose an Adequate Price

For doing this, you should:

- *Calculate costs (expenses),* including the publicity, the materials, and one important thing: find out how much do the professors want to earn as a minimum.
- *See competitors' price,* because our clients will use the price as a factor (among others) for choosing one course or another. Price and hours are usually the most objective points of comparison for clients.
- *Study the quality the customers expect,* as quality and price must go together. Nobody is going to pay a lot for a course that does not provide high quality teaching.
- *Explain what they will get for this price.* We should be able to explain clearly why our customer is to pay the price of the course, in order to convince them of how right the price is.
- *Study possible discounts.* Customers are quite keen on discounts.
- *Decide if we are doing it as a business or a service.* Universities have other priorities apart from having benefits. Sometimes it is better to lose money but to do something that benefits the society.

Define Right Content
In this case:

- *Know the level and expectations of the client.* Always take into mind the public at whom you are aiming in this course.
- *Capitalise on previous experiences.* Try not to re-invent something you have already done.
- *Structure in the content (how to present).* It is important that all the contents of the course have a logical appearance and they are coherent.
- *Pilot projects.* If you have the opportunity, try your product with a small group before going to bigger groups.
- *Define needs and goals.* Take in account the pre-requisites of the course and define what the student will achieve after the course.
- *To know the state of the art in the field (including comparison with other competitors).* Probably there are similar products with success, look at them.
- *To know your own competencies in the subject.* If you are from a technical university, probably there is no point in designing courses to teach law. Do not deceive your customers with false expectations from the beginning.

Staff Competence
It is important that in your centre the people who are designing the course should be competent enough. To do so:

- *Social competence/communication skills.* Your staff should be prepared in "soft skills".
- *Didactics/pedagogical competence.* The people who are designing the course should have this competence, at least some of them.
- *ICT competence.* Your staff must be aware of the new technologies that can be used.
- To obtain these competences, you can *develop a competence network*, a *system to measure the competences*, and prepare *training* (or prepare interchanges with other centres to see how do the work). But these tasks are part of the Human Resources people.

Recommendations on "Marketing"

Know the Market
It is important to know the customers with whom you want to create a relationship. It is not the same to prepare marketing for CEOs as it is to prepare it for individuals that have just left the University and want to find their first job. To do that:

- Use techniques of *Business Intelligence* (using your professional experience).
- *Define what information you want to get – is it already done?* Sometimes you can find information already prepared to know the market.
- *Find market niches.* This was commented in the Recommendations on "Demand Analysis".
- *Control the success of programs* , not only yours, but from competitors to see how good you are or if you need more improvement.
- *Making interviews (interview team),* as it was commented in the Demand Analysis.

Obtain a good quality in the content of the course
and if it is so, try to get it certified somehow:

- *Use certification to prove the good quality of the contents.* Use examples as the project Abet of quality insurance. If the certification can be European, then that is better than regional. Try it to make it external to your institution.
- *Improve the quality of the providers:* managers or professors. You can use circles of continuing improvement and motivate the individuals with rewards (salary increments, for example). Try to put together managers, teachers and students to improve quality.
- *Take care about the infrastructure of the delivery.* Do not forget any part of the value chain of the product.

Increase Society-University Interaction
The relationship between university (provider) and society (consumers) is part of the marketing. To do that you can:

- *Organise open door days.* You can prepare events for specific target groups in collaboration with an association representing the target group.
- *Student projects can serve the society.* This can be done if this projects are done in collaboration from companies, and helping them to get a prototype from an idea the students have.
- *Advertise the University.* You can make the services of your University better known. The brand of the university must be one strength for our marketing strategies.
- *Make the university an access point of international networks,* that will benefit the region.
- *Organise university-companies partnerships,* so as to solve some specific problems in the society, and let the society know it.

Networking and co-operating with other providers
Creating and studying *alliances and projects* with institutions, be them national o international. In these networks you can *share knowledge,* examples of different ways of working, *formative tools* and you can also *compare* yourself with other institutions.

Recommendations on "Sharing ODL Materials"
ODL has high costs of production, but after that, the distance is less important. But can you spread these materials all over the world? From our experience, there are some points (language, the need to do some "face to face" activities, culture) that recommend you to work with a local institution sharing materials. Here you can obtain some aspects to take into account.

Adaptation of the materials
In the following aspects:

- *Linguistic aspect.* If you have in mind to share, you better use a carrying language, such as English. The idea is to produce in your language and also in English, so that the other institution can use the English version or try to translate it. If they want to translate it, there is a need not only to know the language by the translators, but also for the subjects to be in their domain.

- *Cultural aspect.* There can be a difference in the technologies between the countries, so you should identify which parts are common and which should be reviewed. For example, management training needs always an adaptation. Anyway this cross-cultural course is also enrichment for the student.

Clear protocol/contract
All the things not stated from the beginning can become a problem that can spoil the relationship and confidence between institutions. If the responsibilities are clear from the beginning, the institution can decide to participate or not easily. To do so:

- *Define and use some models* of collaborations, with standard contracts.
- *Talk about all the aspects and the responsibilities in the contract.* Who is going to receive the money from clients, how much is each institution to earn (fixed amount, depending on quantity of students, ...), which institution provides tutors, ...
- *Mutual trust between institutions.* This will facilitate all the tasks.

Modular design & top-down design
If you are going to share materials, prepare them to be chopped into different parts. If you have not yet produced the materials (if so, they will need adaptations), agree with the other institutions in:

- *Didactics, learning styles.* This can be done through meetings between the institutions. This information must arrive to the tutors of the course.
- *Use pilot project in small groups.* After the project get feedback from students and tutors.
- *Keep modules simple,* defining pre-requisites and aims of each module.
- *Be flexible.* To arrive to an agreement, both institutions must be flexible enough.

Other important aspects
- *Create a map of institutions you can collaborate with,* and contact them.
- *In all the ODL courses, the human interaction is quite important,* do not forget it.
- *Give clear instructions to students about how to follow the course.* These instructions should come from an agreement between institutions.
- *Remember the technologies,* as video (live recorded) examples, simulations and remote access to some (expensive) equipment.

2.6.4 From Activity 4 – Recommendations on Internationalisation

Activity 4 recommendations touch upon three aspects: internationalisation of Universities, setting up international project teams, and forming a register of courses offered in foreign languages. The last activity began during the last year of E4 and will have to be further pursued. A study preliminary to the first activity was the identification of the real needs of Industry.

Good practice in internationalisation of Universities

If going abroad is accepted as being the most important component of internationalisation in the university curriculum, then "good practice" can be measured by the extent to which it is facilitated. From the students' perspective the dominant problem was (not surprisingly) (1) financial, followed by (2) encountering excessive bureaucracy, (3) studying in a foreign language, (4) feeling too restricted in choice of opportunities and (5) having inadequate preparation for the change in cultural environment.

Most students (or their parents or family) take responsibility for financing their own studies, with any subsidy for studies abroad being provided by the home state or university. Even ERASMUS funding is administered through the national office of the home country and the home university. Good practice for the home university centres on making the procedures for obtaining funding clear and straightforward; sadly, increasing the funds to meet student wishes is rarely an option, although schemes to obtain additional support from industry or local organisations can only be welcomed. The host university should make available accurate and up-to-date information on all costs the visitor has to anticipate (some of which may be quite unexpected, in view of the variety of levels of social provision in different countries. Ideally the host should make available accommodation and, indeed, most of those participating formally in exchange programmes seem to reserve a number of rooms at a controlled rent for visiting students.

Bureaucracy affects exchanges in many ways. If considered together with the question of preparation for the different study-culture abroad there are two broad aspects. One is the fact that the procedures[1], customs and ways of doing things are just different in different countries, and learning to adapt is part of the experience and the benefit. Nevertheless, there needs to be a mechanism, whether provided by academic staff, administrative staff or other students, to prepare the student before exchange and to help as needed. Such help is needed at both the home and the host universities. In the symposium students regarded widening the choice of opportunities as desirable, although from the university viewpoint support is more easily managed as the number of exchange partners becomes less.

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[1]Examples include:

(1) the format of examinations – are they written or oral?
(2) the timing of examinations – is there only one session of examinations, or is there more than one occasion on which a particular examination can be taken?
(3) duration of examinations – is the time allowed so short that it puts students under pressure?
(4) is reference material allowed in the examination room?
(5) does failure to register well in advance of the examination date, or failure to present oneself for the examination after having registered, constitute failure?
(6) the level of support available from the academic staff – for example, provision of written notes, formal tutorial classes etc.

Within cultural preparation must be mentioned language. There can be few universities at which language courses – even if only self-study for the less widely spoken languages – are not available. Students are clearly aware of the need for preparation before studying in a foreign language; what is less clear is how effective the preparation actually is. At the very least it has to be recognised that there may be a problem, for which an allowance has to be made, by granting an extended study time, by accepting a lower examination performance, or by some other means.
A solution to the language problem is to offer courses given in a more widely-spoken language. This language is often English, but courses given in French or German are also available, as described below. Where such courses are available to the home students the internationalising influences affect all the students, both those from the home countries and the visitors. The experience of those universities – and they are few in number, the University Politehnica Bucarest being one example – where this happens appears to be good, although the topic arose too late for any further study to have been made within E4.
A second question relates to the bureaucracy of transferring credits. In principle this should be made straightforward by means of the European Credit Transfer System (ECTS). In practice matters are not so simple. The host university should have little difficulty, for all that is required is that full information on the guest student's performance be supplied and, at the minimum level, this is just the information provided to home students (subject taken, course hours and content, mark or grade obtained etc.). Good practice requires that the information be converted to ECTS format. Where problems arise is in the home university, because ECTS is generally not, of itself, sufficient to allow automatic transfer of credit. This is discussed later in this report. Suffice it to say that, for the student about to embark on an exchange programme, good practice demands that the home university makes clear, in advance, what studies (course modules) will be accepted for credit and how the credit will be awarded. Since the decisions on such matters are often made by one member of academic staff (even in cases where a committee is formally responsible, its decision is usually based on the recommendation of one or two individuals) the smooth-running comes down to academic staff who will invest the extra effort needed to understand what their colleagues abroad are doing. Annex II is a description of ECTS, prepared by members of E4 in the course of the present work.

Guidelines for setting up international project teams

Size and Composition of Teams
It was agreed that, whilst the absolute minimum for an international team project had to be two students from different countries, a far more desirable constitution would be four or five members, from at least three countries. Too large a team, with too great a number of institutions participating, becomes too difficult to manage.

Institutional Links
It is clear, from the work of H3E, from the difficulties experienced under E4 and from observing the rather small number of schemes which appear to be functioning suc-

cessfully, that the participating institutions have to have strong links, which go beyond the immediate needs of the team projects. Institutions, in this context, can include participating industry, for this may well be an invaluable source of supplementary funding, or of motivation for the students. What clearly does not work well is an open call for students to join a project – this was tried under JEEP and H3E and, although teams were established, the administrative effort required was disproportionately large, and needed to be repeated for each new project. However much use could theoretically be made of the internet, it seems far better to restrict the formation of teams to students from closely collaborating groups of institutions, rather than to devise alternative administrative procedures aimed at recruitment from a wider field.

Level of Project
The general view is that international team projects should be run at the MSc level. This probably reflects the effort needed to organise this type of project, so it is better justified here rather than at lower academic levels. Other, more radical, ideas, such as the formation of teams combining students from several levels, were mentioned in discussion, but were not considered further.

Travel by Students
Nowadays a considerable amount of the project planning and design will be done using software tools. That the team members would be located in different places and different countries, communicating by email and other forms of telecommunication, merely reflects how many of them will be working after graduation. Nevertheless, it is important to generate the level of rapport that comes only from personal contact, so some funding for travel by students is essential. This was one problems encountered in the JEEP work, and which would be more manageable within a group of regularly collaborating universities.

Institutional Commitment
Organising any project demands time and effort from the academics involved. Yet more time and effort is needed where teams of students have to be set up and tutored. The need is even greater when external organisations and other countries are involved. Unless such projects are to be run infrequently, by exceptionally interested and committed staff, it is necessary to give staff proper recognition for their efforts; this will only be done if this type of project plays an important role in the policy and curriculum of the university. Other matters in which the commitment of the institution is important relate to the assessment and recognition of credits, and the alignment of academic timetables; without official support an inordinate amount of time and effort can be expended in smoothing out the problems which inevitably arise.

2.6.5 From Activity 5 – Recommendations on the Use of ICTs

EU Level Activities
”In the e-Learning Action Plan[2], “e-learning” was defined as “*the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources*

and services, as well as remote exchanges and collaboration". However, "e-learning" has become shorthand for a vision in which ICT mediated learning as an integral component of education and training systems. In such a scenario, the ability to use ICT becomes a new form of literacy – "digital literacy". Digital literacy, thus, becomes as important as "classic" literacy and numeracy were one hundred years ago; without it, citizens can neither participate fully in society nor acquire the skills and knowledge necessary for the 21st century. Full development of the Internet's potential to improve access to education and training, and enhance the quality of learning, is the key to building the European knowledge society" (COM(2002) 751 final).
EU policy for ICT in education calls for the effective integration of ICT in teaching and learning. The expectations of the European Union policies and a rapid development of ICT are challenging the higher education institutions to rethink and develop the teaching methods in a creative manner. ICT provides not only new tools for delivery, but also challenges the teacher to find new adaptations of learning theories and obtain new skills to enable students to create the knowledge and develop their professional skills and, thus, increase their competitiveness in the European or global market. ICT will also gradually change the teaching and learning culture.

The use of new technologies in education has been supported by the European Commission in many programmes (the first one was the DELTA programme). As a new approach, a benchmarking of national e-learning strategies can be recommended.

Supporting Change in Higher Education Institutions
In spite of existing financial support, the European Union should give more focused financial support to the higher education institutions to develop their teaching methods to achieve the requirements that the information society demands of professionals. The universities should rethink and develop their learning methods and increase the number of pedagogical specialists to develop the learning process. This need can be seen particularly in technical educational institutions, where the knowledge of substance is first and foremost and very often the learning methods are underestimated and where opposition to changes is often very strong. Therefore, more pedagogical expertise is needed to increase and disseminate the knowledge of the latest research results in the area of pedagogical and expertise development and, thus, form an important and significant area in support of learning and teaching in technical institutions throughout Europe.

Supporting Thematic Networks
The thematic network idea is very good but involves some significant problems. The main problem is that participants are not very committed due to scarce financing, lack of responsibility and lack of time. The participants take part in the projects while working full-time and often have neither the time nor the interest to work effectively to achieve the objectives of thematic networks. Moreover, there are often no pedagogical experts involved in the networks of engineering education, especially on the technical side. That often means a lack of current knowledge of pedagogical research

and possible misunderstandings of the new learning methods. This can also be seen in the symposia where students and academics discuss the learning methods and innovations in learning and teaching. One significant point is that there is a need to increase the number of pedagogical experts especially in technical universities and institutions to solve such problems.
The proposal is that the European Union continues to support the thematic networks or other kinds of networks, where academics and students throughout Europe can meet and exchange ideas concerning the development of learning and teaching in and for the information society. The structure of the thematic network should be clearer and the objectives should be more precisely focused. The concentration on one particular theme and subject area could give more results and added value for the participants. Moreover, the project structure should be supported so that the network can hire a substance co-ordinator to make the network more active. That could make a backbone for the project and activate and motivate the participants to reach the set objectives.

Supporting Change in Engineering Education Institutions
Because of the requirements of the information society and the rapid change in the learning environment, more direct financial support is needed for higher education institutions and especially for technical ones. The short programmes for technical teachers or some optional possibilities to develop their pedagogical knowledge are insufficient, especially in technical universities. Therefore, the change in the information society and its requirements for higher educational institutions should be supported by its own programme which will make it possible to increase the number of pedagogical experts and strengthen and speed up the change from the traditional learning and teaching methods to the new methods thus increasing the added value to both students and teachers and, finally, develop experts by using new learning methods for the information society.
The proposal is that the European Union support the higher educational institutions, especially technical ones, to increase the number of pedagogical development projects where the new research results, new learning methods and the use of information and communication technology in teaching and learning will support the development of students' expertise and change the attitudes of both teachers and students by increasing the information and knowledge in the field of pedagogical research and practise. The project finance would create a foundation for the development whereby the multi-science co-operation throughout European technical universities would support the change and development and, thus, would give not only added value to both students and teachers, but also to the information society. It also means support to develop the digital learning materials by taking into consideration people and their ability to learn not just technical possibilities.

National Level Activities
On a national level, governments should support the development mentioned above by projects where pedagogical expertise has a significant role. The national level financing should be in line with the European Union financing support so

that the programmes support each other. The technical institutions should have a special area because of the lack of pedagogical experts, the opposition to changes in teaching and learning and the technical approach concerning the development of the methods and information and communication technology in teaching and learning.

University Level Activities

Supporting Change of Learning Paradigm

Every university should commit to the learning paradigm change (including ICT in learning and teaching) by making a policy and supporting co-operation and open discussion within a university. They also should pay positive attention and concrete support to the forerunners who often are underestimated, alone with their views and often meets opposition and isolation. The co-operation and networking between universities on national and international level should be strongly supported.

In engineering education, institutions should arrange for all teachers and planners including the assistants (students), to receive continued training where the main area should be not only new methods and technical possibilities, but also the strategy of the institution including the pedagogical and technical possibilities in teaching. Special attention should be paid to changing attitudes by increasing the knowledge of pedagogy and the e-learning production process. Another very important area is to get teachers to commit to the objectives where the new learning paradigm is prevailing. The institutional level programmes should be planned according to the latest results of pedagogical and expertise development research.

Establishing Development Groups

The higher educational institutions, especially in engineering education, should establish development groups where a pedagogical expert is involved in the activities. The groups could specialise in different kind of areas where the development is necessary. The information and communication technology should play a significant role in teaching development. Both technical and pedagogical experts should co-operate in this particular area. Co-operation is important so that not just the technical view dominates when making decisions regarding the kind of learning platforms or other technical solutions that will give added value to students, teachers, administration staff and, finally, the university.

The developing group should consist of both pedagogical experts and content experts. Students should also take part in such a development group work. This is very important for two reasons: firstly, students can give their view on development, but, at the same time, they can become familiar with the obstacles and opportunities, as well as new pedagogical development (theory and methods, research results). The development group should co-operate with other development groups on a national and European level. The development groups should participate in the students' symposia in order to disseminate the latest information on the field of pedagogical and expert development. Moreover, the continuing short seminars at the university level should be the norm. It will take more hard work to change the attitudes than has previously been the case. Financing for such co-operation should be arranged.

Supporting Teachers
More support should also be given to individual teachers. The new pedagogical knowledge is of the utmost importance, not just the information and communication technology in teaching and learning, but also the learning theory, methods and the newest research results. The pedagogical expertise is underestimated, especially in technical universities. The technical universities should take this deficiency seriously and change the situation by organising support for teachers more carefully, by increasing the number of pedagogical experts who are up-to-date on the changes in that research area, and by supporting teacher training.

Immaterial Property Rights
Universities should be active and keep abreast of the times concerning Immaterial Property Rights (IPR) questions and developments in this area. This is important because it is possible to have problems with the content that teachers have produced. It is a hot topic when making content in digital learning environments.

Administration Structure
The global dimension, which will grow more rapidly because of the development of information and communication technology, does not only affect the learning methods or the need to increase the number of pedagogical experts in technical universities and other higher institutions. It also means paying more attention to the administration structure, which should be ready to handle the increasing number of foreign students, not only in the traditional manner, but also by using information and communication technology more effectively (e.g. virtual Erasmus).

Recognition System
One of the important questions when offering students net-based courses is the recognition system between universities throughout Europe. When using ICT in teaching and learning, students want more net-based courses in the future when the infrastructure in universities throughout Europe is at a suitable level, and the pedagogical development and e-learning production process will be at the level where more completely net-based or blended courses (where the university supports the student) are possible. The universities should be active in solving the problem in the near future.

Co-operation with the Industry
At all levels, the universities and industry should seek for co-operation so, that the new knowledge of the universities could be combined with the educational needs of the industry. ICT-based continuing education can help the engineers in the industry to update their knowledge and the wider demand for educational modules can help the universities to finance the new developments.

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3. History of the TN

Broadly the purpose of this Thematic Network (TN) has been the same of that one financed under Socrates I, that is to *develop the European dimension in Engineering Education (EE)*. In other words to enhance the compatibility of the many diverse routes to the status of Professional Engineer which exist in Europe and, hence, to facilitate greater mobility of skilled personnel and integration of the various situations throughout Europe. It must be emphasised that, according to the spirit of the Bologna Declaration, enhanced compatibility does not imply greater uniformity, and is certainly not intended to lead to a reduction of standards to the best common level that can be found. Rather it is envisaged that wide visibility of examples of and recommendations for good practice will allow recognition based on mutual understanding and respect.

The "roots" of the first proposal were obviously constituted by the experience gathered during the first three years project having the same objective, co-financed under Socrates I, and known by the acronym H3E* . Main points of the proposal have been: (a) a set of innovative Activities, which aimed at the best balance between study type activities and experimental ones, so that the TN could be regarded as an *experimental laboratory for EE*; (b) a simple management structure, taking into account the changes characterising Socrates II with respect to Socrates I; (c) a strict coordination of the various activities in order to enhance the cohesion of the whole project; (d) a strong attention given to the dissemination phase, in order to reach all potentially relevant actors in EE in Europe; (e) a direct involvement of the professional world; (f) a strong link with other initiatives and TN's in similar fields in order to take advantage of cross-fertilisation opportunities.

It is well known that the TN in EE within Socrates I, H3E, of which E4 was a continuation, has been managed by a European Economic Interest Grouping formed for this purpose by three associations: BEST, CESAER and SEFI. These associations supported E4 mainly ensuring the strongest possible participation to the various sub-projects, as well as the most effective dissemination strategy. In fact these three associations constituted the widest network of academic bodies in EE presently available in Europe. The active participation of the European Association of Universities (EUA) and of professional associations such as FEANI and CLAIU, or of industrial ones such as the ERT, have been strongly encouraged.

The most important and numerous target audience of this TN is represented by all EE institutions in Europe, their teachers and students, to which the dissemination

*More precisely H3E is the acronym identifying the European Economic Interest Grouping managing a set of thematic networks in EE (DEDHEE, JEEP Teams, PiE and Protect).

activity is mainly targeted. This first group has been reached more effectively through all the members of the associations actively involved in the TN, such as SEFI, CESAER and BEST. On a third level, professional and industrial associations ensured an even larger audience.
One of the main new aspects characterising Socrates II is certainly the greater importance given to the Institutional Contract (IC) as a general tool for handling any Erasmus initiative. This includes the TNs as well and therefore it has been proposed that the E4 was part of the IC of the *University of Florence*, which has declared, through its highest representatives, its strong interest and commitment. This institution has a comparatively young engineering faculty, thus facilitating the acceptance of this coordination role by more famous institutions of Europe. On the other hand it is also an institution of great traditions and with a strong international component, as can be appreciated considering that each faculty has its own international office, and by the fact that it managed the largest IC within Socrates I. The University of Florence has also a strong commitment to *innovation*, and an important budget dedicated to this, a fact reflected by the existence of the position of Pro-Rector for Innovation: this is part of the productive environment in which the TN management has been operating.

E4 has been conceived as a homogenous set of five *Activities* on which worth to concentrate the efforts of the TN. The detailed description of the working groups and their outcomes can be found in Chapter 2.2.

Main Steps of E4 TN:

15/11/1999 Declaration of Interest
08/11/2000 Official approval
01/09/2000 Requested starting date by the EC
01/03/2001 Renewal Application for the 2nd year
30/09/2001 End of the 1st year
01/10/2001 Starting date 2nd year
31/10/2001 Final Report 1st year
01/03/2002 Renewal Application for the 3rd year
30/09/2002 End of the 2nd year
01/10/2002 Starting date 3rd year
31/10/2002 Final Report 2nd year
01/03/2003 Renewal Application of the 4th year (dissemination Year)
30/09/2003 End of the 3rd year
01/10/2003 Starting of the 4th year (dissemination Year)
30/11/2003 Final Report 3rd year

The Kick Off Meeting in Leuven (March 2001)

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4. Brief Introduction to the IAB

Prof. Jack C. Levy
Member of the International Advisory Board of E4
City University London
United Kingdom

4.1 Background

It was a very positive initiative of E4's leadership to create an International Advisory Board (IAB) to help ensure that E4 decisions and activities would be based upon the broadest possible knowledge of the field and background trends. This philosophy behind the establishment of the IAB has been amply confirmed by experience. The IAB can, and did, provide useful information and viewpoints and also served as a link between the various internal networks and sometimes the relaying of E4 activities to the external world.

4.2 Role and Composition

Role
The role of the IAB was conceived as that of three external, independent, persons providing expert views and advice particularly drawing the attention of the E4 leadership and Management Committee to relevant present and forthcoming issues. IAB members were to act as observers without any executive or fiscal responsibility. While they may participate in discussions at E4 information events or meetings they may not represent the thematic network in any formal or legal way. Periodically, formal views and advice are made to the President and Coordinator rather than to the full Management Committee.

Composition of the IAB
Guy Haug 2000-2001(resigned from the IAB following his appointment to a post in the European Commission recognising that remaining on the IAB might have involved a conflict of interest).

Professor Jack Levy (United Kingdom)
Dr. Kruno Hernaut of Siemens AG (Germany)
Mr. Markku Markkula (Finland)

Ground Rules
The following 'ground rules' were agreed for efficient/useful functioning of the IAB:

- IAB members serve *ad personam* and do not represent any organisation.
- IAB members were expected to participate in a small number of meetings each year, usually of the Management Committee (2 to 4, not necessarily the same for all IAB members) but not to get involved in too many meetings of E4 groups.
- The quality of the work of the IAB was dependent on good information on E4 activities and issues. So the practice was followed of sending to the IAB details of all meetings, however with no obligation to attend.
- IAB members had opportunity to meet between themselves on occasions and did avail themselves of this possibility;
- IAB members should speak openly, including commenting on deficiencies and problem areas, as indeed the members have been able to do;
- IAB costs to remain modest in the overall E4 budget.

4.3 IAB Observations on the Work of E4

General

It is pleasing to report that IAB participation has been helpfully facilitated by the E4 organisation. IAB opinion has been sought extensively and its responses have evidently been useful to the Network and rewarding for IAB members.

Structure/organisation

Given the complexity and ambitions of the Project, its basic structure/organisation into 5 Activities and 3 Transversal Actions was logical and covered all major issues. There was however a perceived danger that E4 activities may be too many and too diverse and suffer from the difficulty of gearing them all towards the main operational objective.

Consequently at the beginning of this third year of the project the IAB emphasised to the President, the Co-Ordinator and the Management Committee the importance of making solid progress during this, the central period. Necessarily the first year of such a project must organise and align the effort while the third year must appraise data, formulate conclusions, make recommendations and finalise the outcomes.

Responding to this need for solid progress in the second year, more than 40 meetings were convened of the Bureau, Management Committee, Working Groups, and relevant Round Tables and Symposia. Also, the IAB affirms that the leadership and the whole E4 team have commendably undertaken huge information efforts by way of brochures, website (both in public and private areas), consultative documents and reports. On the organisational side we observe that the central organisation is supported by an efficient group of staff and that the financial arrangements are well administered.

Tribute is due to Professors F. Maffioli and C. Borri who have invested an immense amount of time and effort to ensure progress across the board. This has helped all the five working groups to make progress in their tasks – though more in some cases than others. Encouragingly some 'outputs' have been achieved, for example on the TUNING project and on the 'Glossary of Terms', building on the work of E4 in this and other respects. Also commendable is the considerable involvement of engineering students through IAESTE and BEST and the contacts maintained with engineering education associations in Europe (SEFI) and North America (American Society for Engineering Education and the United Engineering Foundation).

In summary the IAB confidently acknowledges E4 as an important – even crucial – project for the future of engineering education in Europe. A dissemination period is strongly recommended and supported, as are carefully planned successor projects building on what has been learnt. IAB members feel that subsequent decisions should place considerable weight on major pan-European developments and needs in engineering education – such as the Bologna Declaration, qualification attributes and continuing engineering education – the significance and importance of which may have actually increased since E4 began its work.

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5. Some Thoughts about the Role of Thematic Networks in European (Engineering) Education

Prof. Francesco Maffioli
Scientific Co-ordinator of E4
Politecnico di Milano, Italy

5.1 About Thematic Networks in General

Thematic Network Projects (TNP) (quoting from a DG EAC document of some years back):

"aim to define and develop a European dimension within a given academic discipline or other issues of common interest … through cooperation between university faculties or departments, academic or professional associations, and other partners. … (omissis) … A successful TNP might help provide a more favourable environment for a deeper understanding of the discipline concerned … Furthermore … TNP should: work towards assessing the quality of cooperation and curriculum innovation; promote, within an active forum, discussions on improvements in teaching methods …; foster the development of joint European programmes … and improve the dialogue between academic and socio-economic partners".

It is therefore natural to ask if this European dimension has been sufficiently built or not, and second if TNP contribute substantially to the efforts for achieving this goal. Most people involved in higher education would probably answer NO to the first question and YES to the second one. Many of those who have worked in one or the other TNP have also the impression that the contribution of existing TNP has been often underestimated, among other reasons because it is difficult to measure the importance of *networking* on the future of any area of knowledge.

In the future a successful TNP has to blend study activities, forum organisation, pilot projects and keep as a main overall goal the production of all sort of *TOOLS* for enhancing the European dimension in the field concerned. This may well be confined to a particular discipline (preferably in such a case one presenting innovative/ interdisciplinary aspects), or to a broader transversal set of topics. For instance, considering the Engineering Education field only, the E4 TNP has been targeted to "hot" issues of transversal interest for Engineering Education, whereas EUCEET has been focused on Civil Engineering and USAEE on Agricultural Engineering. In order to work productively a TNP must provide evidence of progress during its life, possibly building up some form of *self-assessment* in its own management structure (e.g. the International Advisory Board of E4).

Another key issue for the success of a TNP is its *visibility*: it is of paramount importance that the results of such a big effort, from the part of the persons and institutions involved as well as from the part of the European Commission, are brought to the attention of the whole community, students, enterprises, academic and professional associations, teachers, etc. A TNP must therefore, helped as much as possible by the DG EAC, put together a big dissemination effort, during its life, but mainly at the end of it.

The simultaneous running of TNP in similar areas of knowledge supports the opportunity of creating *Aggregates* of TNP. Without imposing a too heavy schedule to such a group of TNP, it is advisable that joint initiatives be established, as for instance a joint discussion Forum once a year, in order to increase networking and take advantage of cross-fertilisation, comparing opinions on issues of high priority. It has been suggested that at least 3 Aggregates could be formed, one of hard sciences TNP, one of soft science TNP, and one of TNP in the humanistic area.

A final aspect in which TNP provide an advantage sometimes underestimated, is the fact that they contribute to the formation of a European Area of Knowledge via a truly *bottom-up* approach, probably perceived by higher education institutions as being one of the most democratic.

For all these reasons it is of paramount importance that the support given to TNP by the European Commission continues, guided by a careful and motivated selection procedure for identifying the projects eligible for financial support.

5.2 Some Ideas about a Successor of E4

The 4 guidelines for the future that the DG EAC has put in evidence several times must be given paramount importance in any new project. They are:
(A) Tuning,
(B) Erasmus Mundus,
(C) Education and Research,
(D) Sustainability.

One simple innovative idea on the organisation side, is offered by the successful activity of the working group in charge of the preparation of the Glossary during E4. The new TN could be structured with a quite large (say, from 12 to 18) Special Interest Groups (SIG), each one with the task of producing a well defined “tool” for enhancing Engineering Education. These tools (inquiries, guidelines, reports, seminars, etc.) should be presented as related to one or more of the guidelines of the DG EAC mentioned above. One way (but surely not the only one) of doing this would be to articulate the TN activity following 4 “streams”, one for each of the guidelines, like the rows of a matrix, whose columns represent the different SIGs.

A tentative list of SIGs is reported below for the sake of exemplification. (Note: capital letters following each topic refer to the 4 priorities of the EC mentioned).

- A new core for first level engineering curricula in Europe: suggestions and examples. (A)
- Motivating for engineering and technology: examples of good practice. (A, D)
- The formation of good adult learners. (A, C)
- From ECTS to a complete qualification profiling of engineering students. (A)
- The key role of research in high level engineering formation. (C)
- Effective continuing engineering education in European universities. (D)
- Examples of good practice in open and distant learning. (A, D)
- Forming entrepreneurial engineers. (A, D)
- The effective use of new teaching/learning ICTs. (C, D)
- Increasing the quality of the majority: a key challenge. (D)
- Status of doctoral (PhD) studies in engineering in Europe. (C)
- Availability of courses for foreign students in engineering in Europe. (B)
- Sustainability of European engineering universities. (D)
- Thesis abroad facilitator (or what did we learn from JEEP). (B)
- Real needs of European enterprises regarding the international formation of engineers. (A)
- The learning value of projects and design. (A, C)
- A tool-kit for Quality Assurance. (A, D)

I think a successor to E4 should begin with a general conference aiming at the formation of SIGs , similarly to what was done in Leuven for E4.

The MC of the new TNP could not, obviously, see the participation of all SIG leaders. One possibility would be to identify “stream leaders”, where the word stream refers to the four priorities of the EC. The IAB should be maintained, playing the very important role of a real-time assessment of the TNP.

The 18 SIGs listed above are not all of the same nature. Some could very well begin with a Forum/Round Table discussion; some would aim at developing some real “tool”; some others are easier to conceive as aiming to some kind of report or survey. It would also probably be advisable to divide SIGs into at least 2 groups, one to be developed during the first year, the second during the second year, leaving the third year for putting everything together.

The role of organisations supporting actively the new TNP could in some case be to nominate the leader of a SIG, in order to avoid concentrating responsibility only in academic hands. SEFI Headquarters would remain responsible for publications. I see these publications as a series of documents/reports.

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6. Appendixes

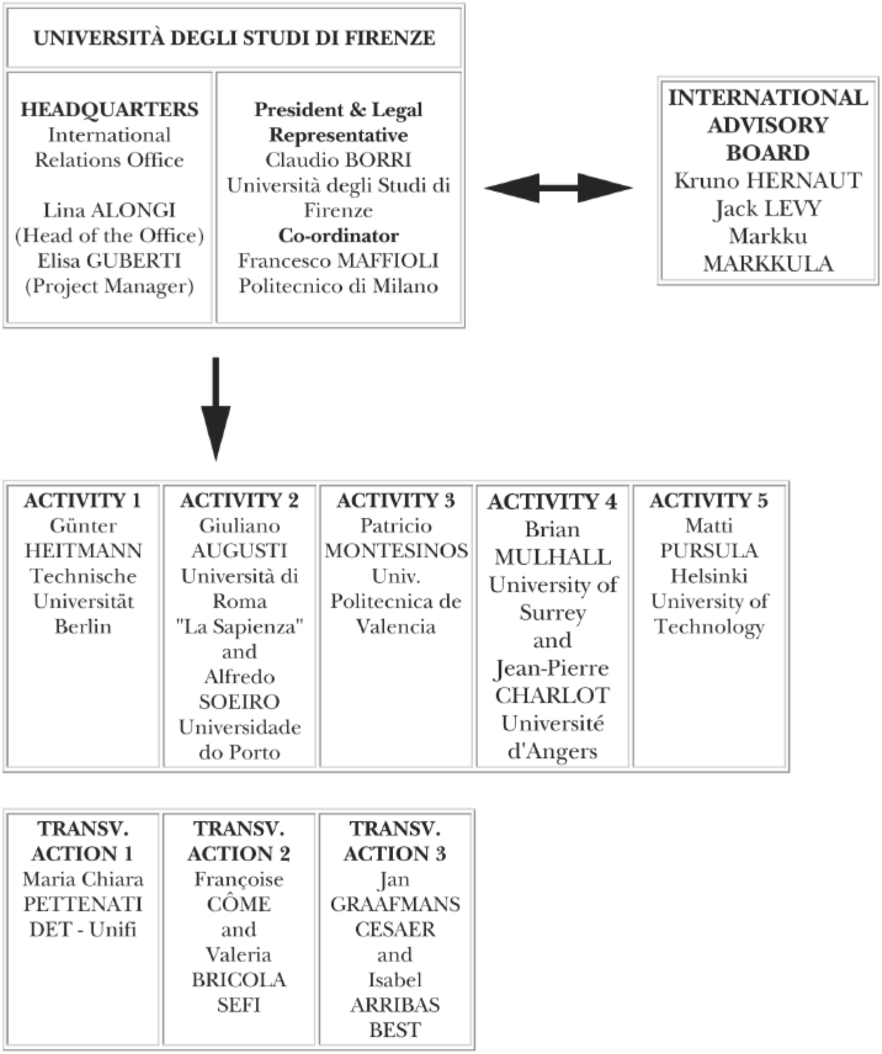
6.1 Management Structure of E4 Thematic Network

The main management structure of E4 is the *Management Committee* (MC), composed of the Legal Representative of the University of Florence and the Co-ordinator, of the Promoters of the five Activities, of representatives of the Associations most heavily involved (BEST, CESAER and SEFI). The TN Administrator Manager as well as the person in charge of the maintenance of the web site of the TN are permanently invited to take part in the MC meetings. These are chaired by the Co-ordinator and are convened at least each 4 months. A detailed report on the five activities is given in the following section. Their Promoters are: G. Heitmann (Technical University Berlin) for Activity 1; G. Augusti (Università di Roma, "La Sapienza") and Alfredo Soeiro (University of Porto) for Activity 2; A. Hagström (ETH Zurich) and P. Montesinos (Universidad Politecnica de Valencia) for Activity 3; B. Mulhall (University of Surrey) and J.P. Charlot (Université d'Angers) for Activity 4 and M. Pursula (Helsinki University of Technology) for Activity 5.
Main tasks of the MC are:

- Define the Activities guidelines;
- Establish suitable synergies between them;
- Ensure the respect of time-tables and activity schedule;
- Provide that all reports be issued in time;
- Promote the visibility of the project and organise the dissemination of results;
- Interface with the EC (DG-EAC in particular).

The *Legal Representative* (Prof. Claudio Borri), appointed by the Rector of the University of Florence in the person of his Deputy for the SOCRATES Programme, is the *President* of E4 and represents, in any academic or managerial duty, the Head of the Institution. He has a *supervising function* on behalf of the contracting Institution. In particular this ensures that the project receives a significant co-financing support from the contracting Institution, but also from other sources. During the first financial year this has ensured the constitution of the Headquarters of E4 according to expectations. The permanent staff is formed by two members: Ms. Lina Alongi (head of the International Office of the School of Engineering in Florence) and Ms. Elisa Guberti (project manager). The maintenance of the web site of E4 is under the supervision of Dr. M.C. Pettenati of the Dept. of Electronics and Telecommunications.
The *Co-ordinator* (Prof. Francesco Maffioli of the Politecnico di Milano) has also been appointed directly by the Rector of the contracting Institution. He has the responsibility of the management and co-ordination of the project, ensuring all scientific duties are fulfilled satisfactorily.

The day-by-day running of the TN has been ensured by a *Bureau*, chaired by the Co-ordinator and including the Legal Representative, a representative of the administration of the School of Engineering of the University of Firenze and the staff of the Headquarters. The Bureau has met at least once every month physically in Florence, but has been in continuous contact through e-mailing, on average twice a week. The Co-ordinator and the President are the unique official contact persons of E4 with the DG-EAC



6.2 The Headquarters in Florence

E4 Headquarters are located at the International Relations Office of the Faculty of Engineering of Florence. The office was established in 1997 and is run under the lead of Deputy Dean for International Relations of the School of Engineering (presently, Prof. Claudio Borri, who started up the Office is still acting in such position). The permanent staff of the office is composed by 4 persons working on different activities (Socrates Programme: Students/Teaching staff Mobility, Intensive Programmes, Thematic Networks; Leonardo Da Vinci Programme; Organization of Conferences and Seminars, etc.). The staff of the office involved in the E4 TN is formed by two members: Ms. Lina Alongi (Head of the Office) and Ms. Elisa Guberti (working full time for E4 as Project Manager).

6.3 List of Active Members

Key: Bold = promoting institution; AP = Active Partner

Country	Institution	Lastname	Firstname	Role in E4
AT	Leopold-Franzens University Innsbruck	PROPPE	Carsten	
AT	Technical University of Graz	BEER	Gernot	AP
AT	Technical University of Wien	REICHL	Franz	
BE	"Vrje" University of Brussels	CARDON	Albert H.	AP
BE	University of Gent	VERHE	Roland	AP
BE	**CESAER**	**GRAAFMANS**	**Jan**	AP
BE	University of Liège	RONDAL	Jacques	AP
BE	Polytechnic of Mons	BOUCHER	Serge	AP
BE	Catholic University of Leuven	BERLAMONT	Jean	AP
BE	CLAIU	VAN EYCKEN	Ann	
BE	GROUP T High school Leuven	DOCHY	Frank	
BE	Libre University of Brussels	PONCELET	Robert	
BE	FEANI	WAUTERS	Philippe	AP
BE	SEFI	CÔME	Françoise	AP
BE	ADISIF	GODARD	Michel	
BG	"Angel Kunchev" University of Rousse	IVANOV	Rosen	
BG	University of Architecture, Civil Engineering and Geodesy	BORISLAV	Belev	AP
CH	Federal Polythecnical School of Lausanne	NIBBIO	Nadia	
CH	Swiss Federal Institute of Technology Zurich	SCHAUFELBERGER	Walter	AP
CH	SUPSI – University of Applied Sciences of Southern Switzerland	FLUECKIGER	Federico	
CH	IGIP – International Society for Engineering Education	FLUECKIGER	Federico	
DE	Bauhaus-Universtiät Weimar	BRANNOLTE	Ulrich	AP

DE	**Technical University of Berlin**	**HEITMANN**	**Günter**	AP
DE	Technical University of Aachen	MESKOURIS	Konstantin	AP
DE	Technical University of Braunschweig	SEBASTIAN	Astrid	
DE	Technical University of Darmstadt	WÖRNER	Johann-Dietrich	AP
DE	Technical University of Dresden	RUGE	Peter	AP
DE	Technical University of Ilmenau	KERN	Heinrich	AP
DE	University of Applied Sciences Esslingen	KURZ	Günther	AP
DE	University Kaiserlautern	SCHMIDT	Helmut	AP
DE	University of Hannover	PIRSCH	Peter	AP
DE	University of Karlsruhe	HAMMER	Gerald	
DK	The Engineering College of Copenhagen	VINTHER	Ole	AP
DK	Technical University of Denmark	JENSEN	Hans Peter	AP
DK	The Engineering college of Horsens	AALYKKE	Peter	AP
EE	Tallinn Technical University	PAPPEL	Toivo	AP
ES	Polytechnical University of Madrid	GARCIA FERNANDEZ	Marinela	AP
ES	Polytechnical University of Catalunya	VILARDELL	Abelard	
ES	**Polytechnical University of Valencia**	**MONTESINOS**	**Patricio**	AP
ES	University of Granada	VERDEGAY GALDEANO	Jose Luis	
ES	University of Seville	NAVARRO	Alfredo	
ES	University of Valladolid	DOMINGUEZ GARRIDO	Urbano	AP
FI	Espoo-Vantaa Institute of Technology	KARHU	Markku	AP
FI	HUT– Helsinki University of Technology	PURSULA	Matti	AP
FI	IACEE – International Association for Continuing Engineering Education	HAGSTRÖM	Anders	AP
FI	Tampere Polytechnic	AALTO	Heikki	AP
FR	**BEST – Board of European Students of Tecnology**	**ARRIBAS**	**Isabel**	AP

FR	National Polytechnical Institute of Grenoble	BARIBAUD	Michel	
FR	Albi School of Mines	ALAVERDOV	Jean Michel	
FR	Alès School of Mines	WEBER	Philippe	
FR	Central School of Paris	DEPEYRE	Dominique	
FR	Central School of Nantes	LUCAS	Michel	
FR	EIFFEL NETWORK	ALLIES	Christian	
FR	ENST – National School of Advanced Techniques	COMPOINT	Philippe	
FR	EPF – Feminine Polytechnic School	TISCHBIREK	Gay	
FR	ESTP – Special School of Civil Engineering	GOEDERT	Marie-Jo	
FR	**ISTIA Innovation**	**CHARLOT**	**Jean-Pierre**	AP
FR	University Joseph Fourier Grenoble I	MERCHEZ	Fernand	
FR	University of Angers	DUBOIS	Dominique	
FR	University of Limoges	GUILLON	Pierre	
FR	University of Technology of Compiegne	MOREAU	Claude	
FR	Bureau National des Elèves Ingenieurs	LALLEMENT	Regis	AP
GR	Aristotle Univ. of Thessaloniki	AVDELAS	Aris	AP
GR	Polytechnical University of Crete	MATSATSINIS	Nikos	
HU	Banki Donat Polytechnic	TOTH	Agnes	AP
HU	Budapest Polytechnic	CSNIK	Laszlo	
HU	University of Miskolc	SZENTIRMAI	Laszlo	AP
IE	University College Dublin	DODD	Vincent	
IT	Engineers Order of Florence	ANGOTTI	Franco	
IT	**Politecnico di Milano**	**MAFFIOLI**	**Francesco**	AP
IT	Polytechnic of Torino	GOLA	Muzio	AP
IT	University of Rome “La Sapienza”	PODESTA	Luca	
IT	University Cattaneo – Castellanza LIUC	NOÈ	Carlo	AP
IT	University of L’Aquila	PELINO	Mario	
IT	University of Palermo	DI MAIO	Bruno	AP
IT	**Università di Roma “La Sapienza”**	**AUGUSTI**	**Giuliano**	AP
IT	**University of Florence**	**BORRI**	**Claudio**	AP
LT	Vilnius Gediminas Techn. University	VALIULIS	Algirdas Vaclovas	

LT	Kaunas University of Technology	DUMCIUVIENE	Daiva	AP
LU	Highschool of Technology of Luxembourg	RETTER	Albert	
MT	University of Malta	MALLIA	Celia J.	
NL	University of Technology Eindhoven	DIJKHUIS	Anneroos	
NL	University of Twente	SPOEK	F.	
NL	Delft University of Technology	GROOT KORMELINK	Joost	AP
NO	Vestfold University College	ARNE	Oddvin	AP
PL	Polytechnic of Warsaw	FILIPKOWSKI	Andrzej	AP
PL	Rzeszów University of Technology	SOBKOWIAK	Andrzej	AP
PL	Silesian University of Technology	BIALECKI	Ryszard A.	AP
PL	Technical University of Czestochowa	DURLIK	Ireneusz	
PL	Wroclaw Universtiy of Technology	RADOSZ	Andrezej	AP
PT	Ordem Engenheiros – Centro	MARIANO	Jorge	
PT	Technical Institute Lisboa	PEREIRA	Manuel Seabra	
PT	University of Minho	MENDES	José	AP
PT	**University of Porto**	**SOEIRO**	**Alfredo**	AP
PT	University of Aveiro	FERRARI	Antonio	
RO	Polytechnic of Bucharest	CHISLEAG	Radu	AP
RO	Technical Univ. of Civil Engineering Bucharest	MANOLIU	Iacint	AP
RO	University of Craiova	TOPAN	Dumitru	AP
RU	Bauman Moscow State Technical University	KHARITONOV	Vladislav	
SE	Boras College	MATTSSON	Anders	
SE	Chalmers University of Technology	SJOBERG	Jorgen	
SE	Lulea University of Technology	HEDBERG	Torbjörn	AP
SE	Royal Institute of Technology	WAHLBERG	Bo	
SK	University of Zilina	POKORNY	Michal	
TK	Istanbul Technical University	OZKALE	Lerrzan	
UK	Cambridge University	PADFIELD	Christopher J.	
UK	Middlesex University	GOLDSPINK	G.F.	

UK	The Queen's University of Belfast	LONG	Adrian E.	AP
UK	**University of Surrey**	**MULHALL**	**Brian**	AP
UK	University of Ulster	NORTON	Brian	
UK	University of Derby	DODRIDGE	Melvyn	AP
UK	EPC – Engineering Professors' Council	MAILLARDET	F. J.	AP
UK	University of Birmingham	BAKER	Chris	

6.4 List of Outputs

Title	Details of supplier
Best Practice Examples of Innovative Engineering Curricula and Curriculum Development	Activity 1
Document on the former Chap. 1 "Review of EU Engineering Educational Systems"	Activity 1
Collection of data about the Engineering Education Systems in Europe and the Implementation of two Tier Curricula as a part of the State of the Art Report on Systems and of Innovative Curriculum Development	Activity 1
State of the Art Report on Curriculum Innovation	Activity 1
Guidelines for the development of innovative EE curricula with special focus on the enhancement of the European dimension	Activity 1
Report on motivation for EE and how can engineering programmes and curricula be developed to attract more young students, not only male but increasingly female ones	Activity 1
European CORE CURRICULUM for engineering education	Activity 1
Standing document on *"Accreditation and Recognition in European Engineering"* Based on Chap. 3: "Accreditation and Recognition" of the "State-of-the-art" Report of Working Group no. 2 "Quality and Recognition in Engineering Education" of Thematic Network H3E – Higher Engineering Education for Europe. Rapporteur: Giuliano Augusti, Roma "La Sapienza"	Activity 2

Standing document on "Quality Assessment and Quality Assurance" Based on Chap. 2 "Quality Assessment and Quality Assurance" of the "State-of-the-art" Report of Working Group no. 2 "Quality and Recognition in Engineering Education" of Thematic Network H3E – Higher Engineering Education for Europe. Rapporteur: Muzio Gola, Politecnico di Torino	Activity 2
Report on New Trends on International Accreditation and Recognition of Engineering Study Programmes. Rapporteur: Alfredo Soeiro, Universidade do Porto	Activity 2
Establishment of ESOEPE (European Standing Observatory for the Engineering Professions and Education) and contribution to its start and good running	Activity 2
Joint discussions with ASEE on Accreditation and co-operation with UNESCO and WFEO on Accreditation and Recognition at global scale of Engineers	Activity 2
Collection of examples of good practice in Quality Assurance of Engineering Education; suggested common list of QA and assessment criteria	Activity 2
Annual Seminar 2000 of the SEFI Working Group on Continuing Engineering Education – "CEE as a Business" – Helsinki 13-16 December 2000	Activity 3
Survey on Continuous Engineering Education	Activity 3
E4 Kick off meeting – results of the A3 WG Meeting – Leuven 2-3 March 2001	Activity 3
Annual Seminar 2001 of the SEFI Working Group on Continuing Engineering Education – "Competence Development in CEE" – Vienna 13-14 December 2001	Activity 3
Annual Seminar 2002 of the SEFI Working Group on Continuing Engineering Education – ODL in Continuing Engineering Education: is that a business? Threats and Opportunities for ODL Marketing, Production and Delivery – Valencia 12-13 December 2002	Activity 3
Collection of case studies of successful practice	Activity 3
Jeep Team group: ISTIA – Univ. d'Angers	Activity 4
Jeep Team group: Politechnica Bucharest	Activity 4
Planning Documentation	Activity 4
Questionnaire to find out how far the reality of international experience matches the expectations	Activity 4

Survey conducted among graduates and students of ISTIA, in the University of Angers, France, about best practice in enhancing the international dimension in Engineering Education (IAESTE Conference - Paris, 29/11-1/12, 2001)	Activity 4
International BEST Symposium Chania: "Enhancing the Modern Technical University "	Activity 4
Design of a "code of good practices" for enhancing European dimension in HEE	Activity 4
Production of registers of sum of the more obvious activities in internationalisation such as courses given in foreign languages and courses leading to double diplomas	Activity 4
Design of an effective organization for experiences like JEEP teams and pilot projects experimenting with this tool	Activity 4
Report on European work environment and its needs of internationally formed engineers	Activity 4
WEB-SITE Site Activity 5	Activity 5
From the classroom to the internet: pedagogical and technological aspects of eLearning (IBS Trondheim)	Activity 5
PBL Problem Based Learning (IBS Trondheim)	Activity 5
Survey of Virtual Campus and Virtual University Activities in Europe	Activity 5
Survey on the working methods A5 has been using and people's attitude and responses to those	Activity 5
Studying in e-space and other challenges for learning (Helsinki, 27-30 Sept. 2001)	Activity 5 & BEST Symposium
International BEST Symposium Chania: "Enhancing the Modern Technical University"	Activity 5
Survey of "Good Practices in the Use and Support of New Teaching and Learning Technologies"	Activity 5
Survey of "Training for Engineering Teachers on Facilitation of ODL"	Activity 5
Survey of "Transnational Pilot Courses on Both Common Core and Specialised Engineering Discipline Subjects"	Activity 5
E4 Bulletins (Issue #1, #2, #3, #4, #5, #6)	Transversal Action 2
Glossary of terms relevant for ENGINEERING EDUCATION	Transversal Action 2 – Glossary ad hoc group
Round Table on the "Consequences of the Bologna Declaration in Engineering Education in Europe" (General Assembly – Florence 8 December 2001)	

TUNING: Report of the Engineering Synergy Group	Tuning ad hoc group
Report of the International BEST Symposium "One Million Erasmus Celebrations; weak and strong points" (Lyon 10-15 Dec. 2002)	BEST Symposium

6.5 List of Events

CONFERENCE ACTIVITIES 2000/01 (1st year)			
A1: WG Meeting	24-28 Jan. 2001	Berlin	DE
A1: WG Meeting (E4 Kick-off Meeting)	2-3 March 2001	Leuven	BE
A1: WG Meeting	8-9 June 2001	Bruxelles	BE
A1/A2: EUCEET-ECCE Conference	17-21 July 2001	Sinaia	RO
A2: Meeting of Steering Committee of ESOEPE	9 September 2000	Paris	FR
A2: Working Group meeting (during the EWAEP3 Meeting)	26 January 2001	Darmstadt	DE
A2: WG Meeting (E4 Kick-off Meeting)	2-3 March 2001	Leuven	BE
A3: Annual Seminar 2000 of the SEFI Working Group on Continuing Engineering Education – CEE as a Business	13-16 December 2000	Espoo	FI
A3: WG Meeting (E4 Kick off meeting)	2-3 March 2001	Leuven	BE
A3: Workshop – Truths and Lies about Using the Internet in Engineering Education	6 September 2001	Paris	FR
A3: Workshop: Continuing Engineering Education (CEE) as a business – Models for CEE management in Europe	12 September 2001	Copenhagen	DK
A4: WG Meeting (Promoters)	15 January 2001	Angers	FR
A4: WG Meeting (E4 Kick-off Meeting)	2-3 March 2001	Leuven	BE
A5: WG Meeting (E4 Kick-off Meeting)	2-3 March 2001	Leuven	BE
A5: SEFI WGCD & WGICT workshop Information and Communication Technologies on Engineering Education – "The Impact of ICT on the Curriculum"	2-3 May 2001	Galway	IE
A5: preparatory meeting for the Helsinki Symposium	17 September 2001	Berlin	DE
A5/BEST: International BEST Symposium Helsinki: "Studying in e-Space"	27-30 September 2001	Helsinki	FI
International BEST Symposium Trondheim: Alternative learning methods should exams be discarded?	1-3 March 2001	Trondheim	NO
E4 General Assembly: Kick-off meeting	2-3 March 2001	Leuven	BE

CONFERENCE ACTIVITIES 2001/02 (2nd year)			
A1: WG Meeting (E4 General Assembly – Florence)	7-8 December 2001	Florence	IT
A1: Core Curriculum Group Meeting	22-23 March 2002	Valladolid	ES
A1/A2: Workshop: The role of In-put and Out-Come Orientation for Curriculum Development, Accreditation and Recognition (EPC/QAA)	26-27 April 2002	London	UK
A1: International Seminar on Curriculum Development in Engineering Education "Bologna Spirit in Two Tier Engineering Education Curricula Development"	17-19 May 2002	Vilnius	LT
A1: WG Meeting	11-12 June 2002	Brussels	BE
A2: Workshop (originally planned to be held during the ASEE-SEFI_TUB International Colloquium)	17 September 2001	Berlin	DE
A2: WG Meeting (E4 General Assembly – Florence)	7-8 December 2001	Florence	IT
A2: International Workshop on Accreditation (Organised by ESOEPE)	12 March 2002	Paris	FR
A3: Annual Seminar 2001 of the SEFI Working Group on Continuing Engineering Education – "Competence Development in CEE"	13-14 December 2001	Wien	AT
A3: WG Meeting	13 March 2002	Brussels	BE
A3: Workshop "CEE as a Business: The Use of Open and Distance Learning" (30th SEFI Annual Conference: SEFIrenze 2002 – The Renaissance Engineer of Tomorrow)	9 September 2002	Florence	IT
A4: WG Meeting	16 November 2001	Guildford	UK
A4: IAESTE Conference – Results of the survey conducted among graduates and students of ISTIA, in the University of Angers (FR) about best practice in enhancing the international dimension in Engineering Education	29 Nov. - 1 Dec. 2001	Paris	FR
A4: Plenary session on Jeep Teams during the E4 General Assembly in Florence	7 December 2001	Florence	IT
A4: WG Meeting (E4 General Assembly – Florence)	7-8 December 2001	Florence	IT
A4: International BEST Symposium Chania: "Enhancing the Modern Technical University"	20-24 March 2002	Chania	GR
A4: WG Meeting	26 April 2002	London	UK

A5: WG Meeting (E4 General Assembly – Florence)	7-8 December 2001	Florence	IT
A5: Sub-group Meeting	22 February 2002	Weimar	DE
A5: WG Meeting	30-31 May 2002	Weimar	DE
E4 General Assembly	7-8 December 2001	Firenze	IT
BEST International Committee Forum	17-22 February 2002	Tallinn	EE
BEST General Assembly	8-15 April 2002	Paris	FR
30th SEFI Annual Conference (SEFIrenze 2002) – Plenary Session on 10/9	8-11 September 2002	Firenze	IT
CONFERENCE ACTIVITIES 2002/03 (3rd year)			
A1: WG Meeting (ASEE/SEFI/TUB – Berlin "Global Changes in Engineering Education)	5 October 2002	Berlin	DE
A1: WG Meeting	28 February/1 March 2003	Brussels	BE
A1/A2: Joint Workshop (during the Joint Italian-German Meeting on "European perspectives for Higher Education reform: from the Bologna agreement to the Berlin Conference 2003")	13-14 March 2003	Loveno di Menaggio (Como)	IT
A1/SEFI CDWG: Joint seminar of the SEFI Curriculum Development Working Group (CDWG) and the SOCRATES Thematic Network E4 (Enhancing Engineering Education in Europe), Activity 1 on "New Teaching and Learning Methods: How Effective are They?"	4-6 April 2003	Valladolid	ES
A2: WG Meeting (ASEE/SEFI/TUB – Berlin "Global Changes in Engineering Education)	1-4 October 2002	Berlin	DE
A2: ESOEPE Permanent Steering Committee Meeting	22 October 2002	Lisbon	PT
A3: Annual Seminar 2002 of the SEFI Working Group on Continuing Engineering Education – ODL in Continuing Engineering Education: is that a business? Threats and Opportunities for ODL Marketing, Production and Delivery	12-13 December 2002	Valencia	ES
A5: WG Meeting (ASEE/SEFI/TUB – Berlin "Global Changes in Engineering Education)	3 October 2002	Berlin	DE
A5: WG Meeting	21 - 22 May	Berlin	DE
BEST IBS: Erasmus, One Million Students: Weak Points and Strong Points	10-15 December 2002	Lyon	FR
Joint CESAER-SEFI Event in preparation of the EUA Graz Meeting	7-8 February 2003	Helsinki	FI

Joint Italian-German Meeting on "European perspectives for Higher Education reform: from the Bologna agreement to the Berlin Conference 2003"	11-12 March 2003	Loveno di Menaggio (Como)	IT
Joint Conference – Engineering Conferences International (ECI) and TN E4 on "Enhancement of the Global Perspective for Engineering Students by Providing an International Experience"	7-10 April 2003	Tomar	PT
EUA Graz Meeting	30-31 May 2003	Graz	AT
30th SEFI Annual Conference	07-09 September 2003	Porto	PT

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Enhancing Engineering
Education in Europe

VOLUME B

Part I

Glossary of Terms Relevant for Engineering Education

Giuliano Augusti, Valeria Bricola, Günter Heitmann

Part II

Tuning Educational Structures in Europe

Report of the Engineering Synergy Group

Giuliano Augusti, Anselmo Del Moral, Anders Hagström,
Günter Heitmann, Francesco Maffioli, Iacint Manoliu, Brian Mulhall,
Matti Pursula, Reinhardt Schmidt, Valeria Bricola

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Part I

Glossary of Terms Relevant for Engineering Education

Giuliano Augusti, Valeria Bricola, Günter Heitmann

With the contributions of

Anders Hagström, Kruno Hernaut,
Horst Hodel, Jack Levy, Francesco Maffioli, Iacint Manoliu,
Jean Michel, Alfredo Soeiro

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1. Foreword

The Thematic Network *E4 – Enhancing Engineering Education in Europe* aims primarily at developing the European dimension of higher engineering education, by favouring greater mobility, better integration of skilled personnel throughout Europe, exchange of skills and competence, and easier communication between academics and professionals. Since the very beginning of its work, E4 participants confirmed the need, already noted in previous experiences and analogous Networks, of a European "Glossary of Terms relevant for Engineering Education". In fact, too frequently, in international meetings and report writing, confusions arise as to correct meaning and the choice of terms, due to several factors: an improper translation from the original language into English (which remains the most used idiom in international activity) and the variety of the European educational structures.

E4 has therefore undertaken the preparation of such a Glossary with the aim, besides the traditional one of explaining the meaning of the quoted terms, of unifying the terms applied in the context of Engineering Education. Therefore, whenever possible we have indicated for each meaning what we think is the most appropriate word or phrase among possible alternatives. Further comments are in *italic*.

The final draft version of the Glossary is now proposed: its effectiveness will be immediately tested in the preparation of the forthcoming final documents of E4, but we believe it may become a useful tool for all those reading or writing about Engineering Education.

The body of the Glossary is in English, and so is Annex 1, that describes the different structures of European Engineering Education in relation with the reform started with the Bologna Declaration. Definitions of sentences and compound terms are listed in alphabetical order under the most important word: e.g. you will find "continuing education" under "education". Terms used specifically in one European Country will be presented in a series of "National" Annexes, in this first version limited to Germany (Annex 2-DE) and some other extremely incomplete examples.

This Glossary has been prepared within Transversal Action 2 of E4, by an *ad hoc* working group under the responsibility of the European Society of Engineering Education (SEFI). The group was co-ordinated by Valeria Bricola, with the supervision of Professor Giuliano Augusti, of the University "La Sapienza" of Rome, Promoter of E4 Activity 2, and Günter Heitmann, of the Technical University of Berlin, Promoter of Activity 1. Anders Hagström, Kruno Hernaut, Horst Hodel, Jack Levy, Francesco Maffioli, Iacint Manoliu, Jean Michel and Alfredo Soeiro actively and effectively contributed to the preparation of the Glossary.

The first phase of the preparation of the Glossary consisted of research and the collection of many relevant sources: works not completed by previous Thematic Networks, existing glossaries, unpublished papers. We thus arrived at a document with a considerable number of terms, many of which presented several possible definitions: this was clear evidence of the many alternative possibilities given to the same word, in different contexts and in different countries, or even in the same context or in the same Country, and further confirmed the usefulness of proposing a unified Glossary. After long meetings and deep discussions, the *ad hoc* group has arrived at the list presented here.

We are perfectly aware that a language is *per se* in constant evolution, as well as any particular, sectorial, language is. Therefore, this work could not and does not pretend to be "the ultimate glossary". On the contrary, also because of the limits imposed by the composition of the authors' group (none of us is a professional linguist) and by time constraints, it may be incomplete.

We shall be extremely grateful to all the readers and users of this Glossary who may let us know their critical remarks and comments, and to suggest additions and/or modifications. The Glossary is submitted to the publisher in August 2003 to be included amongst the final printed documents of E4, but it is planned to keep it continuously up-dated, on the E4 web site: http://www.unifi.ing.it/tne4.

Giuliano Augusti, Valeria Bricola, Günter Heitmann

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2. Glossary

ABET
Accreditation Board of Engineering and Technology (USA).

Ability (see also *Capacity*)
Ability, Capability, Capacity, and *Potential* all mean "power to do something".
Ability often implies skill (mathematical ability). *Capability* implies the possession of the required qualities (the capability of a good engineer to design energy-efficient solutions). *Capacity* suggests the power to receive or absorb (a capacity for learning languages). *Potential* applies to an inherent but untried power (a person with leadership potential).

Access to higher education
The process by which candidates apply and are considered for admission to a higher education study programme.

Accreditation
May refer to study programmes, institutions or prior learning.

> **Accreditation** of programmes
> The process by which a qualification, a course or a programme comes to be accepted by an external body to be a satisfactory quality and standard. Accreditation involves a periodic audit against published standards of the engineering education at the appropriate level. It is essentially a peer review process, undertaken by appropriately trained and independent panels comprising both engineering teachers and engineers from industry.
>
> *Note: when no third-party is involved, E4 recommends using the term "recognition" rather than "accreditation". Quality Assurance should not be identified with accreditation, but rather be a prerequisite of it.*
>
> **Accreditation** of institutions
> Accreditation is a formal, published statement regarding the quality of an educational institution, that provides some (but not necessarily only) accredited study programmes. It may also refer to a provider of non-formal study programmes.
>
> **Accreditation** of Prior Learning (APL)
> A process by which individuals can claim and gain credit toward qualifications based on demonstrated learning that has occurred at some time in the past.

Admission to higher education institutions and programmes
The process which allows qualified applicants entry to pursue higher education

studies at a given institution. Sometimes the admission process involves an entrance examination.

Assessment
The total range of written, oral and practical tests, as well as projects and portfolios, used to decide on the student's progress in the Course Unit, Module, or Study Programme. These measures may be mainly used by the students to assess their own progress (formative assessment) or by the University to judge whether the course unit or module has been completed satisfactorily against the learning outcomes of the unit or module.
Note: the term also refers to the process for establishing the educational quality of a higher education institution or programme.

> **Assessment** criteria
> Description of what the learner is expected to do, in order to demonstrate that a learning outcome has been achieved.
>
> Continuous **Assessment**
> Tests taken within the normal teaching period as part of an annual or the final assessment.
>
> Self **Assessment**
> Process of appraising your own skills, knowledge, attitudes etc. (e.g. your contribution to an annual appraisal).

Attitude
The way a person regards something or tends to behave towards it, often in an evaluative way.

Awarding body
A body issuing certificates or diplomas, which formally recognise the achievements of an individual, following an assessment procedure.

Bachelor (see also *Degree*)
Usual term for *First Cycle Degree* (FDC) awarded after successful completion of a First Cycle Study Programme. Often used with extension to indicate a discipline or a specific profile of the course (Bachelor of Arts (B.A.), Bachelor of Science (B.Sc.), Bachelor of Engineering (B.Eng.), etc.). (For a peculiar use in German, see Annex 2-DE).
Note: in some Countries (e.g. USA) it is also used as an academic qualification at lower level than FCD.

Benchmark
Reference point or standard against which progress or achievements may be compared.

BEST
Board of European Students of Technology.

Bologna Declaration
An Agreement of 29 Countries, signed in Bologna in June 1999 by their Ministers of Education, to establish a “European Higher Education Area” and adapt the national education systems to a common “European Higher Education System” by 2010.
Note: it covers all disciplines.

Bologna process
Term often used to refer to the process of *convergence* (see) of the European systems of higher education, in accord with a series of Declarations of Higher Education Ministers (Paris, 1998; Bologna, 1999; Prague, 2001; Berlin 2003).

Branch of study (see also *Discipline, Field, Specialty*)
Specialisation within a given field of study (e.g. Mechanical Engineering, Electrical Engineering). It can also refer to a specialisation within a broader branch (e.g. Hydraulic Engineering, within Civil Engineering).

Capability (see *Ability*)

Capacity (see also *Ability*)
The ability of individuals and organisations or organisational units to perform functions effectively and efficiently over the long-term.

Certificate
The official document stating the completion of studies meeting specific requirements. Note: in the UK it is also used at sub-degree level, e.g., ‘Certificate in Work Study’.

Certification
The process by which a recognition is granted to persons meeting pre-determined standards.

Certification of competences
The process of formally validating knowledge, know-how and/or competences acquired by an individual following a standardised assessment procedure. It may result in the issuing of certificates or diplomas by an authorised awarding body.

CESAEER
Conference of European Schools for Advanced Engineering Education and Research.

Class
Group of students following a course for a determined period of time (usually a term, semester or academic year). Sometimes used as a special type of teaching activity (e.g. Sub-group, Laboratory). (For a peculiar use in Italian, see Annex 2-IT, *Classe*).

Competence
A wide concept which embodies the ability of an individual to transfer skills and knowledge to specific situations.
Note: the term can also refer to organisations.

Competence list (see *Profile*)

Core **competence** (see also *Core Skills*)
The basic, fundamental competence of an individual, with regards to specific demands.

Contact hour
A time-tabled period involving teaching staff and students, part of a formal study programme.

Continuing Education (see under *Education*)

Continuing Education Unit (see under *Education*)

Continuous Professional Development
The planned acquisition of knowledge, experience and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout an engineer's professional life (see also *Continuing Education*).

Convergence (see also *Harmonisation*)
Policy aimed at making national systems gradually more similar to each other (this is e.g. the aim of the *Bologna Process* (see) with reference to the higher education systems within Europe).

Course
It may refer to a complete study programme or to a single component (such as *Unit* or *Module*) of a study programme.

Elective **Course**
A course unit chosen from a predetermined list.

Intensive **Course**
A short course usually of one to four weeks concentrating on a particular topic.

Internet **Course** (see also *Distance Education*)
A course that is fully or largely communicated through the Internet. The course provider often has a web page with relevant course information.
Course Unit
The basic division of a study programme usually consisting of a self-contained, formally structured learning experience with a coherent and explicit set of learning outcomes and assessment criteria.

Course Module
A course unit or a sub-division of a course unit.

Creativity
The *ability* to produce new ideas or connections. Creativity underpins (but is not the same as) *innovation* (see).

Credit (see also *ECTS*)
The "currency" used to measure student workload in terms of the notional learning time required to achieve specified learning outcomes. To each course unit a certain amount of credits are assigned. A credit system facilitates the measurement and comparison of learning outcomes achieved in the context of different qualifications, programmes of study and learning environments.

Credit accumulation
In a credit accumulation system the achieved learning outcomes must total a specified number of credits order to successfully complete a term, an academic year or a full study programme. Credits are awarded and accumulated if the achievement of the required learning outcomes is proved by assessment.

Credit transfer
The acceptance of credits obtained for one purpose, to be used as credits towards another purpose in the same or another institution.

Curriculum (see also *Study Programme*)
Comprehensive description of a study programme. It includes learning objectives or intended outcomes, contents, assessments procedures.

Core **Curriculum**
Basic part of curriculum with regard to each engineering branch.

Cycle (see also *Degree*)
A study programme leading, if successfully completed, to an academic degree. One of the objectives indicated in the Bologna Declaration is the "adoption of a system based on two main cycles, undergraduate and graduate". Doctoral studies are generally referred to as the third cycle.

Degree
Qualification awarded to an individual by a recognised higher education institution after successful completion of a prescribed study programme. In a credit accumulation system the programme is completed through the accumulation of a specified number of credits awarded for the achievement of a specific set of learning outcomes.

First Cycle **Degree**
According to the Bologna Declaration, it is a qualification awarded after the successful completion of first cycle studies which last a minimum of three years of full time studies.
(See Annex 1)

Second Cycle **Degree**
A qualification awarded after the successful completion of second cycle studies.
(See Annex 1)

Third Cycle **Degree**
A qualification awarded after the successful completion of third cycle studies.
(See Annex 1)

Double **degree**
A degree is defined "Double degree" when there are two or more Higher Education Institutions each awarding its own degree to the student who fulfilled the prescribed requirements. In the USA, sometimes used for *Dual degree* (see).

Joint **degree**
Single document jointly issued by all H.E. Institutions involved (in addition or not to the degree of one of the Institutions).
Note: sometimes people include double degrees in the category of joint degrees: this can create many misunderstandings, not only among the students.

Dual **degree**
Degree in two disciplines (or two branches).

Diplom-Ingenieur [Dipl.-Ing.] (see Annex 2-DE)

Diplom-Ingenieur Univ. [Dipl.-Ing.Univ.] (see Annex 2-DE)

Diplom-Ingenieur (FH) [Dipl.-Ing. (FH)] (see Annex 2-DE)

Diploma
A document stating that a student has earned a qualification from an educational institution. May refer to any qualification or award (from high school, college, university, etc.) but in some countries it characterises specific awards or titles. (See Annex 2)

Diploma supplement
An annex to the original qualification designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the holder of the qualification. It aims at improving the international transparency and the academic/professional recognition of qualifications.

Discipline
Word used with different connotations. Not recommended for use. Instead use *Field of study, Branch of study, Subject.*

Doctor
Usually, the holder of a title awarded after successful completion of a Doctorate Programme, sometimes characterised as Ph.D. (Doctor of Philosophy). When used without extension, the title usually refers to a Doctor of Medicine. The term “Doctor” is used also in higher and honorary titles: *Doctor honoris causa, Doctor of Science,* etc. (For a peculiar use in Italian, see Annex 2-IT).

Doctorate
A study programme leading towards a high level qualification recognised as qualifying someone for research and/or academic work. It will include a substantial amount of original work presented in a thesis. In the European Higher Education System it is generally identified with the third cycle study.

Doktor-Ingenieur [Dr.-Ing.] (see Annex 2-DE)

Dottorato di ricerca, Dottore di ricerca (see Annex 2-IT)

E4 – Enhancing Engineering Education in Europe
A *Thematic Network Project* (see www.ing.unifi.it/tne4) operative in 2000-2004.

ECTS (see also *Credit*)
Acronym for *European Credit Transfer System*, developed by the European Commission in order to increase the transparency of educational systems and facilitate the mobility of students across Europe through credit transfer. It is based on the general assumption that the global workload of an academic year of study is equal to 60 credits.

Education (see also *Training*)
The act, process or art of imparting knowledge, understanding, skills and attitudes normally given by formal education providers like schools, colleges, universities, or other educational institutes. Education may be general or related to specific fields (e.g. Engineering education).

Continuing **Education**
Any form of education, vocational or general, resumed after an interval following initial education. (It may include, for example, education for full-time mature students, liberal adult education, part-time degrees and diplomas, post-experience professional education and training courses, staff development, open-access courses and regional development through open and distance learning).

Continuing Education Unit
Measure originating in the USA and designed to provide a record of an individual's continuing education (non-academic credit) achievements (see also *Credit*): it is usually considered the equivalent of ten *contact hours* (see).

Distance **Education** (see also *Internet Courses*)
Instructional delivery that does not constrain the student to be physically present in the same location as the instructor. Historically, distance education meant correspondence study. Today, audio, video, and computer technologies are more common delivery modes.

Higher **Education**
All types of study programmes at the post secondary level which are recognised by the competent authorities as belonging to its higher education system.

Higher **Education** Institution
An establishment providing higher education. (See *Higher Education*)

Higher **Education** Programme. (See *Study Programme*)

European **Higher Education** Area: see under *European*

Employability
The capability an individual demonstrates, within the prevailing socio-economic circumstances, to find a job, keep it and update his occupational competencies.

Engineer
A person qualified by education, training and/or experience to practice the art and science of engineering. The qualifications leading to the title of "engineer", "professional engineer", etc. vary considerably from country to country (see also *Recognition*).

Entrance Examination (see *Admission*)

Equivalence
The recognition by an organisation/competent authority that a course unit, a study programme or degrees awarded by different institutions of higher education in the

same or different Countries are equivalent. When not considered complete, equivalence is often qualified as *substantial equivalence.*

Erasmus
A European programme included since 1994 under the umbrella of the wider Socrates programme. “Erasmus” started in the late ‘80s as “European Action Plan for the Mobility of University Students” and developed through several consecutive programmes, mainly – but not only – connected with students’ exchange.

ESOEPE
European Standing Observatory for Engineering Profession and Education.

EUCEET
European Civil Engineering Education and Training, a Thematic Network operative in 1998-2001.

EurIng
A title conferred by FEANI to an individual qualified to enter their register of Professional Engineers.

European Higher Education Area (EHEA) (see *Bologna Declaration)*

European Higher Education System (EHES) (see *Bologna Declaration)*

Evaluation
The process of examining and judging.

Examination (See also *Assessment*)
Normally formal written and/or oral tests taken during or after the end of a course unit. Other assessment methods are also in use.

Fachhochschule (see Annex 2-DE)

FEANI
European Federation of National Engineering Associations.

Fellowship (See *Scholarship*)

Field of study (See also *Branch of Study*)
The main subject area of a study programme (e.g. Engineering). Within a *field of study* there may be different *branches.*

Franchise
The situation where an institution agrees to authorise another institution (nationally or internationally) to teach an approved programme whilst normally retaining overall control of content, delivery, assessment and quality assurance arrangements.

Grade (or **Mark)**
An evaluation in the form of a letter or number given to a student after an examination, test, paper, project, at the completion of a course unit in order to indicated the level of proficiency demonstrated by that student.

GPA
Grade Point Averaging scheme, used in some US universities.

Graduate or **Postgraduate studies**
A course of study following a first cycle degree and usually leading to a second cycle degree.

Grande Ecole (see Annex 2-FR)

Grant (See *Scholarship*)

Harmonisation (see also *Convergence*)
The process of increasing compatibility and comparability of educational systems and/or outcomes of similarly aimed study programmes.

H3E – Higher Engineering Education for Europe
Higher Engineering Education for Europe, a *Thematic Network Project* (see) operative in 1996-99.

Hochschule (see Annex 2-DE)

ICT teaching
Teaching/studying/learning making use of information and communication technology. Usually takes place in e-learning environments.

Independent Study
A learning activity run independently by the student outside the classroom (in library, at home, etc.). Sometimes referred to as “private study” or “individual study”.

Ingenieur (see Annex 2-DE)

Innovation
The successful implementation of creative ideas.

Integrative thinking
The ability to bring a variety of factors to bear simultaneously on complex problem-solving tasks.

Interactive Media
A facility that enables for a two-way interaction or exchange of information.
Internship (see *Placement*)

Know-how
A problem-solving capability based on experience (cf. *Understanding*).

Knowledge
An imprecise term in everyday use which embraces *factual knowledge*, sometimes used to refer to anything that has been learned.

Laboratory (in educational context)
Practical class where the students perform tests or experiments and are supervised by a staff member and/or assistants.

Laurea (see Annex 2-IT)

Laurea specialistica (see Annex 2-IT)

Learning
The process whereby individuals acquire knowledge, skills and attitudes through experience, reflection, study education and/or instruction.

> **Learning** agreement
> Document required for the mobility of Erasmus students. It is concluded between the three parties involved (sending institution, hosting institution and student) and specifies the task assigned to the student for his/her study period abroad.
>
> Contextual **Learning**
> Contextual learning is learning beyond the classroom. With hands on experience, it stresses the development of authentic problem-solving skills and is designed to blend teaching methods, content, situation, and timing (see also *Non-formal Learning*).
>
> **Distance Learning** (see also *Distance Education*)
> Any form of learning in which the teachers and students are not in the same place.
>
> Formal **Learning**
> Learning typically provided by an education or training institution, structured (in terms of learning objectives, learning time or learning support) and usually leading to certification.

Informal **Learning**
Learning resulting from daily life activities related to work, family or leisure. It is not structured (in terms of learning objectives, learning time or learning support) and does not lead to certification.

Non-formal **Learning**
Learning which is embedded in planned activities that are not explicitly designated as learning, but which contain an important learning element (see also *Contextual Learning*)

Learning Objectives
The specific knowledge, skills and/or abilities that students are expected to learn.

Learning Outcomes
The specific knowledge, skills and/or abilities gained by the successful completion of a unit or whole programme of study.

Lifelong Learning
All learning activity undertaken throughout life, with the aim of improving knowledge, skills and competence, within a personal, civic, social and/or employment-related perspective.

On Site **Learning**
See *Internship, Stage, Placement*

Open **Learning** System (see also *Distance learning*)
Aims at increasing educational or training opportunities especially for those excluded from traditional systems through educational, administrative, social or psychological reasons. It includes flexibility in order to improve accessibility. Often indicated by the expression "ODL – Open and Distance Learning".

Problem Based **Learning (PBL)**
Learning stimulated and directed by solving small scale, predominantly teacher determined problems with specified learning objectives usually within a certain subject or course, preferably performed by groups of students. The problem solving process requires the problem related acquisition of knowledge and skills and is in general not the application of previously acquired knowledge based on traditional courses.

Project Oriented **Learning (POL)**
Learning taking place through working in groups of students on complex problems, often real-life or research related, usually encompassing a range of (partly open-ended) problems and requiring system approaches and the integration of contents and methods of different subject areas or even disciplines.

Lecture
Theory (basic concepts or facts) or examples presented by a lecturer to an entire class of students. Typical length of a lecture is one hour.

Level
A threshold standard of achievement within a hierarchy of levels, e.g. within a qualifications framework.

> **Level** descriptors
> Specifications of generic standards or intended learning outcomes with regard to a certain level in a qualifications framework or a multi-tier educational system.

Lycée (see Annex 2-FR)

Master
Usual term for *second cycle degree* (see *degree*); it can be characterized as Master of Arts (M.A.), Master of Science (M.Sc.), Master of Engineering (M.Eng.), etc. (For its special meaning in Italian and in German, see Annex 2-IT and Annex 2-DE).

Mark (see *Grade*)

Mobility
The ability and possibility of an individual to move – and to adapt – to new environments.

Multimedia
A general term that refers to the presentation of information by integrating a variety of methods of delivery, e.g. text, video, audio, still images and graphics.

Notional Learning Time
The number of hours an average student will take to achieve specified learning outcomes and gain credits.

Open and Distance Learning (see *Distance Learning* and *Open Learning System*)

Outcomes (see *Learning Assessment*)

Parchment
The official credential or scroll testifying the attainment of a qualification.

Peer Review
External review and evaluation of the quality and effectiveness of an institution's academic programs, staffing and structure, carried out by a team of external evaluators

("peers") who are specialists in the fields reviewed and knowledgeable about higher education in general. Reviews may be based on self-evaluation (see) and on site visits (see) and refer to standards set by the accrediting organisations or on quality standards set more broadly.

Placement
A planned period of learning normally outside the institution at which the student is enrolled, where the intended learning outcomes are an integral part of his/her programme. Sometimes referred to as *Internship* or *stage*.

> **Placement staff**
> A person or persons designated by the institution to arrange and/or approve placements and support students during the placement period.
>
> **Placement provider**
> Persons, partnerships, companies, institutions and organisations providing opportunities for placement.
>
> **Placement supervisor/mentor**
> A person, designated by the placement provider, who is responsible for the supervision of the student while on placement.

Politecnico (see Annex 2-IT)

Polytechnic (see Annex 2-UK)

Potential (see *Ability*)

Prerequisites
Any prior conditions or specific courses that must be fulfilled before access to another programme or part of programme.

Profession
An activity, access to which, the practice of which, or one of the modes of pursuit is subject, directly or indirectly, to legislative, regulatory or administrative provisions concerning possession of specific higher education (and possibly training) requirements.

> Regulated **Profession**
> A profession which is subject to rules set by national legislation.
>
> *De facto/De jure* **Professional Recognition** see under *Recognition*

Profile
List of attributes for specific competencies.

Study Programme
A study programme refers to a set of course units or modules to be taken in order to acquire a specific set of credits.

Convergence of **programmes** (see also *Harmonisation*)
Increasing similarity between the final outcomes of courses, even if the processes of achieving these outcomes differ (see *Bologna Declaration*).

Intensive **Programme** (see *Intensive Course*)

Full Time **Study Programme**
Programme that can be completed in the minimum stipulated time.

Part Time **Study Programme**
Programme that is planned to be completed in a longer period than the stipulated one.

Project
In general, a set of planned, interrelated activities aimed at achieving defined objectives. In Engineering education it may also be a study task developed by one or more students.

Qualification
A generic term that usually refers to an award granted for the successful completion of a study programme, in accordance with the standard set by an institution of education in a particular field of study.

Higher Education **Qualification**
Any degree, diploma or other certificate issued by a competent authority attesting the successful completion of a higher education programme.

Qualification giving access to higher education
A certificate issued by a competent authority attesting the successful completion of an education programme giving the holder the right to be considered for admission to higher education.

Professional **Qualification**
The set of requirements necessary for access to a profession, especially a regulated profession.

Quality in higher education
The extent to which a course, the teaching activities and the provider's facilities help students achieve worthwhile learning goals.

Quality Assessment (QA) (see also *Accreditation*)
Process usually carried out by an external body. QA assesses the performance of a Higher Education Unit against written objectives that might be determined solely by the Higher Education Unit or by agreement between it and the Assessing Authority.

Quality assurance
The process by which an institution maintains the quality of its provision by planned and systematic actions.

Recognition
The provision by which a body or institution (the recogniser) considers another body or institution (the recognised) appropriate or competent for a certain purpose.

Academic **Recognition**
A formal acknowledgement, by a competent authority or a higher education institution, of academic qualifications as an indication of the capabilities obtained in a study programme or part of it. Such recognition may refer to an individual or be included in a recognition agreement between education institutions or authorities. Usually this is sought as a basis for access to further studies (cumulative recognition) or as a recognition allowing some exemptions in a programme offered by the host institution (recognition by substitution, such as in *ECTS* (see)).

Competent **Recognition Authority**
A body officially charged with making binding decisions on the recognition of qualifications.

Professional **Recognition**
A distinction can be drawn between *De facto Professional Recognition* and *De jure Professional Recognition* (see below).

De facto **Professional Recognition** (cf. *de jure Professional Recognition*)
Refers to situations where the profession is not regulated. In that case, after the completion of a study program, Engineers may be recognised on the basis of their academic degree.

De jure **Professional Recognition** (cf. *de facto Professional Recognition*).
A formal acknowledgement by a competent authority of the professional qualifications and/or capabilities of individual applicants to practice their profession at a specified level of responsibility. It refers to the *right* to practice and the professional status accorded to a holder of a qualification.

Sandwich Course
A study programme when periods at the university are alternated with periods in industry.

Scholarship (**Fellowship**, **Grant**, **Studentship**)
Financial support provided to a student to cover, in total or in part, fees and/or living expenses. It may come from national governments, charitable foundations or private sectors.

SEFI – Société Européenne pour la Formations des Ingénieurs
European Society for Engineering Education.

Self-evaluation
The review and evaluation by an Institution of the quality and effectiveness of its own academic programs, staffing and structure, based on standards set by an outside quality assurance body, carried out by the institution itself. Self-evaluations usually are undertaken in preparation for a quality assurance site visit by an outside team of specialists. Results in a self-evaluation report (see *Peer Review*).

Self-study material
Instructional materials used for study with little or no teacher involvement. These can include books, videotapes, computer softwares, etc.

Semester
Half an academic year.

Seminar
Didactic activity in which the teacher and/or the students select and discuss a particular topic or subject.

Site visit
Evaluation by a team of peer reviewers who examine the institution's self-evaluation, usually including interview with faculty, students and staff; and examine the structure and its academic performance.

Skill
The ability to carry out a task properly, correctly and/or efficiently. An organised and co-ordinated pattern of mental and/or physical activity in relation to an object, person, event or display of information. Skills may be described as perceptual, motor, manual, intellectual, social, etc., according to the context or the most important aspect of the skill pattern.

Core **skills**
Those skills which are needed in a wide range of tasks and which are essential for a successful performance in those tasks.

Measurable **skills**
The skills for which there are clear performance criteria.

Transferable **skills**
Skills which can be used in different work and learning environments, in other words, which can be transferred from one situation to another.

SOCRATES
European Commission programmes on Education, started in 1994.

Specialty (see also *Branch)*
Can be used as a synonym for *Branch* with particular reference to "new" branches.

Stage (see *Placement*)

Student
A person officially enrolled in a part-time or full-time study programme.

Studentship (see *Scholarship*)

Subject
A taught course, sometimes used instead of *Course Unit.*

Substantial equivalence (see under *Equivalence)*

Syllabus (cf. *Curriculum*)
List of topics (content) of a *Course Unit.* In the USA it is also used for the content of a *Study Programme.*

Technische Hochschule (see Annex 2-DE)

Technische Universität (see Annex 2-DE)

Term
A part of an academic year (usually a third).

Thematic Network Projects
A co-operation between departments of higher education institutions and other partners (e.g. academic organisations or professional bodies). The main aim of these programmes is to enhance quality and to define and develop a European dimension within a given academic discipline or study area. Alternatively, they can investigate a topic of an inter- or multidisciplinary nature, or other matters of common interest. Co-operation within Thematic Networks is expected to lead to outcomes which will have a lasting and widespread impact on universities across Europe in the field concerned.

Thesis
A formally presented written report, based on independent work, which is required for the award of a degree (generally a second cycle degree). In the case of a doctorate it must contain elements of original research.

Training
Systematic instruction and programs of activities and learning for the purpose of acquiring skills for particular jobs. It is worth emphasising the importance of integrating education and training and that there is no clear dividing line between the two (see also *Education*).

Transcript
The official record or breakdown of a student's progress and achievements. Many modular credit-based education systems employ detailed transcripts that show the individual grades for units undertaken.

Transferability
Condition that favours the recognition of vocational or academic degrees and study credits in situations other that those in which they are originally awarded, including the recognition of credits and studies by different educational institutions.

Transparency
The public visibility necessary to identify and compare the value of qualifications and procedures at sector, regional, national and international levels.

Tuning
Tuning Educational Structures in Europe, a European Union financed project operative in 2000-2002.

Tutorial
Didactical activity with a relatively small number of students per staff member, often involving problem solving. Students are expected to take an active part.

Undergraduate studies
A course of study leading to a first cycle degree. (See Annex 1)

Understanding (cf. *Know-how*)
The capacity to use scientific concepts creatively in problem-solving', for example in explaining new phenomena, designing new artefacts, diagnosing unfamiliar faults and determining how to correct them, asking searching questions, etc.

Università telematica (see Annex 2-IT)

Universität (see Annex 2-DE)

University
An institution officially recognised for the purpose of providing higher education.

University of Applied Sciences (see Annex 2-DE)

Virtual University
A university that caters to distance learners and has no physical classrooms.

Validation
May refer to a study programme or a process of informal/non-formal learning.

Validation of a study programme
The process by which an awarding institution judges that a programme of study leading to an award is of appropriate quality and standard. This can be a programme of its own or that of a linked or subordinate institution.

Validation of informal/non-formal learning
The process of assessing and recognising a wide range of skills and competencies which people develop through their lives and in different contexts, for example through education, work and leisure activities.

Vocational Education and Training
Education and Training which aims to equip people with employable skills and competences.

Web-based Education (see *Internet Course*)

Workload
The extent of time for all learning activities required for the achievement of specified learning outcomes.

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3. Main sources

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Annexes

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Annex 1: European Higher Education Area (EHEA) and alternatives

Educational systems are, in a special way, an expression of the cultural identity of each individual country. Despite many common roots, this has led to pronounced structural differences in Europe.

In order to improve the mutual recognition of university programmes and degrees, Ministers of Education from 29 European countries signed in June 1999 the so called "Bologna Declaration" whereby they committed to establish the European Area of Higher Education and to promote the European System of Higher Education. Among others the ministers affirmed their engagement in co-ordinating the national policies to reach in the short term, and in any case within the first decade of the third millennium, the following objective:

"Adoption of a system essentially based on two main cycles, undergraduate and graduate. Access to the second cycle shall require successful completion of first cycle studies, lasting a minimum of three years. The degree awarded after the first cycle shall also be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree as in many European countries".

A higher education system can be organised in several different ways (Fig. 1).

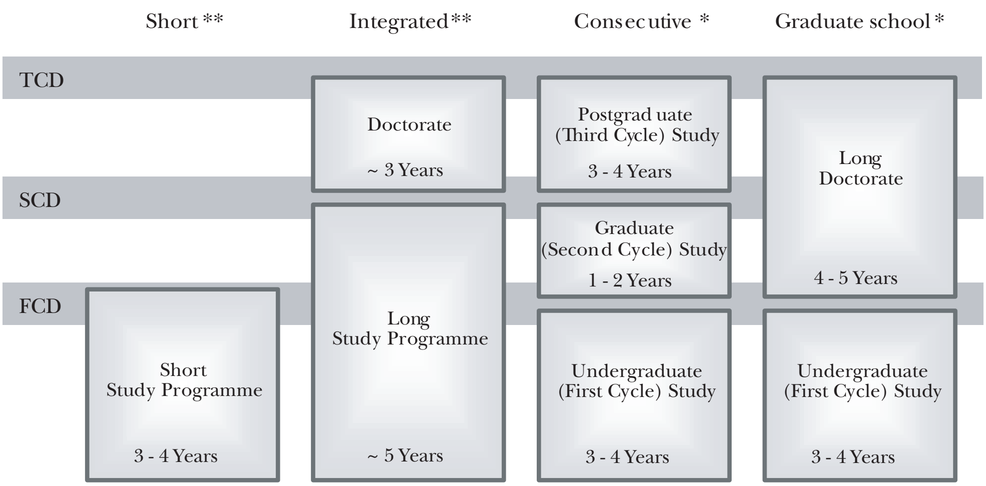

Fig. 1 Typical options for Higher Education Systems
*** Options compatible with the Bologna declaration**
**** Tradizional in continental Europe**

The **consecutive** system consists of three subsequent study programmes leading to three consecutive degrees with different degree levels:

- First Cycle Study (undergraduate study), leading to **First Cycle Degree (FCD)**
- Second Cycle Study (graduate study), leading to **Second Cycle Degree (SCD)**
- Third Cycle Study (postgraduate study), leading to **Third Cycle Degree (TCD)**

It is to be expected that the European Higher Education System will essentially have this structure.
Other alternatives exist and are also shown in Fig. 1. Some institutions of higher education offer only "**short**" study programmes (undergraduate study) leading to a FCD level. Other combine the first two cycles (undergraduate and graduate study) in one **integrated** "long" study program leading to a SCD level. **Graduate school** combines the second and third cycle (graduate and doctorate study) into a "long doctorate" programme leading to a TCD level.
It appears clearly, that a "first degree" in one system (e.g. the degree of an integrated long study) may correspond to a "second degree" in another system (e.g. the degree of a fully consecutive graduate study). In order to avoid such confusion the definition and use of the terms "first cycle degree" (FCD), "second cycle degree" (SCD) and "third cycle degree" (TCD) is suggested in this Glossary. Such terminology facilitates the comparison of degree levels between different programmes and different national higher education systems, at least in terms of time spent.

Annex 2: Terms used in Germany

FOREWORD:

Engineering education in Germany takes place at two types of universities:

- FH – Fachhochschule (University of Applied Sciences)
- **U**– Universität & Technische Universität, Technische Hochschule
  (Research oriented University)

The new EHES (see Annex 1) and the Bologna process was implemented in German legislation in 1998. Since then German universities offer both the traditional study programmes as well as the new EHES study programmes leading to advanced (honours) degrees with different EHES degree levels:

EHES Degree level	Degree	University type	Study duration	Programme Type
FCD	Diplom-Ingenieur	FH	4 years	Short traditional
FCD	Bachelor	FH / U	3 - 4 years	New EHES
SCD	Diplom-Ingenieur	U	5 years	Long traditional
SCD	Master	FH / U	1 - 2 years	New EHES
TCD	Doktor-Ingenieur	U	~ 4 years	Traditional

LIST OF TERMS (in alphabetical order):

Bachelor
New EHES FCD from German *Hochschule*, usually spelled as Bachelor of Science (B.Sc.) or Bachelor of Engineering (B.Eng.).

Diplom-Ingenieur [Dipl.-Ing.]
- Traditional SCD degree in Engineering from *Universität, Technische Universität, Technische Hochschule.*
- Traditional FCD degree in Engineering from *Fachhochschule* (in some federal states of Germany).

Diplom-Ingenieur Univ. [Dipl.-Ing.Univ.]
Traditional SCD degree in Engineering from *Universität, Technische Universität* in Bavaria (a federal state of Germany).

Diplom-Ingenieur (FH) [Dipl.-Ing.(FH)]
Traditional FCD degree in Engineering from *Fachhochschule* (in some federal states of Germany).

Doktor-Ingenieur [Dr.-Ing.]
Traditional TCD degree in Engineering from *Universität, Technische Universität, Technische Hochschule.*

Fachhochschule
University of Applied Sciences with focus on education programmes in engineering, informatics, economy and social science.

Hochschule
University. General term for Institution of Higher Education (includes *Fachhochschule, Universität, Technische Universität, Technische Hochschule*).

Ingenieur
General professional title for a person who has been awarded a degree in engineering by a German *Hochschule.* Protected by law.

Master
New EHES SCD from German *Hochschule*, usually spelled as Master of Science (M.Sc.) or Master of Engineering (M.Eng.).

Technische Hochschule
Synonym for *Technische Universität.*

Technische Universität
Research oriented University with focus on education programmes in Engineering, informatics and natural science.

Universität
Research oriented University with wide range of education programmes including arts, humanities, low, science and (not necessarily) Engineering.

University of Applied Sciences
Synonym (official translation) for *Fachhochschule.*

Annex 3: Terms used in France
(partial)

Grande Ecole
A special type of higher education institution, mostly in engineering or management, with a very severe admission procedure.

Lycée
A type of upper secondary school. Some Lycées provide two-year programmes of basic science (*Biennie Propédeutique*) leading to the admission to a Grand Ecole.

Annex 4: Terms used in Italy
(partial)

Classe
A group of programmes and degrees in a specific branch (e.g. "classe di ingegneria industriale").

Dottore [Dott.]
The holder of any University degree (see *Laurea*).

Dottorato di ricerca, Dottore di ricerca
Third Cycle Study programme; the holder of the corresponding title.

Laurea
University degree. Up to 1999, it was awarded after a study programme of 4 to 6 nominal years (5 in engineering). According to the 1999 new University Law, it is the First Cycle Degree, awarded after 3 years of study.

Laurea specialistica
The Second Cycle Degree, awarded after two further years of study beyond the *laurea.*

Master
Differently from most other countries, in Italy, according to the 1999 University law, "Master" [sic] is a non-degree study programme on a specific subject, usually of no more than one-year full-time study, to which only degree holders are admitted.

Politecnico
Italian for Technical University.

Università telematica
Italian for Virtual University.

Annex 5: Terms used in the United Kingdom
(partial)

Polytechnic
An institution of higher technical education. Since the ‘90s, all Polytechnics have been transformed into Universities.

PART II

TUNING Educational Structures in Europe

Report of the Engineering Synergy Group

Final version (July 2002)

GIULIANO AUGUSTI, ANSELMO DEL MORAL,
ANDERS HAGSTRÖM, GÜNTER HEITMANN, FRANCESCO MAFFIOLI,
IACINT MANOLIU, BRIAN MULHALL, MATTI PURSULA,
REINHARDT SCHMIDT, VALERIA BRICOLA

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1. Introduction

1.1 Background

The European labour market is developing fast. At the same time the Bologna process is promoting fundamental changes in the Higher Education (HE) sector. The meeting of European education ministers in May 2001 in Prague has confirmed the intention of gradually arriving at a fair degree of convergence between the different educational systems in Europe by 2010 [1]. This implies the necessity of adapting curricula in terms of structures, contents, learning attributes, learning tools, assessment methods. The project "Tuning Educational Structures in Europe" (from now on Tuning for short) aims at "pooling together and capitalising on available experience and recent developments in several of the Member-states, particularly from previous and on-going European co-operation in the context of the Socrates programme."[2]

The Tuning project aimed initially at enabling European universities to conduct a joint debate on these issues in five areas: Mathematics, Geology, Business, History, and Educational Sciences. Many other synergy areas were soon identified on the basis of previously done and/or on-going work in the context of the ERASMUS Thematic Networks (TN) action, in particular when concerning the European Credit Transfer System (ECTS), quality assurance, definition of core curricula. Selected areas include Chemistry, Physics, Languages, Law, Medical Sciences and Engineering.

The Engineering Synergy Group (SG) of the Tuning project includes:

Giuliano Augusti	Università di Roma "La Sapienza"
Anselmo Del Moral	Universidad de Deusto, Bilbao
Anders Hagström	ETH Zürich
Günter Heitmann	TU Berlin
Francesco Maffioli	Politecnico di Milano (co-ordinator)
Iacint Manoliu	TU of Civil Engineering, Bucharest
Brian Mulhall	University of Surrey
Matti Pursula	Helsinki University of Technology
Reinhardt Schmidt	Università di Firenze
Valeria Bricola	European Society for Engineering Education (SEFI) (secretary)

The Engineering SG has been formed with the declared goal of taking advantage of the experience being obtained within the Thematic Network (TN) "Enhancing Engineering Education in Europe" (E4) (and of the experience gained within previous TN's in the field of Engineering Education such as H3E (Higher Engineering Education for Europe, 1996-99) and EUCEET (European Civil Engineering Education and Training, 1998-2001). This has implied some differences in methodology with respect to other areas of Tuning for arriving at recommendations, in particular the Engineering SG decided not to use the questionnaire approach of other Groups of Tuning, but rather to rely on recently done surveys of similar characteristics. The needs to respect the time schedule of Tuning as well as that of producing a report as much in line as possible with those of other areas are very well recognised by this SG. Another difference immediately apparent is the relatively small number of members of the Engineering SG, which may cast doubts on how representative it is of the European Engineering Education world. However it must be pointed out that GA, GH, AH, BM and MP are Promoters of the five Activities of E4 and that FM is its co-ordinator, whereas JM is the General Secretary of EUCEET. It is through these links to Thematic Networks in the engineering field that the representativeness of the Engineering SG is ensured together with the active role that engineering education societies such as SEFI and CESAER, and professional organisations such as FEANI, play within E4.

The background work done within these organisations has been very helpful, informing the work of the Tuning Engineering Synergy Group. SEFI and CESAER, together with CLUSTER, have also made their views known in a joint letter to the Ministers of Education emphasizing the need to take into account the specific aspects of higher engineering education when implementing the objectives of the Bologna Declaration.

It is a pleasure to acknowledge here the support that the Engineering Synergy Group of Tuning has received and which has made it possible to produce this report. These acknowledgements go first to all the Institutions of the members of the group for having allowed to use some of the time of the colleagues members of the group, then to the Directorate General for Education and Culture of the EC for having suggested the need of such a group and having hosted some of its meeting at its premises, and, last but not least, to the Thematic Network E4 (in the person of its President Prof. Claudio Borri) for having strongly supported this “side” effort of the Promoters of its five Activity Working Groups and for having accepted to consider as part of the E4 mission to allow Ms. Bricola to act as secretary of the Engineering Synergy Group.

1.2 Objectives of the Bologna Declaration

The main objectives of the Bologna Declaration are:

- Adoption of a common framework of readable and comparable degrees, “also with the implementation of the Diploma Supplement”;
- Adoption of a system of higher education based on two cycles, undergraduate or first cycle studies, lasting a minimum of 3 years and a maximum of 4, and postgraduate or second cycle studies following successful completion of first cycle studies and leading to a master and/or doctorate degree;
- Implementation of the European Credit Transfer System (ECTS);

- Elimination of obstacles to free movement of students and teachers;
- Inclusion of a European dimension to quality assurance in higher education.

The objective to promote the adoption of a two-cycle system of higher education is the one that poses the greatest challenge. The European Universities in March 2001 in Salamanca, accepting this challenge, endorsed the move towards a compatible qualifications framework and pointed out that "There is broad agreement that first degrees should require 180 to 240 ECTS points but need to be diverse leading to employment or mainly preparing for further postgraduate studies. Arriving at a good level of convergence in higher education in engineering may well be easier than in other fields, because of the fact that Engineering Education (EE) institutions have always been keen to respond to the requests coming from the labour market, nevertheless the diverse scenarios still existing in different countries [6] suggest the necessity of a long phase of gradual modification.

This enhances the importance of initiatives like Tuning aiming at identifying the instruments, which can help in this delicate phase. However the EE world resents the fact that technical universities and faculties are not properly represented in the Bologna process, which has lead to the specific needs of EE not being taken sufficiently into account. Hence a question of particular importance for EE would be to reconcile some of the contradictions between the general needs of higher education, as developed in the Bologna process, and the specific needs of technical education.

1.3 Objectives of this Report

The objectives of this report emerge quite clearly from its table of contents. After having summarised the European scenario in EE in chapter 2, some current important trends are surveyed in chapter 3, in chapter 4 the four lines of Tuning are considered as far as EE is concerned, chapter 5 presents briefly some consideration about the doctorate level in Europe. Chapter 6 is devoted to life-long learning issues. Based on this analysis a number of recommendations and tools for arriving at a certain degree of convergence within EE in Europe are presented in chapter 7.

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2. Engineering Education (EE) in Europe

2.1 Models

A description of engineering education in the European Union at the end of the 20th Century can be found in Chapter 1 of the "State-of-the-art" Report of Working Group 2 of H3E [7]. A striking similarity between the national systems is portrayed: with only a little simplification, it can be said that EE in Continental Europe followed two basic "models", often coexisting "in parallel" within each country.

The first model, to which we shall refer as "long cycle" engineering education, evolved in the 19th century from German and French schools. Its characteristics are, firstly, a strong theoretical base (which shows itself in the requirement for mathematical competence even at the entry stage) and, secondly, a strong research orientation (which shapes the syllabus and the form of teaching at the later stages: according to Von Humboldt, these links to research activity should be encouraged not only for innovation purposes, but also to let the universities be less influenced by political and industrial forces). This education takes place within an environment that is centred on the individual work of the student, rather than on highly structured classroom teaching. A consequence is that the duration of the course of studies is often not well defined or regulated, and even the structure may be very flexible – leading to the time to graduation being up to as much as twice the nominal 5 or 6 years. It may well be that it is the learning or discovering for oneself which makes the graduate fitted for a professional career where high level judgements have to be made independently.

As a result of the growing and changing needs of industry, in the early 1970's Germany, the Netherlands and some other countries developed "short-cycle" engineering diploma programs, of 3 to 4 years duration, usually provided by separate Institutions, such as the German Fachhochschulen. In the short-cycle courses the emphasis in the content is more practical, the course of study is more rigidly controlled, and there is often a stronger emphasis on formal teaching. The result is that the study period is usually quite close to the nominal 3 or 4 years. In addition, there is usually a requirement for periods of practical experience that are quite well defined both in content and in duration. "Short cycle" engineering education has since spread, in different forms, to most European countries. It may be worth noting that in the early 1990's it was introduced in Italy too, with the notable peculiarity that "short cycle" courses of studies (called "Diplomi Universitari") had to be provided by the same Institutions (the Universities) that provided "long cycle" education (Diplomi Universitari took off only to a very limited extent, and have been eliminated by the recent law introducing the so-called 3+2 system: see section 3.1).

Most current long-cycle courses of studies are not merely short-cycle programs followed by a suitable length of additional study, as is very clear from the rules governing transfer from one type of course of studies to the other. In going from “short” to “long” there is usually a requirement not only for the time to be made up, but also for additional time to be spent in taking care of the (supposed) deficiencies in basic knowledge. Thus, as a matter of fact, short- and long-cycle engineering courses of studies remain essentially in parallel, rather then forming a “two-tier” system, as envisaged in the Bologna Declaration, according to which the “short-cycle” courses of studies should lead to a complete qualification “relevant for the job market”, and be the entry point for “post-graduate” programs leading to advanced degrees.

There is however some evidence that, in many countries, the systems are evolving (often with a lot of resistance from the higher level institutions) to make the short-cycle Degree equivalent to the first stage of a long-cycle degree, in formal accord with the Bologna Declaration (see section 3.1). Despite this, it is to be expected and in our view desirable, that a great variety of scopes and goals will remain between the “short-cycle” courses of studies, some of them being more oriented towards being the first stage of a “long-cycle” course of studies, others towards really providing a self-contained practically oriented technical formation (see sections 2.1 and 3.2).

The Bachelors and Masters degrees of the “Anglo-Saxon” countries (UK and Ireland) do not fit this pattern as well as might be expected from the nomenclature. The Bachelors degrees, although like a short-cycle degree in length, often have an underlying theoretical content closer in concept, even if not in quantity, to that of the continental European long-cycle degrees. However, the course of study is quite rigidly controlled, and most students graduate within the nominal study duration. The picture is confused by the fact that there are also many short-cycle degrees, with the title Bachelor, which are closer in content to practically oriented short-cycle Diplomas of other European countries. There are also quite wide differences between universities in the style of teaching and learning; at one extreme the emphasis is on a learning environment, like in the continental European long-cycle courses of studies, whilst at the other the courses have a strong teaching focus.

2.2 Likely Requirements for European Employability

“Engineering is directed to developing, providing and maintaining infrastructures, goods and services for industry and the community.” (SARTOR, 3rd edition). Creative problem solving and designing technical artefacts is still perceived as the core of engineering, but the range of activities connected and identified with engineering is far bigger. Engineering as an academic discipline is continuously undergoing a process of rapid expansion and diversification currently significantly characterised by interdisciplinary approaches. Engineering as a profession has to deal with scientific and technological matters, but increasingly also with economical and political matters as well as with ethical, societal and environmental aspects. An engineer has to be educated and trained to work in permanently changing technological, social and working environments; he contributes to a great deal to these changes and must be prepared to take over different functions as an employee in industry or in the public services sector, as well as an entrepreneur, researcher, educator or politician. Education, practical training and professional development of engineers must therefore reflect these conditions and demands.

What makes a good engineer? A general profile for a good engineer in the Learning Society of the new millennium is built on the ability and willingness to learn, on solid knowledge of the basic natural sciences and on good knowledge of some field of technology. Other skills include general human values and the communication and leadership capacities needed in modern working life.

As an example of a list of skills, the following is given here [9]:

Ability and willingness to learn
Solid basic knowledge of the natural sciences
Basic engineering skills
Good knowledge of one's major technical discipline
Commitment to quality
Internationalisation oriented skills
Ability to work in teams
Good communication skills
Ability to lead and manage resources
Professional and ethical responsibility
Ability to deal with uncertainty and ambiguity

There are other, very similar lists, for example those of BEST (the Board of European Students of Technology), ABET (Accreditation Board of Engineering and Technology), and Finnish Academies of Technology. All these lists seem to have in common the fact, that an engineering graduate at Master level has to be able to continuously learn new approaches, theories and methods. Thus, she/he has to be prepared for lifelong learning. She/he has, of course, the knowledge of technology, but also needs to have good communication and team work skills. Technology alone is not enough in the present world. These lists lead to lists of required competencies (cf. Section 4.1) and, although different weights should be given to each "attribute", they are basically valid for either short-cycle and long-cycle engineers.

It is widely agreed that industry requires (and will continue to do so) a large number of engineers of both types, in many countries more of the "applied" (i.e. short-cycle) kind than of the other. This fact can be attributed to the rapid development and wide range of new technologies in modern industry. This development has created the need for professionals with the skills and knowledge needed to take advantage of the new technologies, both for current use in the manufacturing process, as well as for the development of new products. The growth in importance of enterprises in the service sector has also contributed to change the overall picture, giving a greater importance to, for instance, formation in Information and Communication Technologies (ICT) in both "short" and "long" cycles of EE. Further reasons for stimulating an updating of curricula are the growing relevance of basic financial/economic formation and, last but not least, the internationalisation aspects of formation, mainly the need for foreign language skill, but also cross-cultural competences, crucial for working in a wider European environment.

To reach full professional qualifications in three years is not possible. Therefore the focus in university education must lie in basic sciences and the basics of the field of engineering in question, thus making the student able to either learn more in the working life or continue in the university towards a master degree, that gives her/him a full spectrum of engineering skills.

Since a certain level of simplification helps in grasping the full picture, we can schematise and distinguish only a "long cycle" of nominally 5 years (often becoming 6 or 7) and a "short cycle" of 3-4 years, but remembering that it is only a rough approximation of reality. FEANI distinguishes also, in its *FEANI Index* and in the requirements for the professional designation "Eur Ing", between a professional (*theoretical*) degree and professional (*applied*) degree.

2.3 Issues at Entry Level

In many European countries a number of factors have contributed reducing the enrolment of students in EE. The main ones are (besides the effect of reduction in birth rate):

- The low level of interest in science and mathematics of secondary school students;
- The perception that engineering studies are more difficult than equally (or more) lucrative choices (such as business, accountancy, law, etc.);
- The negative opinion coming from stereotypes of bad working environment and/or impact on the environment.

The consequences of the above are very serious, not only for the engineering schools, but also for industry and by and large for the European economy.

Another issue is the difference implicit in the existence or not of a selective entrance examination. In this respect European institutions differ substantially, hence implying a quite different interpretation of, say, dropout rates in different countries. It is unlikely that this major factor of difference will change at the entry level of the first degree (Bachelors), whereas the need of an entry selection system to the second level (Masters) must be stressed.

2.4 International Agreements

The European Union has established a legal framework for the mutual recognition of professional qualifications. Directive 89/48/EEC of 21st December 1988 establishes a general system for the recognition of higher education diplomas awarded on completion of professional education and training of at least three years duration. This general system concerns all regulated professions that are not subject to a specific directive, including engineering. (Specific procedures have been established for certain professions, for example, the medical professions, architects, and lawyers). The directive is limited by its focus on regulated professions: for the engineering professions it only applies in nine out of eighteen states [12].

Some international agreements relevant to the engineering profession have been signed in recent years and have to be taken into account. Among these the most important are the followings.

- The *Washington Accord* requires the 8 signatories (national professional or accrediting organizations from Australia, Canada, Hong Kong, Ireland, New Zealand, South Africa, UK, USA) to give the same professional recognition to holders of engineering degrees obtained in any one of these countries. Japan in June 2001 applied for "provisional status" in the accord.

- The "*Trilateral Accord*" (for short) has been signed by the professional organisations of Italy, France and UK. This agreement will apply to registered engineers (of both "cycles") with four years post-qualification professional experience, allowing them to work as professional engineers in the language of the receiving country. Ireland is now negotiating its admission.

- The *Engineers Mobility Forum Agreement* establishes an International Register of Professional Engineers signed in South Africa in June 2001 by the 8 countries of the Washington Accord plus Japan, Korea and Malaysia. Expected to become operational in 2002.

- The agreement to establish a common Register of Engineers for the Asia-Pacific Economic Community (APEC), should initially cover Australia, New Zealand, Canada, Hong Kong, Japan, Korea, Malaysia, and in the near future be enlarged to Indonesia and Philippines (with some accord also with the USA).

- The "*Paris Agreement*" (September 2000) established the European Standing Observatory for the Engineering Profession and Education (ESOEPE), aimed at exchanging information on accreditation and recognition procedures and facilitating mutual recognition agreements. New members are being added to the initial signatories (institutions from France, Germany, Italy, Portugal, UK along with European associations).

- The *FEANI Register* was set up by FEANI in 1987 to facilitate movement of practising engineers and to establish a framework of mutual recognition and qualifications. Engineers who satisfy the FEANI requirements can apply for registration and receive the designation “Eur Ing”. The *FEANI Index* is an accompanying list of higher engineering institutions and programs, recognised by FEANI and its national members.

- The ECCE (European Council of Civil Engineers, an organisation created in 1985 and grouping professional civil engineering associations of 19 countries) decided in October 2000 to create and maintain a Register of European Civil Engineers. ECCE aims at ensuring that persons entered into this Register offer demonstrable level of academic achievement, professional skill, and continuing professional development.

- The Nordic countries (Denmark, Finland, Norway and Sweden) have had already for about forty years a common labour market, and the agreements include full recognition of academic degrees of other Nordic countries, including engineering.

Although these agreements are to be welcomed, because they facilitate the bottom-up internationalisation of the engineering formation and recognition, it can be noted they often overlap with each other. Therefore, care should be taken to see that too many “accords” do not result in “cacophony”.

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3. Current trends

3.1 Examples of Existing Initiatives [6]

In Germany, the existing EE programme structure is being complemented in many institutions, both at universities and fachhochschulen, by a “Bachelor”+”Master” structure. It is not yet decided if this structure will ever replace the old one.

In Italy, a rigid structure of degrees in series (the so called “3+2” structure) has been established by law for all university education: it is compulsory since academic year 2001-2002, but some engineering faculties (e.g. Politecnico di Milano) introduced it one or two years earlier. According to this law, which applies very formally the letter of the Bologna Declaration, all university students should obtain first a “Laurea” after a three-year course of study; only afterwards they may apply for two further years of study, leading to a “Laurea Specialistica”. Only disciplines for which there exist special European Community Directives (i.e. Medicine and Architecture – and consequently Architectural Engineering) are not obliged to follow this pattern.

Even if the French Minister of Education at the time was one of the very first signing of the Bologna Declaration (indeed even the preceding Sorbonne Declaration), French EE does not seem to try to adapt its complicated system to the Bologna model. This is particularly true in the case of the Grandes Ecoles, for which the introduction of an intermediate degree at the Bac+3 level, would appear to be purely “cosmetic”, having little relevance to the European labour market as an appropriate level of professional qualification.

In the Netherlands, for the three Dutch technical universities (Delft, Eindhoven and Twente) the adoption of the 3+2 structure looks purely formal, with a Bachelor degree relevant to mobility, but again not to the labour market.

In the Czech Republic a two-tier system is being introduced with a 4+1.5 structure. It will be implemented starting with the academic year 2003-2004. The short-cycle 4-years programmes that used to exist in parallel with the long-cycle ones will cease to exist.

In Romania a two-tier system (4+2) seems acceptable to fields such as electrical, electronics, and automation engineering, but not to civil engineering faculties, still favouring the parallel offer of a long and a short cycle curriculum. This attitude appears to be widely spread in Europe and grounded on real differences perceived to exist between the civil engineering profession and the others.

A 3-year Bachelor degree without professional ambitions is being introduced as a facilitator of student’s mobility in many European schools. It must be emphasised, however, that this is not fully in line with the objectives of the Bologna Declaration.

3.2 Diversity within the Two-Tier Systems

The Bologna Declaration recommends a two-tier structure of undergraduate and post-graduate studies as a common reference structure for the "European Area of Higher Education", applicable to most of the disciplines and subject areas. The recommended sequenced structure challenges mainly those higher education systems in Europe, which are constituted by binary or other parallel structures, prevalent in most countries of continental Europe. They tend to offer programmes of study with different profiles and length of study, often delivered by different, also non-university institutions, but usually focused on only one type of degree after three, four, five, sometimes even six years of study. In other words, there was or is no second cycle or post-graduate education. Respective contents of an elsewhere post-graduate education are already integrated in a first-degree programme. Qualifications achieved, even at the level of the first and only degree, range from Bachelor to Master levels and often raise problems of comparability when related to the so-called Anglo-American system of higher education.

Strongly professionally oriented disciplines like engineering are characterized by a great diversity of profiles and degrees – even within a single country. In the parallel degree structures of continental Europe all these programmes and degrees in engineering claim to provide a professional education and award the title of engineer. Degree holders can thus work as professional engineers without any additional training or registration immediately after the first degree, at least in the country where the degree was obtained.

In the traditional two-tier Bachelor/Master systems of the UK and Ireland employability is an aim also for engineering Bachelors after minimum 3 years of study, but to become a professional engineer with the respective title (Chartered Engineer or Incorporated Engineer) some years of Initial Professional Development (IPD) on top of a Bachelor or a Master degree are required before registration with one of the Engineering Institutions. In some contradiction to the two-tier reference structure of the Bologna Declaration the UK recently implemented integrated 4-years programmes in engineering leading directly to a Master of Engineering degree (MEng) with no Bachelor degree in between. This degree is now the compulsory minimum requirement and initial phase for the registration as a Chartered Engineer (CEng). The ordinary 3-year Bachelor degree is now a prerequisite for the registration as Incorporate Engineer (IEng). At the same time the USA continues to base its engineering education and professional licensing mainly on 4-year Bachelor degrees. The difference in the length of the courses of studies arose in large part from differences in the secondary school systems.

For the creation of a European Area of Higher Engineering Education it is therefore a crucial question whether the existing diversity should be replaced by a common and strictly consecutive system of Bachelors and Masters degrees or whether another structure, e.g. a multi-level and multi-profile systems with a high degree of transparency, flexibility and mutual recognition would be more suitable. Whereas Italy already in all areas of higher education started to implement the two-tier 3+2 system, many other countries have started either to introduce Bachelor/Master programmes as complementary offers to the existing traditional degree programmes or to integrate additional degree levels into their existing systems and programmes. These strategies also include keeping existing long-cycle research-based university programmes leading directly to a Master degree as an option among others.

Tuning Higher Education in Engineering should therefore be more focused on defining adequate and comparable profiles and competence levels, on modularisation and a qualified system of transferable credit points, on output standards and assessment, than on the implementation of a rigid two-tier system. However, the advantages of a flexible system of undergraduate and post-graduate programmes have to be taken into account. With regard to the first cycle the central question will be what kind of undergraduate education will be needed to guarantee employability, professional standards and quality, a basis for post-graduate specialisation and life long learning, flexible profiling to satisfy different demands and students abilities and, last but not least, trans-national recognition and mobility.

3.3 Importance of Learning to Learn

As technology continues to develop at an increasing pace, certain "lifelong learning skills" are a prerequisite for every professional engineer. The must is to be fully effective "adult learners" able, fluently and without external direction, to:

- audit and assess what they already know and can do
- work out, at a level of detail that will differ from individual to individual, a career and a learning development plan
- integrate, into their learning, acknowledgement of their need for continuing *personal* development in the private as well as the professional realms
- understand the qualities of different kinds of knowing, of understanding, of skills, personality traits and attitudes; how these different aspects of competence interrelate and reinforce each other
- reflect upon their experience, establishing links between different kinds of knowledge, and formulating relevant theoretical constructs to explain it
- conduct research into elements of professional practice and competence that lie within the context of their work, in pursuit of solutions to "problems of the day", personal professional development, and (more generally) the development of their profession.

In short, the adult learner knows *how to learn.* (A summary of some interesting theories about what is "learning" can be found in the Appendix).

First-degree education should equip every graduating engineer with the foundations of these important life skills. It should be a goal of every professional's own lifelong learning to develop the full portfolio. By implication, it should be a goal of the engineering education system – including, in their various roles universities, trades unions, professional institutions, employers and government agencies – to teach the necessary skills and to facilitate individuals through the process, throughout their working lives. These same institutions should continue to support and encourage individuals to continue their learning in professional practice, though here the emphasis should primarily be on achieving learning from every opportunity that arises, rather than through attendance at formal courses.

3.4 Trans-national Employability

Barriers to trans-national employability fall into two categories. On the one hand, the regulation of professions will demand that those practising the profession can demonstrate their competence, at least in a legal sense, by having the appropriate qualifications. The qualifications required usually include an academic degree, but may well include other certification. The legal framework varies quite widely throughout Europe, and also varies widely by industry. In general the Civil Engineering and Construction industries are the most strongly regulated, and Electronic Engineering the least. The European Union provides a general framework for trans-national recognition of professional qualifications. In principle a qualification gained in one country of the European Union (see also section 2.5) must be recognised in any other. Each country has a national authority the function of which is to manage and ensure this. An achievement of H3E, continued with the support of E4, was to promote the establishment of ESOEPE (the European Standing Observatory on the Engineering Profession and Education). Formally this body may not be needed, but it is already clear that far more exchange of information is required, both to make recognition easier within the current arrangements and to facilitate the evolution of new ways of expressing qualifications which will be more transparent.

Outside the legal framework the barriers to employability will be twofold. On the one hand, employers may have difficulty in recognising exactly what a particular qualification means, and in making an adequate comparison with those of their home country. On the other hand, there are many impediments to employees moving away form their home country.

It is possible that in the future the new two-tier education system recommended by the Bologna Declaration makes the difference between a Bachelor from a polytechnic and a Bachelor from an engineering university hard to understand in the labour market. Therefore the definition of goals of the education is extremely important.

The latter, the barriers from the point of view of the employees, are largely outside the scope of the educational system. What education can provide, through internationally oriented elements of the degree programmes are a stronger awareness of the opportunities abroad and a better capacity to adapt to living abroad, along with instilling the students with an open and flexible attitude to the world at large. Education can also (and usually does, apart from the English-speaking countries) give the linguistic capability for moving abroad.

On the employers side, there are, broadly, two categories of companies: firstly, those, which employ only one or two Professional Engineers, and a commensurate number of other technical staff, and, secondly, the rest. The rest here are usually large companies, where there is a Personnel Department. These larger companies appear to have little difficulty in recruiting staff with a plethora of qualifications; this is probably true even where new graduates are concerned, and much more true when considering applications from more experienced staff. The very small companies are thought to have more difficulty, but such companies are also less oriented to recruiting from a wide area. A further point concerns technicians and technician engineers. Here there seems to be less mobility and greater impediments. However, this aspect is outside the remit of this report.

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4. The Four Lines of the Tuning Project

4.1 Line 1: Learning Outcomes

The demands on Engineering Education have seen remarkable changes during the past twenty years for a number of different reasons:

- The demand for more graduates in engineering resulted also in changing qualitative demands leading to a diversification of profiles because of different functions of engineers. Simplifying it can be said that first the demand for application oriented graduates increased, followed by a demand for engineers with an economical and management background.
- Technological development has led to a demand for competencies in new specialities like computer science, mechatronics, micro-technologies, bio-engineering as well as for system-oriented, often interdisciplinary, design abilities, taking ecological and ethical dimensions into account.
- Changes in organisation and work processes in manufacturing and services have lead to an increasing need for transferable skills in teamwork, communication and leadership.
- The rapid pace of technological and organisational change have resulted in the need for lifelong learning and self-management abilities enabling graduates to adapt flexibly to new requirements. The use of ICT's and open and distance learning for continuing education further emphasise these needs.
- Globalisation and internationalisation have created the need for abilities in intercultural communication and international project work,
- The expectations for an increased contribution of engineers to economic growth and welfare have raised the requirement on entrepreneurship abilities of graduates along with the promotion of scientific and engineering excellence.
- Finally, the need to attract more students of different background and abilities for engineering have raised the general demand for diverse and flexible programme profiles and learning arrangements allowing students to follow own interests and personal preferences in learning.

The diversity of these needs makes it difficult, if not impossible, to define a common requirement profile or general output standard for engineering graduates on a European level, and even more difficult to meet all the needs listed above. As national political, economical and cultural contexts still play a dominating role, the reaction to the changing needs has up to now lead to an increasing diversity of engineering education in Europe. However, as far as needs and not programmes deliveries and institutional backgrounds are concerned some general trends can be observed:

- an increasing need for transferable skills and competencies
- a stronger application orientation

- integrative approaches and system orientation in engineering design, with the inclusion of context dimensions e.g. economical, social, environmental, and ethical
- explicit and differentiated outcome orientation.

In order to influence engineering curriculum development and the teaching/learning practice the changing demands should not only be statements of various interest groups and stakeholders but must be part of a framework of regulations for programme design or accreditation. Most countries in Europe embody in law rules specifying what has to be fulfilled or achieved by the respective programmes mostly approved by government bodies. Accreditation as a procedure ensuring certain common standards of programmes, based on external assessment by an accreditation agency or by peers, is becoming common in ever more European countries. The procedures usually show a stronger influence of the engineering practice and profession in comparison to the role of academia and state government bodies.

Like the USA accreditation by ABET (Accreditation Board for Engineering and Technology) also in the UK the accreditation of engineering programmes is run by professional bodies, the Engineering Council and the Engineering Institutions. It is therefore more closely related to engineering practice than governmental approval procedures. In both countries accreditation is primarily concerned with the first-degree level (BEng or MEng, respectively). The recent new set of criteria and standards both in the US and in the UK indicate a trend switching from input to output orientation and require, besides a solid mathematics and engineering foundation, transferable skills and competencies.

The new German Accreditation Council and in particular the Accreditation Agency for Study Programmes in Engineering and Informatics (ASII), have been established to ensure a certain quality standard of the newly implemented Bachelors and Masters degree programmes. They explicitly address not only the first but also the second degree level and in addition the two different profiles at each level (practice and application orientation versus theory and research orientation). This approach with different profiles and types of graduates is new. The traditional German system has known only the two profiles of Fachhochschule Diploma Engineer (Dipl.-Ing.) and University Diploma Engineer (Dipl.-Ing.) degrees, but each of the two types of institutions have offered only one level of (first) degrees. With the new sequential Bachelor/Master structure the question of levels has to be answered explicitly, and the relation between old and new degrees must be articulated. From the previous experiences in Germany it looks like the definition of the requirements on Masters level is less difficult than determining the first cycle degree level. From some experts point of view a Bachelors degree after three years of study in engineering does not satisfy professional demands; it should therefore be mainly a “pivot” leading into different Masters programmes or into a structured phase of Initial Professional Development rather than an exit level. In contrary to this opinion the German Frame Law requires all Bachelor degrees in general to focus on employability (Berufsfähigkeit) with access to Masters level programmes therefore limited and selective and not a necessary supplement to a Bachelors degree in order to achieve a basic level of employability. The same expectations seem to apply to the 3 years Laurea degree in the newly implemented system in Italy.

Since 1997 the UK has seen an attempt to define level descriptors in general, applicable to the whole education system including higher education. Besides sub-degree levels they determine the requirements not only for the three-years Bachelors degrees, but also for the four-years Bachelors with Honours and Masters levels. The general descriptors have been specified in subject-specific benchmarking documents, among many others also engineering. In a corresponding activity the Engineering Professors Council (EPC) is developing a list of Engineering Graduate Output Standards. This takes the form of a list of twenty-six "ability to" statements, which are expressed in generic non-discipline-specific terms. The standard is applied to a particular engineering discipline in two steps. The first step is of course to ask the providers to interpret the generic "ability to" statements in the context of the specific discipline. They then provide benchmark statements to describe the threshold level of attainment required for each ability. This outcome-oriented approach may well contribute to a more diversified solution for the European Area of Higher Education than a rigid 3+2 frame.

It is obvious that up to now significant differences concerning learning outcomes exist between sub-degree levels like the French IUT and the Greek TEI, now supposed to award bachelor level degree after some additions and changes, the new Italian Laurea degree after 3 years of study and the Fachhochschule type of degrees after 3.5 or 4 years of study. Some of the Fachhochschule degrees claim to be at MEng level rather than at Bachelor level and at the same time state that they represent a certain necessary standard for professional engineers. Regarding the learning outcomes it also has to be taken into consideration that the duration of studies is not a very valid indicator for learning outcomes as remarkable differences exist concerning selectivity and the entrance level to engineering programmes throughout Europe. This is another reason why qualified out-put standards and reliable learning outcome assessments are needed for a Bachelor at the end of the first cycle.

From a competitive global point of view competences and learning outcomes at the end of the first cycle for a professional engineer from Europe should not be lower than, but at least of comparable level to what is required for the USA ABET accredited Bachelors degrees. From a regional point of view and with regard to the idea of a flexible multi-level higher education system it may be also justified to continue with sub-degree levels or qualifications lower than this kind of professional Bachelor.

Accredited engineering programmes should therefore be *outcome oriented* and achieve the following qualification attributes or competencies*:

* This list is similar to that of ABET.

- an ability to apply knowledge of mathematics to engineering problems,
- an ability to design and conduct experiments, as well as to analyse and interpret data,
- an ability to identify, formulate and solve engineering problems,
- an ability to design a system, component or process to meet desired or customers needs,
- an ability to use the techniques, skills and modern engineering tools necessary for practice,
- an understanding of ethical and professional responsibility,
- an ability to communicate effectively,
- an ability to cooperate in multidisciplinary and international teams,
- a recognition of the need for and the ability to engage in life long learning,
- a broad education necessary to understand the impact of engineering solutions in a societal, economical and global context,
- a knowledge of contemporary issues.

Further considerations will have to fix the level of attainment up to which each of these competencies have to be achieved by the end of the first and of the second cycle.

4.2 Line 2: Knowledge – Core Curricula – Content

There should be certain common standard on outcomes and qualification profiles, but the way a programme attempts to achieve these outcomes should be free and object of decisions of the higher education institution offering the programme. Therefore it can be questioned whether besides common outcome agreements also common core curricula and contents have to be defined. In some ways such attempts would be the continuation of traditional input-oriented approaches to curriculum design, accreditation and comparison, and would ignore the problem that with the rapid development of scientific and technological knowledge, it is difficult and risky to fix core contents in detail. It also limits the freedom for universities and faculty to decide how certain outcomes can best be achieved.

However, up to now it is still a widely used approach to start curriculum development with lists of subjects and contents and then to reflect on what kind of outcomes in terms of knowledge, understanding, skills and attitudes should be achieved in relation to these contents. It is also a widely shared opinion that there is or should be a certain common core of fundamentals in engineering, which should be a compulsory part of any engineering programme. It is argued that precise content lists facilitate mutual recognition and mobility of students. On the other hand they limit the flexibility and individualization of curricula and the profiling of programmes.

As pointed out the proposal put forward here starts from learning outcomes and core profiles from which the contents and appropriate teaching/learning arrangements are delivered. Nevertheless, it seems possible and helpful to complement the outcome oriented approach with input-oriented content decisions. This is even part of accreditation criteria particularly when it comes to subject area related specifications.

A less prescriptive approach is not to go into details of subjects and contents but to require certain shares of contact hours, credits or workload to groups of subjects. The German Accreditation Agency for Study Programmes in Engineering and Informatics, ASII, recommends that engineering curricula for Bachelors programmes should consist of at least:

20% mathematics and natural sciences,
25% engineering subject specific fundamentals,
15% specialisation in the chosen engineering branch,
10% to 15% other than engineering subjects,

plus a minimum of 3 months for a final thesis and 3 months for practical training and internships.

ABET in its Criteria for Accrediting Engineering Programs at bachelor level specified the Criterion 4, which is addressing the Professional Component as follows:

"The professional component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objective of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. The professional component must include:

a) one year of a combination of college level mathematics and basic science (some with experimental experience) appropriate to the discipline
b) one and one-half year of engineering topics consisting of engineering sciences and engineering design appropriate to the student field of study
c) a general education component that complement the technical content of the curriculum and is consistent with the program and institution objectives.

ABET does not specify in detail what is expected in each branch of engineering; for example for mechanical engineers it says:

"The program must demonstrate that graduates have: knowledge of chemistry and

calculus based physics with depth in at least one; the ability to apply advanced mathematics through multivariate calculus and differential equations; familiarity with statistics and linear algebra; the ability to work in both thermal and mechanical systems areas including the design and realization of such systems".
These ABET determinations of compulsory core components and contents provide a flexible framework for a variety of different profiles, specialisations and modes of course delivery. So far many European approaches defining core components and contents tend to go much more into detail but they also often differentiate already during the first cycle between different profiles with a strong emphasis on mathematics and natural sciences in theoretically and research oriented programmes or with a stronger component of practical engineering in application oriented curricula. Most likely this diversity will continue to exist and will not be replaced by a common European Core for the first cycle, with diversity being offered only on Masters level or within other kinds of post-graduate degrees or qualifications.

4.3 Line 3: ECTS and beyond

Behind any credit transfer scheme is the idea that study carried out in one (or even several) institution should be able to satisfy in part the requirements for an award at another institution. The development of the European Credit Transfer System is directed to satisfying a very clear need, as ever more students are spending part of their studies at other universities (and, in the vast majority of cases, in another country). A secondary use of a credit transfer system is as a means of comparing courses and, moreover, of comparing the quality of courses. Of course, the way that courses are built up, and marks awarded and combined to determine the final Diploma or Degree, are based in almost all institutions on a credit accumulation system, or on a system which is, in essence, a credit system, even though the word credit may not be used. It is only when transferability of credit is desired that all the implicit assumptions and compromises inherent in any academic system become apparent.

The basis of ECTS is that each course of studies should be divided into a number of modules. The modules are at different levels, depending on where in the course of studies they are normally taken. The most common pattern is for each level to correspond to a year of study, and for it to be necessary to have obtained credit in (that is, passed) a sufficient number of modules at a lower level before any modules at a higher level may be studied. Unfortunately, even at this point problems arise, caused by the fact that there exist quite different understandings and perceptions of what a module is. These range from a module being understood to consist of just a single normal lecture course or seminar to a module being a comprehensive learning arrangement embracing various teaching/learning and working activities, with their different course contents and targeted to a defined multi-dimensional learning outcome. A step forward, consistent with the thrust of much of the work in all Activities of the Engineering Thematic Network, E4, would be for the description of modules to be in terms of learning outcomes, rather than in terms of syllabus content. It may well happen that virtual university approaches and the development of world wide accessible learning software will contribute positively to an acceptable module and credit system.

The credit value of a module is a measure of the amount of study demanded. A crude measure is the number of hours of lectures or instruction given, perhaps expressed as the time spent in the classroom or the number of hours of contact with the teaching staff. A better measure, to be used within ECTS, is to focus on student learning and the overall workload for students, contact (teaching) hours then being only one factor in the estimate of workload. For lectures, for example, a 1-hour lecture might demand a further 4 hours of private study. A full year's study corresponds to 60 European Credits. Unfortunately, even with this measure of Credit (but there are yet other factors, to be discussed below), there are constraints to developing a generally accepted and satisfactory scheme of credit transfer and accumulation; such constraints are not engineering specific, but are of a more general nature.

1. The workload associated with 1 credit differs significantly throughout Europe: Some countries using ECTS tend to calculate 30 hours per credit, so 60 credits (a year's worth of study) corresponds to a total workload of 1800 hours, all examinations included. At the other extreme, in the UK, the total workload is only 1200 hours, calculated on the basis of 120 credits per year, but only 10 hours of workload per credit. So, although 2 UK credits should be equivalent to 1 ECTS credit, this is clearly often not the case on a workload basis. Other countries like the Netherlands use to attribute 40 hours per credit equal to a one weeks workload. There is some consistency, in that the UK calculations also assume 40 hours work per week; however, in the UK the undergraduate academic is only 30 weeks long (the remaining 22 weeks are vacation, the greater part being in the summer). Moreover, in the UK the examinations are included within the 30 teaching weeks, whereas in some other countries the examinations are held outside the 30 teaching weeks.

Needless to add, the number of hours to be spent by the typical student in earning each credit is not scientifically determined, but is based on the estimate (guess?) of the lecturer giving the course.

2. The ECTS pilot project has tended to encourage a simple, mechanistic conversion between contact hours and credits by just using a specific factor – e.g. a factor 1.5 if 20 contact hours per week in a semester is to be worth 30 credits. Yet it is the experience of every academic that the demands made of a student vary widely between courses and between styles of teaching. The use of standard factors discourages serious reflection on these matters.

3. The award of Credits implies that the student has successfully finished a course or module, but that alone is rarely sufficient, even for the internal purposes of the institution, and certainly not for international transfer of credit. Further

measures of the credit are needed, specifically (i) a measure of the quality of the pass, (ii) a measure of the place in the course of studies, or the level, and (iii) a description of the course content.

Since there is already so much divergence on the matter of credit value, despite the fact that it is the measure which it would be expected would be most amenable to objective analysis and harmonisation, it might appear futile to discuss the other measures. Nevertheless, if a satisfactory transfer and accumulation scheme is to be devised, these other matters must also be resolved.

Even the level of study is not easy to define. Clearly any university will know at which stage (year) a particular module is usually given, but even this is rarely a sufficient specification, given the variations between countries, and even between institutions within a country, in the education preceding this stage. It is also sometimes the case that a module is taken by students at quite different levels – the outcomes may then be different, but in a certain sense all will be successful.

The measure of the success with which a student has completed a module is a further important factor in specifying the credit. We might refer to this as the "points value" or "mark" attributed to the credit, as opposed to its "amount" or "credit value". In a Grade Point Averaging scheme (the GPA used in the USA) the mark is obtained by multiplying the credit value by the points value, and aggregating the total; the average is then found by dividing the final total by the aggregate credit value. In ECTS the points value is defined by a letter (A is high, down to E, and F for failure to attend the examination) with the boundaries being expressed in terms of a supposed normal (Gaussian) distribution of marks. This appears to be objective, but transferability will only be practicable if the performance statistics of the class in the sending university are similar to those in the receiving university. Among the many problems are:

(i) In practice marks distributions are rarely normal, even in large classes,

(ii) Even in universities where there is tight control of the examination process, so that the mean marks for the different modules are consistent among themselves, the standard deviations tend to be much less well controlled,

(iii) The mechanism for calibrating one university against another hardly exists. Theoretically the system of external examiners in the UK, where each course of studies in a university has in its panel of examiners teachers from other universities, ensures consistency, but there are few who believe that the worth of a Degree is independent of the University awarding it.

Despite the foregoing, it is relatively easy to perform the statistical calculations needed to generate ECTS points values. This is done in the Department of one of the authors (BM), where it can be shown that at least point (ii) above is satisfied.

However, because transfer both is wanted and already takes place, and because it must, therefore, be assumed that a form of ECTS will continue to be implemented more and more widely, some crucial questions should be studied and answered. First, should the requirements for first- and second-cycle degrees be expressed in terms of years of study or in credits? It may be that resolution of the problems of credit value will also provide the answer here, or it may be that there are other, more subtle factors to be considered. However, it should be noted that in some countries the discussion has already started on how to count intensified studies, with nearly no holidays, and whether to allow the accelerated collection of credits by individual students (as is quite normal in the USA, for instance). Second, should a first-cycle degree in engineering be specified as 180 ECTS credits, or should it really be more, Bologna notwithstanding? And, then, is a masters' degree achieved by an overall sum of 300 ECTS credits or can it be less? Another question is whether and how to recognise within ECTS credits gained by the accreditation of prior, informal and experimental learning, by open and distant learning, by continuing education or just credits by providers other than higher education institutions, even schools of the upper secondary level.

Up to now in engineering education not much open mindedness and trust can be observed. Change in this behaviour and in the administrative processes of student transfer will depend very much on whether the credit system can include not just a quantitative workload but also the additional dimensions.

4.4 Line 4: Methods of Teaching and Learning, Assessment and Performance

Methods of teaching and learning in engineering education are under pressure to adapt to new demands and learning resources. In due course the assessment methods are to be questioned and often need to be enhanced. Challenges and changes derive from:

- the general shift towards student learning, in other terms the shift from teacher centred delivery of content towards a learner centred process of achieving a wide variety of targeted learning outcomes;
- the increasing demand on engineering graduates raise better employability by acquiring more practical skills and particularly transferable key skills (or even competencies);
- the enrolment of students with a growing diversity in profiles and capabilities at entry level and with often quite different learning styles;
- the availability of an increasing range of e-learning facilities, requiring and encouraging flexible self directed student learning in different learning environments;
- finally, the modularisation of programmes with a focus on complex outcomes of modules in terms of abilities and/or key competencies.

Compared to other disciplines engineering education already in the past comprised quite a big diversity of teaching and learning situations. Besides lectures, labs and exercises usually practical work in internships in industry or in research projects and final thesis work belong to the methods employed. Reacting to the mentioned challenges the move towards "active learning" caused the implementation of problem based and project oriented learning, team work, international projects, communication and presentation activities, special forms of foreign language learning, collaboration with industry, web-and computer-based learning, etc. The increasing variety of learning arrangements or situations reflect the fact that either different learning styles or, even more, the increased diversity of learning objectives require other and better matching approaches to learning and the achievement of diversified outcomes than just providing lectures and exercises.

How far certain learning objectives, in a European or national qualifications framework possibly fixed by out-put standards or benchmarks, are achieved by the enrichment of teaching and learning methods has to be proved by adequate assessment procedures. In a European framework of degree levels and credits it is an additional crucial question how assessment (and also grading procedures) must be designed to not only assign credits to workloads or programme levels to inputs but to provide comparable qualitative indicators of learning achievement.

For these purposes in engineering education an increased move towards outcome and performance related assessment concepts and methods is favoured in many higher education institutions as well as in national accreditation procedures and quality evaluations. This applies also for European Networks like the Socrates Thematic Network E4 but also ESOEPE and ENQUA. A satisfactory format applicable on a European scale does not exist yet but has seen some valuable contributions recently e.g. in the respective discussions in the UK, particularly with regard to qualification levels and output standards. However, output standards or accreditation criteria and standards may well express what kind of demands are explicitly taken into account and what kind of learning outcomes are expected.

Whether and to what extent these outcomes are achieved is an open question and has to be proved by different assessment systems and procedures. The challenge is to bring the development of varied assessment systems as a part of the curriculum development process (e.g. [13]).

The first and most direct assessment system is the examination and grading system, which has to be consistent with the intended outcomes on a certain level. In this area, there are significant differences across Europe, which cause quite some constraints for mutual recognition and mobility. Modularisation, common or at least comparable credit point systems, and the Diploma Supplement, which documents learning outcomes in detail, may partly overcome these differences.

A second approach of learning outcome assessment is incorporated in accreditation and external quality assurance evaluations on programme level. Recent developments with a big variety of outcome assessment methods in use prove that these external evaluations are quite effective with regard to programmes as a whole. But usually they take place only in regular intervals of 5 to 8 years.

A third approach is the assessment of individual capabilities and competencies, including the accreditation of prior and experiential learning. It extends normal higher education examination results in the direction of structured self-assessment and methods used in Assessment Centres, and culminates in learning outcome portfolios, individual qualification profiles or records of achievements.

Concerning the real learning outcomes of engineering education in Europe it is sometimes argued that despite all the diversity of traditions, institutional contexts and teaching/learning arrangements, the learning outcomes are already quite homogenous and comparable, at least at Masters level. This has not been proved in valid empirical studies, apart from some trans-national comparisons of selected programmes in certain engineering subject areas, either organised as comparative surveys, e.g. in electrical engineering, or as part of a trans-national quality evaluation. Also some multinational companies employing engineers from many different countries provide anecdotal evidence confirming this assumption.

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5. A Few Words about the Doctorate Level

The contents and organisation of doctoral studies falls beyond the scope of the Tuning project, but a few words about this aspect appear worth including. Doctoral students represents only a small fraction of the total number of students in Europe: less than a quarter of million compared with a total student population of over 14 million. Hence the justifiable fact that they occupy a small role within education programmes of the European Commission. On the other hand the question of doctoral programmes is of special interest for Higher Education in Europe because of its intermediate situation between education and research and because of the related issues coming from job market considerations. (See [5] for more information).

Recently a project named TRENDS has been launched, jointly by the European Commission's Directorates General for Education and Culture (EAC) and for Research, aiming at exploring the situation of doctoral studies in five areas, corresponding to five existing Thematic Networks: Physics, Political Science, Women Studies, Humanitarian Studies, and Engineering. The DG EAC also supports a survey on national legislation and regulations of doctoral studies. The main issues to be addressed within TRENDS are: how to improve the quality and quantity of exchanges of students at doctoral level in Europe; how to improve the European dimension of doctoral studies; how to favour the development of doctoral studies in the context of the world-wide competition in higher education and research; how to improve the integration of doctoral students in the labour market, both national and European. The heterogeneity of national systems of doctoral studies and of the situation with respect to the job market in different European countries has been observed. A more complete picture will be achieved through an ad-hoc questionnaire survey, which will be circulated within existing Thematic Networks. First results are expected for the autumn of 2002.

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6. Continuing Education and Lifelong Learning

6.1 Continuing Professional Development

When formal education is complete the engineer embarks on professional life, in a majority of cases as an employee of a company. From this point onwards the individual's most important life-skill is commitment. This is truer now than ever before, as individuals must maintain their employability in an open mobile world that is changing rapidly around them as technology advances and as business practices evolve. Their primary source of new knowledge and new competences is no longer formal instruction by experts; professionals rather learn through their activity in and beyond the workplace.

In this context adult professionals learn and develop in response to the current and anticipated future demands of their work, their employer's and their own ambitions. This is an untidy world, which is neither formal nor coherent, but it is the environment in which a professional lifetime's learning must take place. An individual's continuing education cannot be based on formalized curricula – it must respond to change and, where possible, anticipate it. Working engineers need to be able to specify precisely the content of what they learn, and how they learn it, if they are to take the maximum advantage of the limited time available.

Continuing professional development is a matter of acquiring specific knowledge and skills as and when these are needed. There is no place here for the ideal prescriptions of a syllabus or a timetable, and there is little place for the formal teaching style. Adult, experienced professionals expect to participate, to learn by doing, researching and contributing, by applying knowledge, know-how, and skills.

It is difficult to envisage a wholly coherent approach to lifelong learning, or to education and training in the workplace, nor can this be considered desirable given the diversity of needs and the rapid pace of change. Any such attempts will fail, except in closely defined professional or corporate environments that are deliberately isolated from change.

Although learning at work is by far the most important component of professional development, because the focus of the Tuning project is on educational structures in Europe, we concentrate here on continuing education and professional development from a university perspective. For a more detailed discussion of lifelong learning in the corporate context, see the "Call to Action" report of the H3E project [3].

6.2 Professional Competence

The educational deficit in European countries, at least as concerns economic performance, does not rest with the young who are still in schools and universities, but with those who have passed – or in some cases fallen – out of the educational system: the huge numbers of workers, professionals and managers in early and mid-career, and those who have never made it to the bottom rung of the ladder. The deficit is exacerbated by a failure to pursue structured professional development beyond the formal qualification stage.

Everyone is uncomfortably familiar with the increasing gap between the rate of learning and the rate of forgetting. We forget from the moment we leave the examination hall, but even faster is new knowledge accumulated within the research and industrial communities of the globe.

Knowledge forms only a part of the professional tool-kit. Universities have traditionally been good places to teach basic knowledge and understanding, but they have been much less good at teaching *professional skills* or *know-how.* These are best developed through practice, at work, and most effectively when there is in place a support system; where older, experienced people take a professional interest in the development of young professionals, and where mechanisms are in place to ensure that an individual continues to acquire the intellectual frameworks that are essential to understanding, in pace with the growth of their professional know-how and competence.

As professional competence and know-how develop, so an individual is ready for promotion and greater responsibility, which in turn requires an ever-increasing fund of knowledge and a broad range of understanding across discipline boundaries. Senior people operate in an interdisciplinary environment, where they make more use of the competences of critical thinking and creative response than of their basic technical knowledge.

At school or at university this broad context-related knowledge has little relevance to the individual's life experience, and, even if taught, would be very imperfectly understood and remembered. It needs to be acquired stage by stage, as needed in the context of the individual's own aspirations and in the relevant organizational context. Nevertheless the foundations for this broader range of educational and competence accomplishments need to be laid during formal education.

6.3 University-based Continuing Education

Universities currently have only a limited role in the post-degree development of professional engineers. For the health of the entire system, it is vital that universities should play their small part *fully***,** rather than not at all.

If universities neglect to seek ways of engaging with the learning of professionals beyond graduation, they will by default be accepting a role that ends at a relatively early stage in the professional development system. They can expect, over time, to lose their pre-eminent status to other institutions that will come to be seen as having authority in the field of higher professional development.

In response to this observation, some universities have already begun to customize Master's programmes to individual students' requirements. Some provide extensive mentoring services for professionals in industry, helping them plan and reflect upon their learning. Others encourage practising professionals to register for part-time research degrees.

The role of the academic institutions in continuing education has increased, but possibly not so fast as other kinds of organization have in this area. If universities wish to be engaged at a strategic level with companies in professional education and the management of knowledge, they must put in place structures and processes to promote and manage their relationships with those companies.
Much research conducted by companies is directed towards specific development. University research is mostly in longer-term scientific subjects, but is often carried out in collaboration with companies. However, these distinctions are becoming less clear. Today knowledge-based competition is so intense that companies often outrun universities in the scope and pace of their technological and scientific advance. They may employ a greater number of high-calibre professionals and they often have greater resources at their disposal.
One of the main contributions that university research performs for society is therefore, and always has been, to work on complex and diverse subject matter, codifying and reducing it to patterns that are comprehensible, recognisable, and teachable. Research of this kind contributes as much to understanding as to new knowledge.
University teachers can communicate new knowledge and teach new skills, but more importantly they can also help professionals to learn from their own experience.
Professionals who are seeking to become fully-effective "adult-learners" need to become competent in these processes, to become researchers into the professional concerns of their day, and thus steer their own development, play a leading role in shaping their profession and drive forward the competitiveness of their organisations. The essential processes here are research, scholarship and reflection. These are precisely the techniques used by academics in their own work.
Helping professionals to learn from experience creates a new role for university teachers in continuing education: the *facilitation of learning*. This is different from teaching, but complementary to it. It is a different, peer-to-peer relationship that is entirely consistent with the interaction of expert academic with expert professional.

6.4 Standards and Accreditation

In spite of the many differences in initial engineering education across Europe, the overall picture is still uniform when compared with learning after graduation. The universities of Europe educate engineers of comparable knowledge and qualification. In the informal and unstructured world of lifelong learning there are no standards, no systems, and little comparability. And yet, as we have seen, the knowledge and skills acquired in this fluid environment are likely to be the most valuable that individuals acquire during their professional lifetime.
What can be done to give prospective employers – and engineers themselves – some benchmarks for evaluating the learning achieved, post-experience? Two main suggestions have been repeatedly put forward: the accreditation of continuing education courses and providers, and the introduction of new qualifications. Both approaches have their difficulties.

Proponents of accreditation believe that a system would accelerate the adoption of shared standards, and guarantee consistent quality. Accreditation becomes appropriate when there is consensus on the nature of the system being accredited:

- the definition of learning objectives
- the provision of learning opportunities (e.g. courses)
- the assessment and quantification of learning outcomes
- the award of credit/qualification in recognition of learning achieved against the objectives.

This is the case in initial education, but in continuing education there is no consensus within Europe on a system to be adopted for these important elements. Although there are various initiatives for providing post-experience education and development in some countries, there are no comprehensive structures and systems for continuing education in professional practice that can compare with those for initial education and qualification.

Although the traditional "gate-keepers" of the profession (professional institutions or universities) have an important role to play, they are not the key players and should not be allowed to design and control any universal system of accreditation. The key players are the engineers themselves and their employers. The concerted voices of the engineers are rarely heard and companies can rarely be persuaded to speak in unison. Any attempts to establish an accreditation system without the considered support of these representatives of the industrial community will not be worthwhile, and could even lead to the evolution of unhelpful restrictive practices.

One further objection to any general system of accreditation is that such a system would suggest that "courses" are the key ingredient of continuing professional development. However, courses are only a very minor feature, dwarfed in importance by the potential of the many other forms of professional learning.

6.5 Qualification and Credit in Continuing Education

Systems of qualification have been proposed as the means of measuring lifelong learning achievement. Supporters of this idea have suggested either modifying existing qualifications or creating completely new ones. But qualifications are not necessarily an indication of the amount of learning achieved or of its effectiveness. Universities have often assumed that the solution is simple: create an academic credit system, and encourage people to attend a large number of courses. However, this is not an approach that can provide good linkage and reinforcement between what is learned in class, and its application in practice. A further difficulty is that development needs are individual, and the solutions need to be tailored to these individual needs. One size does not fit all.

Diplomas and degrees symbolize the completion of a course of studies, whereas continuing education is by definition never completed: it is lifelong learning, there is no end. As individuals acquire additional responsibility and as their professional compass expands, the learning agenda expands exponentially, while time itself becomes more precious. If there are to be qualifications for lifelong learning they should be printed using fading ink – ink that becomes invisible after two years or so, requiring an individual to engage in a continuous process of updating and development to keep the ink fresh.

There is, however, a niche market of continuing education courses of studies with objectives similar to that of traditional diplomas and degrees: preparing for a specific job, task or specialization within a profession. We argue for maintaining the flexibility of extent of these qualifications, but recognize the merit of articulating their scope and content within the general qualification framework. But as the Bologna Declaration only indirectly addresses lifelong learning there is a danger that qualifications-oriented continuing education on university level will be further marginalized.

We have suggested that a system of formal qualifications cannot provide the general infrastructure of common language and practice in lifelong learning across Europe. Nevertheless, a flexible system of recording learning, which can be interpreted quantitatively by institutions for the award of credit towards additional qualifications, has potential as a motivator.

Credit systems traditionally tend to measure educational inputs (volume and level of teaching), though an increasing number are sensitive to outputs (achievement against expected learning outcomes). Volume tends to be indicated in terms of hours of study. The ECTS, for example, encourages course providers to offer credit for course modules that can, in principle, be accumulated towards a qualification. To achieve this, the individual registers with a recognized institution, negotiates the acceptance of their existing credit towards the qualification, and then takes a variety of course modules to make up the deficit. It is notable that this facility, which is increasingly being applied by universities across Europe, has had little impact on continuing education practice.

An academic institution may allow exemption from part of the formal requirements for a programme, by giving the applicant credit for "prior learning". The valuation of credit might be on acceptance of credits issued by other organizations (accreditation of prior learning, APL) or based on evidence of the learning achieved through experience (accreditation of prior experiential learning, APEL). The volume of APL credit accepted by an institution towards its qualifications depends very much on its assessment of the status of the institution(s) that awarded the credit.

The negotiation for incoming credit may take many possible forms, but normally good practice demands that the individual has to fit into one of the following categories:

- Curriculum-based qualifications: Credit is only given if the learning can be shown to be relevant to an established course curriculum.
- Individually tailored curriculum: The applicant may put forward his or her own learning plan as an alternative to any established course curriculum. The institution (university or other), considers whether the plan is of sufficient calibre, coherence and weight. If it is so persuaded, then it agrees to accept the personalized curriculum, and judges APL and APEL for credit against it. This kind of individually

negotiated qualification is only available from a small number of universities, but the number is growing, and we welcome this trend.

In both of these categories of learning programme the key considerations are: content (learning outcomes), level of achievement, volume of learning, and assessment strategy (evidence of learning achieved). An institution considering an individually tailored proposal will also need to be convinced that it can offer appropriate support for the learner.
Credit has no absolute value. Just as the US dollar is accepted everywhere, whereas the Tanzanian shilling is accepted less universally and with less enthusiasm, credit from some institutions is more convertible than from others. Credit is "in the eye of the beholder".

6.6 Recording Professional Achievement

We have looked at qualifications and credit, and concluded that neither can offer the necessary common system for communicating what a professional has learned. What are the features of a system that can attribute an agreed value to learning achieved? We suggest that to be acceptable and effective a system must be:

- flexible, as professional lives are subject to rapid unpredictable change;
- open-ended, with no suggestion that learning has been completed: any qualification must require continuous renewal;
- responsive to the real nature of professional learning that is largely achieved through experience in and through work;
- able to meet the needs of the various key stakeholders.

An international system must be relevant and useful to the individual. It must help with the planning and recording of learning. It must be relevant to the employer for recruitment, promotion, and managing staff development. It must add value to professional institutions for recognising increasing professional mastery. Finally it must be applicable to universities for the award of academic qualifications.
Differences between awarding institutions and between countries will continue to rule out a common credit system for continuing education until there is some accepted method for evaluating the learning outcomes: for describing learning and the means by which it has been acquired.
We may conclude that we need a system for recording learning, however achieved, in such a form that any of the key players could make use of the data for recognition within their own credit or qualification systems. We believe that this will be best achieved through a neutral medium such as a *Record of Achievement.* Such a tool can support the capturing and recording of learning, without trying to attribute any value or measure to it. It leaves users freedom to decide for themselves the important question of what form of assessment strategy to adopt in each different circumstance: if they want hard evidence for external purposes, then rigorous external validation and

certification of their abilities will be relevant, whereas if the purpose is to self-monitor progress against a development plan, then self-assessment will be satisfactory.

Universities and other providers of continuing education can play a key role in offering and supporting such a tool for planning and recording professional learning. They can, for example, offer support for developing learning plans, or provide mentoring support for reflecting on and capturing the learning achieved.

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7. Some Recommendations for Tuning Tools

7.1 General Aspects

This Report has put in evidence that a great variety of routes to the formation of engineers exists in Europe, not only from country to country, but also within the same country. In the last few years, two phenomena in apparent contrast have been noted:

- on the one hand, an increased de-regulation and the need for more engineering graduates tends to lead to an increase in the variety of the educational offer;
- on the other hand, the creation of the "European Higher Education Space", strongly supported by the policies and efforts of the European Commission and the "Declarations" of the Education Ministers (Sorbonne, Bologna, Prague), favour an increased "harmonization" of the European educational structures, in engineering as in other disciplines.

To pursue this "harmonization" while avoiding to turn it into a "cage", the means to follow are not strict rules for educational programmes, but rather appropriate procedures for quality assurance and accreditation of courses of studies: in this way, engineering education will be improved, academic degrees and professional qualifications granted in one country will be easily recognized in other countries, and the trans-national mobility of engineers will be ensured.

In working towards the creation of a European Higher Education Area, it is crucial to recognise that specific characteristics of engineering education, which reflect, on one hand, the needs of European industry, and on the other hand, the special nature of scientific and technological studies.

Providing highly qualified engineers able to contribute to the technological progress through their leadership in research and development activities is vital for the economic competitiveness of Europe. The education of these engineers needs to be based on a scientific oriented curriculum. The first degree qualifying for this kind of professional activity should correspond to the second-cycle (Masters) level. The economy also demands graduates from practically oriented engineering studies lasting for three to four years with a first-cycle (Bachelors) degree, the specific qualities of which must be appropriately recognised.

Many thinks that within the two-tier structure envisaged in the Bologna Declaration, we should maintain the option of 5-year integrated programmes (exceptionally 4.5 year) spanning the first and second cycles and leading straight to a Master Degree in Engineering. This should be possible without the mandatory award of an intermediate professional degree. The creation of new Masters programmes of between one and two years duration should also be encouraged: Universities should be fully allowed to set their admission criteria for entry into the second cycle.

To achieve this, all parts of the educational system need to be moving in the same direction. Thus it is very important to ensure the greatest dissemination possible for Tuning results/documents. As far as engineering is concerned, this can be obtained through the existing Thematic Networks (EUCEET, E4, and others) as well as through the associations involved (SEFI, CESAER, BEST, FEANI, CLAIU). Given the role that Promoters of E4 Activities have played in producing this report, and as a first step in its dissemination, this document is also downloadable from the E4 web site, www.ing.unifi.it/tne4.

7.2 Attributes and Qualification Profiles

It is essential that each "type" (i.e. "short-" and "long-cycle") and "branch" of engineering qualification can be easily recognised, including its appropriate differences. This requirement is not satisfied by most existing national systems nor by the FEANI Register, which set only minimum standards.

To further this goal, the emphasis in the programme requirements need to be shifted from the way in which the programme is structured and delivered, i.e. from prescriptions concerning the curriculum, to requirements on its "final product", i.e. on the "competencies" acquired by its graduates. This shift will also turn the great diversity of educational systems throughout Europe into an asset of, instead of being an obstacle to, mutual recognition.

The maximum *transparency* of objectives and contents of the course of studies is a prerequisite for pursuing this objective: each educational institution must provide complete information about itself and its degree programmes. In other words, the type qualification profile produced by each engineering degree programme must be articulated. Each engineering education provider will have to demonstrate which qualification profiles of engineers they have defined and which they produce.

Both academic and professional recognition will benefit from this increased transparency, covering not only structures and input data but also concentrating outcomes and qualification profiles achieved through initial and continuing education as well as professional experience.

Making this information available and easily understandable is a problem in itself: a "common language" is needed to describe educational outcomes or qualification profiles in engineering. It could also be a basis for internal or external assessments employed to ensure adequate recognition as well as quality maintenance and improvement [8].

The tools to pursue this aims might be differentiated lists of "qualification attributes" for engineering education and professional practice, including a categorisation of "types" and "branches" (specialisations) and specifications of levels at which certain attributes must be achieved. These lists should be based on descriptions of aims and objectives of the various programmes and profiles of engineering education, performance records, outcome-oriented criteria and standards of accreditation procedures and competence-oriented assessment approaches. These lists should form a *two-dimensional grid* of Engineering Qualifications, taking into account both academic (and non-academic) *education* (and where relevant, including *continuing education*) and professional *experience and training*. The columns of the grid should correspond to different "*types*" of qualifications, and lines to the different *branches* of engineering.

It isworth noting that, in order to be accepted by a British Chartered Institution, i.e. before full professional qualification, a period of acceptable engineering experience after the achievement of the academic requirements is necessary. Although this requirement appears logical (some experience "on the field" is normally required for the legal, medical and other professions, before the licence to practice a profession in full autonomy is granted), for engineers this seems to happen only in the British system and for the FEANI Eur Ing Register: even ABET accredits only educational programmes and completely neglects external training and professional experience. Also in the examinations required by some European countries for granting professional qualification, field experience does not appear to play any significant role. A study and a definite proposal on this point might be another appropriate "tuning" tool. Finally we should distinguish general employability from professional employability. The Bachelors level needs not necessarily qualify for professional employability.

7.3 Quality Assessment and Recognition

A pre-requisite for mutual recognition of engineering degrees across Europe is undoubtedly the "accreditation" of the courses of study. It is, however, unrealistic to suggest any form of overall European accreditation system, at least for the time being. The best way forward is a bottom-up approach to promote and facilitate increasing contacts and agreements between national bodies, in order to build up gradually a consensus, perhaps starting with mutual recognition of accreditation bodies, and agreements between countries of similar systems and cultural background. In the end, the system might look more like a European "Washington Accord" than a "European ABET".

A step in this direction has been the establishment of the "European Standing Observatory for the Engineering Education and Profession" (ESOEPE), which "*is intended to build confidence in systems of accreditation of engineering degree programmes within Europe*" and not *"to harmonise engineering programmes nor accreditation procedures, but simply to assist national agencies and other bodies in planning and developing such systems"* and to *"facilitate systematic exchange of know-how in accreditation and permanent monitoring of the* *educational requirements in engineering formation"*. An effort to enlarge ESOEPE to all European countries is suggested as a significant "Tuning" tool.

It should be underlined that accreditation is useless, even counterproductive, if based only on formal requirements and not strictly connected with a process of quality assessment and quality assurance. In many European countries this is ensured by a quality assurance procedure, allowing higher education institutions to validate the learning opportunities they offer; and supported by a quality assessment body, managed either by the competent government body, by professional associations, or by both.

A significant Tuning tool would be to introduce functional evaluation structures in the few remaining countries that do not yet have such systems. In Italy, a Pilot Project to assess and "accredit" University courses of study (including, but not limited to, the "Laurea" in engineering) has been started.

Whatever the future steps in this matter, the engineering leadership organisations of Europe, both educational and professional, must play a role in the development of accreditation, quality assurance and recognition at a European level.

7.4 Credits and Quality Level

If the system ECTS should become a system ECAS (for European Credit Accumulation System) then there are two essential additional descriptors which are needed. One should introduce a label to describe the "level" of the course unit, such as: B for basic or introductory course (e.g. Fundamental of Computers or Calculus), A for advanced or intermediate course (such as Electrical Network Theory or Automatic Control), S for specialised course (such as Software Engineering). The other label should describe the "type" of relation of the course unit to the discipline itself, for instance: C for core or major course unit (i.e. belonging to the discipline), R for (closely) related course unit (e.g. some fundamental mathematics course for engineering), M for minor/optional. With these additional descriptors a course such as Automatic Control offered for students in Electronic Engineering would be labelled having perhaps 7AC credits, meaning that it is advanced and belonging to the core of the curriculum.

Another element to add is the measure of the success with which the student has satisfied the requirements of the examination procedure. Without repeating in detail what already illustrated in section 4.3, a system similar to the GAP adopted in many U.S. Universities could be considered satisfactory. A more sophisticated way to measure learning results would be obviously welcome, and in some occasions considered necessary, however it appears difficult to arrive at this result without augmenting substantially the cumbersomeness of the procedure. This is not meant to discourage from using, say, something similar to the Diploma Supplement in order to provide further information. It only suggests that its use will probably be limited to those cases where deeper analysis is mandatory.

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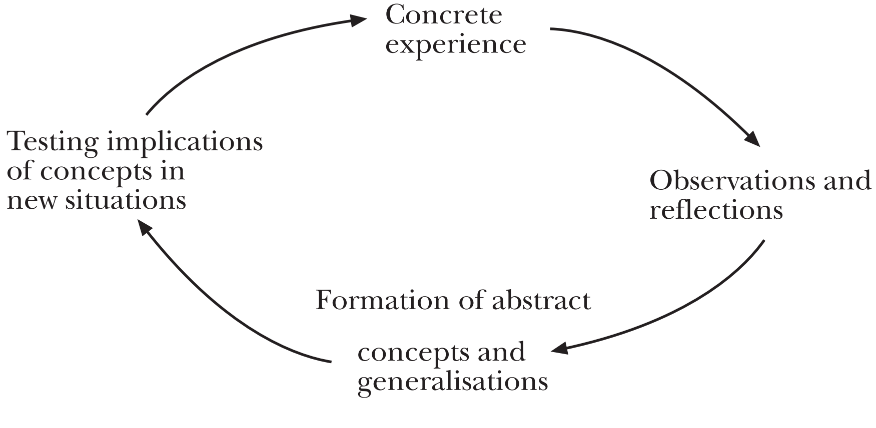
Appendix: What is Learning?

Traditionally, many educators have considered learning to be an individual responsibility, with students accepting the burden of acquiring knowledge and expertise. Recently, the notion of collaborative learning has been strengthened, from a number of sources. These include communicating with other students and tutors across a network in the domain of distance learning. Digital communications networks such as the Internet or the use of e-mail facilities have become the new medium in which group learning is anticipated to take place, and many large businesses have already built internal group learning systems using Internet.

The reader probably knows what learning means. It is, nevertheless, still worth defining it in the present context. Surprisingly little is known about how people actually learn, though there are a number of theories; so it is perhaps easiest to define learning ''after the event" by asking how you know whether or not learning has, in fact, taken place. You know that learning has taken place, when you know something which you did not know before and can show it and/or you are able to do something which you were not able to do before. You will notice that in both cases you are required to offer proof. Thinking that you know something or can do something is not enough; you must be able to show that you know it or are able to do it.

In the same way, it is not sufficient to know the theory; you have to be able to prove that you know it by your actions. This ties in directly with Action Learning, where you are required to apply theory and concept to real situations.

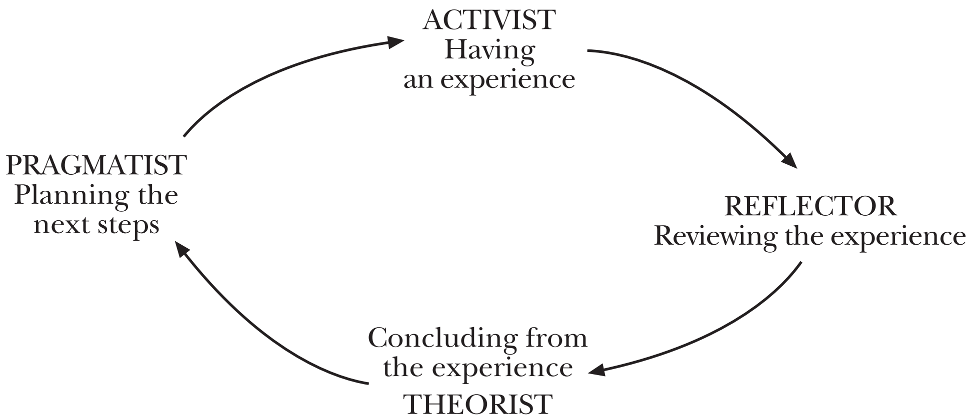
There are several schools of thought and theoretical models of how people learn. One of the most useful for adult learning has proved to be that initially developed by David Kolb [10]. In it learning is presented as a cycle.



Although, hypothetically, a learner would consciously move through every stage in the cycle in every learning situation, practical experience and research show that not all learners are equally at home at all stages of the cycle. Many show marked preferences for one or more of the stages and sometimes positive dislike of one of the others. And there is no evidence to show that such preferences make them better or worse than one another.

Honey and Mumford [11] have identified four different preferences, or ways in which people prefer to learn, each related to a different stage of the learning cycle. These preferred ''learning styles" they call Activist, Reflector, Theorist and Pragmatist. Some people are happiest operating in just one mode, others in two or even three. Perhaps not surprisingly, people's learning style tends to reflect their work style ... or vice versa.

Activists
Activists involve themselves fully and without bias in new experiences. They enjoy the here and now and are happy to be dominated by immediate experiences. They are open-ended not sceptical and this tends to make them enthusiastic about anything new. Their philosophy is "I will try anything once". Their days are filled with activity. They tackle problems by brainstorming. As soon as the excitement from one activity has died down, they are busy looking for the next. They tend to thrive on the challenge of new experiences but are bored with implementation and longer-term consolidation. They are gregarious people, constantly involving themselves with others but in doing so; they seek to make themselves the centre of all activities.



Reflectors
Reflectors like to stand back to ponder experiences and observe them from many different perspectives. They collect data, both first-hand and from others, and prefer to analyse them thoroughly and think about them from every possible angle before coming to any definite conclusions. These they postpone as long as possible. Their

philosophy is to be cautious. They enjoy watching other people in action and prefer to take a back seat in meetings and discussions. They think before they speak. They tend to adopt a low profile and have a slightly distant, tolerant, unruffled air about them. When they act, it is part of a wide picture, which includes the past as well as the present and others' observations as well as their own.

Theorists
Theorists like to analyse and synthesise. They assimilate and convert disparate facts and observations into coherent, logical theories. Their philosophy prizes rationality and logic above all. They think problems through in a vertical, step-by-step, logical way. They tend to be perfectionists who will not rest easy until things are tidy and fit into a rational scheme. They are keen on basic assumptions, principles, theories, models and systems thinking. They tend to be detached, analytical and dedicated to rational objectivity. They feel uncomfortable with subjective judgements, ambiguity, lateral thinking and anything flippant. Theorists learn best when they are offered a system, model, concept or theory, even when the application is not clear and the ideas may be distant from current reality. They like to work in structured situations with a clear purpose, and be allowed to explore associations and interrelationships, to question assumptions and logic and to analyse reasons and generalise. They like to be intellectually stretched.

Pragmatists
Pragmatists are keen on trying out ideas, theories and techniques to see if they work in practice. They positively search out new ideas and take the first opportunity to experiment with applications. They are the sorts of people who return from management courses bursting with new ideas, which they want to try out in practice. They like to get on with things, and act quickly and confidently on ideas that attract them. They tend to be impatient with ruminating and open-ended discussions. They are essentially practical, down-to-earth people, who like making practical decisions and solving problems. They respond to problems and opportunities "as a challenge". Pragmatists learn best when there is an obvious link between the subject matter and their current job. They like being exposed to techniques or processes which are clearly practical, have immediate relevance and which they are likely to have the opportunity to implement.

Engineers fall into these last two categories, they like to analyse and synthesise. They assimilate facts and observations into coherent, logical theories and they are also pragmatists since they always are keen on trying out theories and techniques to see if they work in practice since the main objective of an engineer is to make things work efficiently.

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GÜNTER HEITMANN
Activity 1 Promoter and Editor

with contributions of
ARIS AVDELAS (chapter 3), ODDVIN ARNE (chapter 7)

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Preface

Günter Heitmann
Technical University Berlin, Germany
Promoter of Activity1

From the constitution in Louvain (February 2000) throughout 3 years of activities (until October 2003) the SOCRATES Thematic Network E4[1] (Enhancing Engineering Education in Europe), with its Activity 1 "Employability through Innovative Curricula", contributed in various ways to current discussions on curriculum development in Engineering Education (EE) in Europe.

Immediately after the Bologna Declaration and the ongoing Bologna Process the adaptation of curricula to the envisaged two and three cycle system of the European Higher Education Area (EHEA) ranked high on the agenda. The roughly 15 active participants of Activity 1 therefore concentrated on urgent questions of two tier curricula in the first year of their work. In a sub group chaired by Oddvin Arne, Professor at Vestfold College in Norway, a proposal for core qualifications of two tier curricula was elaborated and presented to the Network. The document has been also discussed during a conference on two tier curricula drafted in cooperation with the Curriculum Development Working Group of SEFI[2], hosted by the Vilnius Technical University, Lithuania, and organised by Professor Algirdas Valiulis, Vice Rector International and member of A1. That proposal is now also a significant part of this publication.

The day by day work of Activity 1 concentrated on topics of quality standards and outcome orientation of curricula, an issue highly relevant not only for curriculum development but also for transparency of programmes and readability of degrees, for quality assurance and accreditation. A workshop on Outcome Orientation and Output Standards, organised by the A1 promoter Günter Heitmann at Imperial College (London) in April 2002, provided a good opportunity to confront the A1 discussions with an ongoing debate on these issues in the UK. To the workshop contributed some invited speakers from the Engineering Professors Council (EPC), the Quality Assurance Agency (QAA) and the Engineering Council (EC). The results have been presented meanwhile to various workshops and conferences on accreditation and quality assurance, partly organised together with Activity 2 of E4, and also to the first International Colloquium on Global Changes in Engineering Education, organised by the A1 promoter together with the American Society of Engineering Education (ASEE) and SEFI and hosted by the Technical University Berlin in October 2002. Outcomes of these discussions are also reported in this volume.

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[1] www.ing.unifi.it/tne4/
[2] Societé Européenne pour la Formation des Ingénieurs (www.sefi.be).

Recent debates within Activity 1 were focused on the question of outcome assessment and its contribution to continuous improvement of curricula and of teaching and learning. These topics were highlighted at a conference of A1 in cooperation again with the Curriculum Development Working Group of SEFI, hosted in May 2003 by the University of Valladolid and organised by Urbano Dominguez, Professor of this University and member of Activity 1.

Activity 1, mainly through its promoter, disseminated the outcomes of the current work by contributions to various activities and events, namely the Engineering Synergy Group of the Project "Tuning Educational Structures in Europe", the Thematic Network of Civil Engineering (EUCEET), ESOEPE Conferences, the Helsinki Conference of SEFI and CESAER in preparation of the Bologna-Berlin 2003 Conference, the Bologna Process Seminar at Villa Vigoni, the World Conference on Engineering Education 2003, organised by the World Federation of Engineering Organisation (WFEO) and the American Society of Engineering Engineering (ASEE), last but not least the Glossary of Terms Group of E4 (see Volume B of this publication).

Unfortunately, due to the small group of active participants and to the limited and decreasing amount of time which they were able to invest, Activity 1 did not cover all the topics originally intended. Moreover, from the very beginning, curriculum issues of special subject areas of engineering and of emerging branches, besides our proposal of qualification profiles (Chapter 7 of this publication), have not been taken into account and left to the respective specialised networks. However, this report covers many issues of curriculum development based on the experiences of Activity 1 members and the previous work done in the same field (e.g. in the frame of SEFI and its Curriculum Development Working Group as well as on examples of good practice presented in Journals of Engineering Education or on SEFI Annual Conferences).

Thanks to all members of Activity 1 for active participation and continuous interest during the time of existence of the working group. In particular a special acknowledgement goes to all those members of A1 who spent a lot of additional time for the organisation of conferences like Algirdas Valiulis, Urbano Dominguez and Otto Rompelman (TU Delft and chairman of the SEFI Curriculum Development Working Group), for the preparation of special reports like the Guidelines for Core Profiles of two tier Curricula, drafted by Oddvin Arne, Urbano Dominguez and Jan Nadziakiewicz (Silesian University of Technology, Gliwice) or contributing to seminars and to this final report, namely Oddvin Arne (Vestfold College, Norway) with the Guidelines on Core Profiles (Chapter 7) and Aris Avdelas (Aristotele University of Technology Thessaloniki the Demands part (Chapter 3).

This report is not an edition of various individual contributions but covers in a systematic way different topics with regard to curriculum development and innovative curricula based on work, discussions and experiences of A1 members. It should invite and stimulate discussions in the dissemination year of E4 started in October 2003.

The hope is that interesting reference points for future development of curricula in EE in Europe are provided and can thus function as kind of a guideline.

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1. Introduction

1.1 Enhancing Engineering Education in Europe and Curriculum Development

Enhancing Engineering Education in Europe requires to a major extent a focused and continuous revision of existing programmes and the creation of new programmes of study based on the development of innovative curricula and the improvement of teaching and learning. This was the reason why within E4 Thematic Network, differently from the previous Thematic Network H3E, curriculum development has been explicitly addressed by establishing Activity 1 "Employability through Innovative Curricula".

Promoting or ensuring employability is certainly an important driving force for curriculum revision and development. As a consequence of the Bologna Declaration it gained actual attention as the implementation of a two-tier system of higher education in Europe was and is coupled with the explicit expectation that at the end of the first cycle and a minimum of three years of study a certain degree of employability should be achieved. Programmes of EE in Europe so far tended to take at least 4 years or even 5 to 6 years, as long as research-oriented university programmes were concerned. A lack of employability in the traditional, and often binary, not consecutive system of EE in Europe was not really perceived as a crucial problem. It appeared that one of the greatest challenges for curriculum development was to find the way to attract enough, and not primarily male, students to study engineering. This was identified in strict connection with the rapid expansion of the body of knowledge in science and engineering and the new ICT[3] media, which contribute creatively to the solution of environmental, technological and societal problems and foster entrepreneurship and economic development. But in addition, since some years, there has been a loud call for changes from the increasing complaints of employers. This referred mainly to a lack of basic economic knowledge and management skills and of so called "soft skills", namely having learned how to learn and obtain communication and teamwork skills.

1.2 Aims, Themes and Working Methods of Activity 1

The Activity 1 group – discussing a work schedule – felt that the relation of employability and innovative curricula is a necessary but by far a too narrow approach with regard to curriculum development and the enhancement of EE in Europe. It was decided that the European dimension should be placed on top of the agenda, in particular:

[3] Information and Communication Technologies.

- how changing frame conditions caused e.g. by the Bologna Process,
- how the facilitation of mobility by different means of harmonisation and increasing transparency, and
- how the improvement of international orientation and quality assurance,

can be tackled by innovative curricula.
Apart from issues of internationalisation and curriculum development some more general aspects of innovative curricula should be approached.

The Activity 1 working methods have been e-mail corresponding, reports, thematically focused seminars, workshops and meetings. With particular reference to the seminars and conferences which Activity 1 organised, or was involved in, an attempt has been made – besides collecting informations about the state of the art – to stimulate discussions on innovations in curriculum development and to disseminate results already achieved.

It turned out that the Thematic Network, as a cooperation platform, offers at best an active forum for state of the art descriptions, systematisation and structuring of knowledge gained, sharing experiences and disseminating good practice examples between higher education institutions. On the other hand, it was observed that the lack of time and of inappropriate financial support, particularly in terms of money for staff or work contracts for necessary research and for time consuming and more representative investigations, definitely limited the outcomes and diminished the interest in networking and working on such a project. However, taking these limitations into account, Activity 1 has tried to contribute to the European process of developing and enhancing engineering curricula in the frame of Bologna by focusing on crucial issues of this process.

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2. Criteria of Innovative Curricula

2.1 Responsive to New Demands, Creative Towards New Offers

The continuous development of curricula and of teaching and learning strategies is emphasised in the Higher Education Law of some European countries as a central responsibility and duty of the Higher Education Institutions. In the frame of growing autonomy of universities on one side and the corresponding call for accountability on the other, it explicitly became a focus of quality evaluation and quality management. Even more recently it turns out to be a powerful and necessary approach towards competitiveness on a national or transnational, if not global, educational market. In EE, because of additional, reasons it seems even more evident than in some other academic branches that continuous innovation is essential in order to adapt to the fast growing body of knowledge and new scientific and problem-solving approaches and to demands from society, students and employers.

Adapting to new contents and methods is by far not the only criteria for innovative curricula. In general "innovative curricula" in this context are understood as curricula, which show responsiveness to new demands and possibilities. In order not to restrict changes to only demand driven reactions the development of curricula should also try to create and provide new offers with regard to modern subject areas and promising qualification profiles, using the potentials of innovative teaching/learning arrangements as well as ICT.

2.2 Specific Criteria of Innovative Curricula

More specifically and besides responding to:

- new developments in science and technology,
- changing demands of employers, and
- governmental calls for internationalisation,

innovative curricula in EE should address the following aspects:

- a shift from a teaching to a learning-centred approach,
- a move towards an explicit competence and outcomes orientation,
- the adoption of a comprehensive and holistic concept of curriculum development aligning competence oriented learning objectives, provision of appropriate learning arrangements and assessment procedures, finally, continuous feedback and quality improvement,
- flexibility to address different learning styles, student interests and abilities and barriers of underrepresented groups of students like e.g. female students,

- an appropriate and effective use of modern teaching and learning technology,
- a support of life-long learning by explicitly educating “reflective” learners.

Most probably many curricula will not deal with all the aspect mentioned. The extent to which they refer to the listed aspects thus can also determine diversity and profiles as well as good practise within European EE, apart from well known attempts to distinguish between e.g. application and research oriented qualifications and levels.

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3. New Demands

3.1 Reacting to Changing Working Environments

One of the major challenges for the curricula is that they should provide capabilities to face the new and/or changing economic and cultural working environments. The internationalisation of trade and industry, the introduction of new materials and processes and the fast expansion of the information technology have changed many aspects of the engineering practice. New demands are often conflicting between themselves. It has to be decided to which ones precedence should be given.

The engineers of tomorrow have to acquire much more and more diversified skills than their predecessors did. They will have to take into account the human dimensions of technology, to be sensitive to cultural diversity, and know how to communicate effectively in a global level.
In addition to a solid basic engineering knowledge, they will also need the ability to face and solve problems together with other scientists. The understanding of subjects such as economics, marketing and management will be required.

So tomorrow's EE will need to be focused not only on technical knowledge but also on providing the students with the ability to learn, to analyse, to synthesise, and to creatively apply fundamental engineering principles to new problems.
In addition to all that, the next generations of engineers will have to have an aptitude for life-long learning.

3.2 New Teaching and Learning Technology

Another challenge for engineering curricula is the incorporation of ICT and ODL[4]. They both rely on long distance communication, an aspect of modern life that will become a very useful tool for future engineers.
The possibilities offered by ICT together with the next generation of engineering software will dramatically change the engineering classroom and will help the students, by improving accessibility to education and training, to more easily understand and solve real life engineering problems. On the other hand, it will be a very important issue for the teachers to balance this new way of learning with the traditional student-teacher and student-student interaction.
In ODL, the design and the implementation of the appropriate environment (considering pedagogical aspects) is very important for high quality EE. The

[4] Open and Distance Learning.

advantages and disadvantages of the different ODL systems (e.g. Computer Based Education, Knowledge Robots, Intelligent Tutoring Systems, Pedagogical Agents etc.) have to be evaluated in each case.
ODL further raises another class of challenges, not technological but "administrative". They refer to the way ODL courses are graded and by whom, how these courses can be accredited and, most important, who teaches and who follows these courses.

3.3 Interdisciplinarity and Working in Teams

Engineers have always worked in teams. Yet this old fact tends to become an unavoidable necessity, since working on very complex systems with close interaction and interdependence of various components and aspects makes ever more necessary for engineering students to become accustomed to think along interdisciplinary lines in their approach to problem-solving. In the following two points such subjects will be briefly outlined.

New Materials
It is now well accepted that materials are crucial to the quality of life, and to economic security and competitiveness. New materials will play a key role in solving many technical problems facing society, improving the design and development of modern devices, structural products etc, increasing the efficiency of energy utilisation, achieving major breakthroughs in future technologies, such as the ones associated with telecommunication, medicine, nanostructures and intelligent materials and helping industry maintain and improve international competitiveness.
The introduction of new materials courses calls for interdisciplinary coordinated curricula cutting across departmental lines. Faculty from various departments and with different backgrounds will have to participate in integrated and interdisciplinary programmes of study encompassing both the necessary scientific fundamentals of chemistry, physics, and mathematics and their technological and engineering applications.

Intelligent Buildings
Another subject that calls for interdisciplinary coordinated curricula is intelligent buildings. An intelligent building is defined as the one that maximizes the efficiency of its occupants while at the same time allowing effective management of resources with minimum lifetime costs. The complex interdependencies of the systems, required for an intelligent building to function, calls again for faculty from various departments that will have to cooperate in the framework of integrated and interdisciplinary programmes.

3.4 Environmental Issues

EE must enhance the environmental sensitivity of the students. Design methodologies incorporating the principles of sustainable development and must be utilised throughout the education of engineers. Furthermore, standards for environmental protection should be highlighted during the formative period of engineers, so that their use becomes a natural part of the later practice of the engineer after graduation.

3.5 Engineering Ethics

The understanding of the rising role of the engineer as a policy maker whose decisions have a wide impact to society has created an increasing need for special courses to help engineers to develop a better understanding of the role of technology in shaping public policy and developing a moral-reasoning process. Courses in ethics and public policy in the engineering curricula will instill in graduates a greater sensitivity to risks, societal values, and the will to resist management decisions not adequately technically supported. They will also give the students a broader understanding of the nature, side effects and societal aspects of technology, of the ethical issues at stake in their professional practice, of their legal and moral responsibility and of the levels of responsibility (individual, corporate and profession, society) induced by the technology they contribute to develop.

3.6 Research versus Application Demands

Research and educational partnerships between universities and industry improve the quality of EE and strengthen the competitiveness of industry. This can be achieved by providing a technology-focused, industry-informed, interdisciplinary educational environment in which students are educated by, through and in conjunction with active participation in the performance of cutting-edge engineering research and technology innovation. The integration of research and education can produce both new technology and curriculum innovations. Faculty members can play an important role in this process by developing teaching material based on their research results, bringing in this way their students in contact with engineering research and by encouraging the innovation capabilities of the students.

Yet, the golden rule is to be found. Although the trend is to train students on how to work in research projects, it must be remembered that engineers are closely related to practice. For this reason, engineering curricula should include an early exposure of the students to practice. In addition, increasing activities should be taken towards entrepreneurship education in the context of EE.

3.7 Attracting Students

Because of various reasons, in many countries the interest in enrolling in engineering programmes of study has dramatically decreased. Consequently the demand for improving the attractiveness of these kind of studies by providing innovative programmes and challenging learning environments has been expressed. In particular it is hoped that innovative curricula could help to interest female students and raise their share on the engineering students and graduates, which, in some engineering branches, is below 10%. Even if it is obvious that the curricula itself are not the main reason for this unsatisfactory state of the art, we know from some experiences that innovative curricula can contribute significantly to better the situation.

3.8 Interests of Students and Graduates

Responding to demands of employers and trying to achieve employability does not necessarily cover all the interests of the students and future graduates, in particular when only short term interests are satisfied in employer-oriented qualification profiles. Graduates need to be prepared for life long learning and for competing successfully on an ever changing labour market. In addition, students as learners with different abilities and learning styles want to find a certain diversity of offers and challenging learning situations addressing the increasing heterogeneity of the student body. They do no appreciate to be threatened by inappropriate assessment and selectivity patterns. They also expect programmes with a certain degree of flexibility in terms of individual options, recognition of prior learning and the opportunity to profit from part time and distant learning.

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4. Internationalisation[5]

4.1 Internationalisation as a Key Strategic Goal in Higher Education

Besides of what has been previously described, internationalisation has become a main challenge and driving force of curriculum development in EE and in due course a key strategic goal on various levels of higher education (EUA 2003). It covers a broad range of approaches and activities, which in different ways affect the development of curricula:

- internationalisation on the higher education systems level through adapting to common reference structures, credit and grading systems, accreditation and quality assurance standards;
- internationalisation at the higher education institution level through transnational cooperation in education and research based on bilateral agreements or multilateral networks; offering programmes of study on a global educational market by attracting foreign students to leave their home country or addressing them in their home country by ODL, Virtual University offers or establishing university extensions abroad;
- internationalisation at the department and programme level offering programmes or courses/modules in foreign languages, incorporating intercultural modules, integrating study or internship abroad phases, creating joint and double degree programmes, facilitating the recognition of modules and outcomes gained in foreign countries;
- internationalisation at the staff and student level by promoting the idea of studying or working part time abroad, encouraging student driven international activities like transnational student bodies, mixed international teamwork and summer courses, funding student and staff exchange through various sources, providing international experiences for students at home and increasing virtual transnational cooperation.

Internationalisation is facing many obstacles namely in the area of national law and institutional traditions and regulations. And by far the majority of staff and students still hesitates or is reluctant to be involved in any kind of international activity. However, governments and Higher Education Institutions through different means are on their way towards internationalisation trying to make it a significant feature of their research and educational offers. Europe with regard to the 15 EU member countries and the associated countries supported internationalisation increasingly through various cooperation and exchange programs like ERASMUS, Tempus, Leonardo, SOCRATES and Alfa.

[5] This topic has been treated also by Activity 4 Working Group which dealt with “Enhancing the European Dimension” (cfr. Volume E of this publication).

A tremendous drive was caused by the Sorbonne (1998) and Bologna (1999) Declarations and the subsequent and ongoing Bologna Process – meanwhile signed and supported by 40 European countries – aiming at the creation of a common European Higher Education Area (EHEA) by 2010 and linking it increasingly to the European Research Area (ERA). Also the Lisbon Convention (2000) contributes remarkably to the process of internationalisation. This is mainly due to the fact that it comprises even more countries as signatories. It addresses and facilitates mutual recognition and introduces the Diploma Supplement as a tool of increasing the transparency of qualifications.
Comparable initiatives and activities are to be registered globally, partly based on values which traditionally characterized university research and education but more and more driven by the strive for economical competitiveness.

4.2 The European Approach: Harmonisation and Diversity

Europe's claim for becoming the most competitive economy by 2010 is to great extent based on the improvement of higher education and research and the achievement of excellence. It is widely accepted that one of the central aims will be the improvement of the quality and comparability of degrees and outcomes. Thereby the international attractiveness of higher education will be increased and the mobility of students and staff, of graduates and finally the work force in general will be facilitated.

Harmonisation of structures and curricula in higher and vocational education could be a means to achieve this aim more or less easily as far as other obstacles are not hindering mobility and exchange of ideas and people. Not surprisingly harmonisation of educational structures as a central goal was already stated during the fifties of last century in the Treaties of Rome at the beginning of the process of European integration and cooperation. But soon it turned out that this aim could only be achieved by a long-term bottom up process due to significant differences and traditions in the European education systems and the lack of power devoted to European bodies with regard to educational and cultural affairs. It also became more and more evident that keeping the cultural heritage and developing diversity could contribute positively to an integrated and competitive Europe. The tension between the conflicting aims of harmonisation and developing diversity thus characterized the European development since decades. Consequently the current move to convergency through a common reference structure of two, respectively three cycles of higher education based on the Bologna Process is still and should continue to be accompanied by the improvement of transparency of divergent degrees and approaches in order to facilitate mutual recognition and the fruitful development and competition of good practice. National recommendations and laws implementing the Bologna Declaration aims thus should not be too rigid and prescriptive to not threaten creative and innovative solutions to emerge.

Besides of common reference structures the development of a "European Dimension" within the programmes offered (or even a "European Curricularisation" in terms of developing transnational modules and joint programmes), as well as agreeing on common core qualifications or curricula, is one of the challenges for innovative curricula and was the focus of the E4 Activity 1 considerations.

4.3 "Global" Education

In EE a strategy of "Europeanisation" tends to be far too limited when answers to the question of necessary international competences of graduates are to be found. What is needed is a kind of "global" education.

To the extent that engineers will be involved in the management of technology in a global context, their education should prepare them for this role. In the years to come, more and more of the engineering projects will be performed by *ad hoc* combinations of specialist firms that come together from different parts of the world to tackle a single project and disband upon its completion. The modern engineer must learn to perform teamwork in an ethnically diverse and geographically distributed global environment. Engineering students must get this ability at least basically already through their programme of study. With regard to changing needs on the local, national but also global labour market engineering graduates will have to achieve a far higher flexibility than they were used to up to previous times.

A significant part of this education should address professional ethics and code of practise and refer to global demands on sustainability and societal demands.

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5. The Overall Frame Conditions and Structures of Engineering Curricula

5.1 Diversity of National Systems and Traditions and the Challenge of the Bologna Process

Since systematic education of engineers emerged and became part of either the vocational or the higher education system in the 19th century the basic approaches and the main structures of the programmes followed different lines according to national traditions and needs. With a growing number of students requiring university education and an uprising demand of differently qualified engineering graduates by a big range of employers the diversity of systems, degrees and programmes increased dramatically. In European countries to a different extent – besides of 4 to 6 years long university programmes often linked to or based on research – a remarkable variety of 3 to 4 years programmes aiming at a more application oriented and professional engineering qualification came into existence. In addition, on a sub degree level different types of technician education were established, mostly based on 2 years programmes.

This parallel system of long and short programmes in EE, either provided within the Universities or Universities of Technology or by different types of additional institutions like Polytechnics, Technical Colleges, higher education Engineering Schools or Fachhochschulen – despite of some problems of mutual recognition on national and international level – in general proved to be quite functional with regard to the needs of employers and society. A certain degree of comparability and transparency of the diverse EE and degrees has been achieved throughout Europe permitting international exchange of students and cooperation of staff to happen. Also the recognition of degrees by the EU General Directive of 1988 and other means like the FEANI register of EurIngs was somehow settled in Europe. Challenges in EE derived primarily from changing demands from employers and the development of science and technology than from recognition and mobility issues. The Thematic Network H3E as a predecessor of E4 therefore tried to contribute to the achievement of issues of improving quality and transparency in European EE rather than proposing new structures.

The Bologna Declaration aims to implement a two cycle sequential system as a general feature for all disciplines of higher education. In many European countries this was perceived more as a threat than a promising frame for future developments and the improvement of quality in EE. In Europe only UK and Ireland had this kind of sequential system with bachelor and master degrees in existence and by transforming the Polytechnics to Universities in 1993 the UK skipped the binary structure and strengthened a 3 plus 2 system. This structure was – at least according to the formal length of studies – also not comparable to the 4 plus 1 bachelor/master system of the

USA. Partly in order to avoid potential problems of international recognition and in addition to raise the quality in EE higher education institutions in the UK, following the so called SARTOR III recommendations of the Professional Institutions, four years programmes have been implemented. They do not provide a bachelor degree like in USA but claim to arrive at a level of quality worth to award a master degree. The MEng degree is now the required educational standard for becoming a Professional Engineer, known as Chartered Engineer, after additional three years of respective Initial Professional Development and registration with an Engineering Institution. In addition a route to a so-called Incorporated Engineer (IEng) was established based on a three years bachelor degree plus Initial Professional Development and registration.

SEFI, as well as CESAER[6] and many national academic and professional bodies of engineering educators and engineers have repeatedly published their support to the general aims of the Bologna Declaration and the creation of a European Higher Education Area (see http://www.sefi.be). In due course they expressed their concern that a too rigid application of a two tier structure with three years of study as the frame for achieving a first cycle degree and additional two years for a second cycle degree may diminish the quality, the typical features and the international competitiveness of the European Engineering Education. In particular this seems to concern the achievement of satisfactory employability and of Trans-European international recognition for three-year programmes and degrees. It also applies to the maintenance of research and theory orientation of long integrated university programmes leading directly to a second cycle respectively master degree level.

CESAER and SEFI, supported by E4 Thematic Network, contributed recently, with the outcomes of their 2003 Helsinki Seminar, to the Bologna-Berlin Summit of the signatories and further shaping of the Bologna process (see Annex 1 of this volume). The recommendation regarding the overall structure is a confirmed support of a two, including a doctoral phase three-cycle structure in general but a strong plea to provide open frames. Options for diversity must be offered e.g. for the conservation of long integrated programmes leading directly to a second cycle respectively master degree.

In addition the successful application oriented programmes towards a first degree in many European countries should be maintained. It is hoped that a time frame will be found, possibly exceeding three years of study, where typical features like internships, semesters in industry, various projects and final thesis work can be kept. Recent recommendations based on stakeholders, signatory countries seminars and discussions in the wake of the Bologna Process, seem to allow these options by stating that the programmes towards a first cycle degree should comprise 180 to 240 ECTS credits. With 60 credits connotated to one year of full time study and with an overall workload of 25 to 30 hours per credit this amounts to three respectively four years of study. Second cycle programmes should comprise 90 to 120 credits with at least 60 credits at

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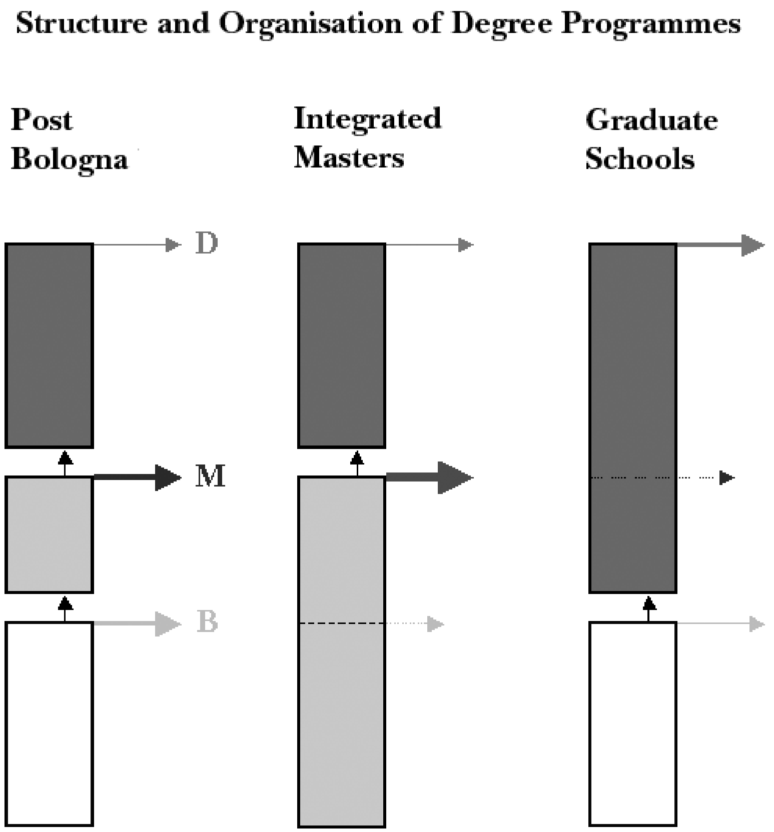
[6] Conference of European Schools for Advanced Engineering Education and Research.

advanced level. As far as integrated 240 to 300 credit programmes are also possible, this frame would provide enough options and flexibility for EE to maintain quality and to develop innovative curricula.

During the Helsinki Seminar the following structure was presented as a possible general "post Bologna" frame encompassing also the doctoral cycle (Gareth Jones, Imperial College London: "Beyond the Bachelors"). This structure would offer enough options with still the crucial question on which role a three years bachelor in EE can play in the future.



For the time being it is not quite clear how the various national authorities will act in the future and whether a flexible approach to different professions and academic disciplines will be taken. Throughout Europe a high degree of diversity, if not confusion, still persists. There are however some indications that a majority of governments would prefer a rigid 3+2 solution with a tendency to let the majority of students finish higher education after a first cycle degree. This is mainly due to financial reasons. The higher education systems in Europe are still predominantly state funded and are facing new challenges if the political goal of increasing the number of students or providing higher education for higher percentage of an age group would be implemented.

Not only for EE it can be questioned whether by a superficial convergence of time frames the envisaged compatibility and recognition can be achieved as long as different intake levels, selectivity patterns, assessment and grading approaches and professional development schemes are not taken into account.

E4 Activity 1 at its 2002 Vilnius Conference on two tier curricula and also by its state of the art investigations has monitored the process of implementation of new curricula and degrees.
(SEFI Document: Bologna Spirit in Two Tier Engineering Education Curricula Development) As far a the Bologna structures have been implemented in EE different types of programmes of 3 and 4 years but also 3 and a half year duration to a first cycle degree can be observed, in some countries like Germany even all of them, in Italy a rigid 3+2 frame (see the SEFI Portfolio on the Bologna Process at http://www.sefi.be). The main challenges for curriculum development obviously concerns the 3 years programmes, in particular when in due course employability and satisfactory professional education and training, as well as a profound scientific foundation for a continuing advanced study in the second cycle, must be provided.

Activity 1 has therefore reacted to this challenge and attempted to design a kind of core curriculum for the 3+2 frame as points of reference, not in the traditional approach of content lists but in an outcome oriented approach as a set of ability statements with regard to core subjects. These cores express minimum standards and have to be enhanced by additional requirements and curricular and educational provisions to arrive at certain qualification profiles (see chapter 7 of this volume). By additional requirements with regard to typical profiles or labels, national conditions and traditions or with regard to problems of international recognition for academic and professional qualifications these enhancements may well exceed the notional time frames for each cycle or the relation between the two cycles up to a frame of 4+1.

5.2 Levels and Profiles

Generalised determinations of levels and profiles in terms of duration of cycles or programmes of study or in terms of credits respectively calculated student workload do not provide a satisfactory frame for curriculum development, quality assurance, for comparability and readable degrees, as e.g. the Bologna Declaration aims at. Besides quantitative and qualitative criteria have to be stated and taken into account. To be operational and assessable these criteria should be focused on outcomes and not on inputs. As long as they are just general statements they have to be specified for different disciplines and professional orientations, as, for instance, the engineering field. Some countries in Europe like the UK, France and to a certain extent the Netherlands since the 90ties have tried to develop comprehensive qualifications frameworks encompassing all levels of their educational system including higher education. Particularly the UK has tried to follow an explicitly outcome oriented approach. In addition, for higher education the Qualification Assurance Agency (QAA) has undertaken the initiative to specify the bachelor with honours level with regard to different disciplines by subject benchmarking. Following a generalized format for each of the subjects chosen, in EE the outcomes and threshold standards have been specified with regard to knowledge and understanding, intellectual abilities, practical skills and general transferable skills. Different bodies have undertaken other attempts and we shall refer to it in some detail in chapter 5.3.

Based on UK experiences and with regard to the two cycles aimed at in the Bologna process the so called "Joint Quality Initiative", a group formed by representatives of some national Quality Assurance Agency which at the same time are members of the European Network of Quality Assurance Agencies (ENQUA) have tried to define certain generalized level descriptors. These so called "Dublin Descriptors" are meant to provide reference points for the necessary qualitative dimension and convergence with regard to the two Bologna Declaration cycles:

Bachelor	Master
Have demonstrated knowledge and understanding in a field of study that builds upon and supersedes their general secondary education, and is typical at a level that whilst supported by advanced textbooks includes some aspects that will be informed by knowledge of the forefront of their field of study	Have demonstrated knowledge and understanding that is founded upon and/or enhances that typically associated with Bachelors level and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
Can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study	Can apply their knowledge and understanding and problem solving abilities in new and or unfamiliar environments within broader (or multidisciplinary) contexts related on their filed of study
Have the ability to gather and interpret data to inform judgements that include reflection on relevant social, scientific or ethical issues	Have the ability to integrate knowledge and handle complexity and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements
Can communicate information, ideas, problems and solutions to both specialist and non- specialist audiences	Can communicate their conclusions and the knowledge and rationale underpinning these, to specialist and non- specialist audiences clearly and unambiguously

Have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy	Have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous

The Joint Quality Initiative also summarised the main differences of the two levels incorporated in this overview.

Besides of representing very basic and general qualitative criteria these kinds of level descriptors do not differentiate between threshold and advanced levels and also not between certain profiles on each level. The latter, however, used to be a crucial issue for EE and in general for those countries which had established a higher education system with two or more parallel tracks primarily aiming at different profiles of engineering graduates not necessarily on levels of qualifications. In many European associated countries, even with different types of higher education institutions, who submitted the respective programmes of study, the most prominent distinction is that one between more-application-and-practice and-more-theory-and-research oriented tracks. Examples with long tradition are to be found in Germany, the Netherlands and Denmark, and with quite recently developed Fachhochschule type of institutions also e.g. in Finland, Switzerland and Austria.

In EE the implementation of the two-tier system recommended by the Bologna Declaration did not yet result in a more or less common European approach. The frames and conditions for developing innovative curricula are therefore considerably different.

Italy with the most rigid and top down approach replaced the old system and skipped the binary structure, established within the universities in the early 90ties, and required to develop three year first cycle programmes to a Laurea degree in the different branches of engineering with no distinction in application or research oriented profiles. The ongoing developments of two years second cycle programmes towards a Laurea Specialistica degree may in the future arrive at different profiles. A master degree so far is delivered for special continuing education programmes only.

Germany quite in contrast started to implement bachelor and master programmes already in 1998 and even before the Bologna Declaration. With a revised Higher Education Frame Law Act of August 1998 Germany gave way to a comprehensive experimentation phase whereby the attempt was made to keep the existing system of two different profiles represented by the programmes of Universities and of Fachhochschulen in both cycles. The profiles should be made visible in the denomination of the degrees: application oriented bachelor or master degrees should be called Bachelor or Master of ... Engineering, with the special subject area mentioned in the title, whereas the more theoretical and research oriented profiles should be named Bachelor of Science in ... Engineering or Master of Science in ... Engineering. Thus four different sets of threshold standards for the four different profiles had to be defined by the newly established Accreditation Agencies which have to accredit each one of the newly developed programmes and their delivery and outcomes. The most radical step undertaken by the new law was the cancellation of the previous institutional links: Fachhochschulen (Universities of Applied Sciences) are no longer restricted to offer just first cycle degrees of the application oriented type but can also provide theoretically oriented science bachelor and in addition they can develop and offer master degrees of both types. Vice versa are the Universities encouraged to offer all different kinds of profiles as well?

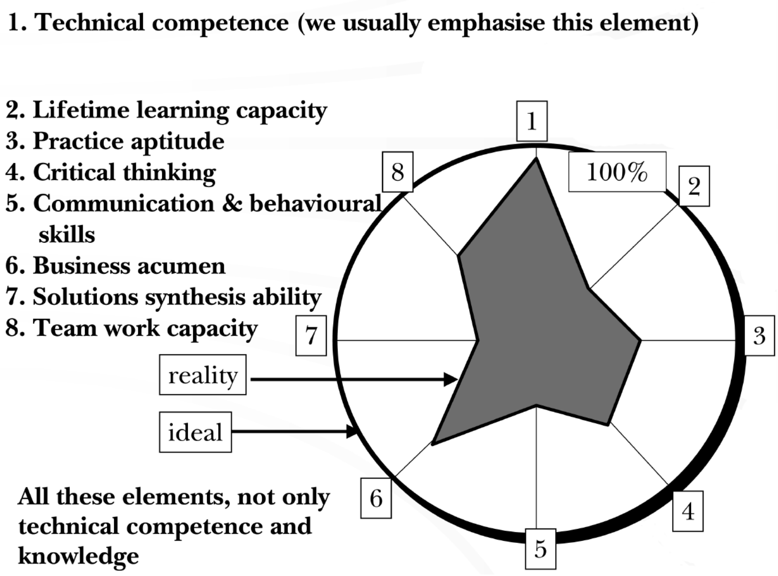
Since 1998 up to 2003 more than 1800 new programmes with bachelor or master degrees have been established. More than 400 are in engineering, mostly in addition to the existing programmes towards the Diplom-Ingenieur (Dipl.-Ing.) degree and with the old system still in place. What makes the situation even more diverse is the fact that bachelor programmes may last from 3 to 4 years, master programmes from 1 to 2 years, in a sequential mode not longer than 5 years. Not surprisingly all variations have been developed. The 16 Federal States (Bundesländer), responsible for educational and higher education affairs, follow partly their own strategies in the implementation of Bologna and executing the options given by the Frame Law Act.

A recent statement (June 2003) of the Conference of the Ministers for Cultural Affairs (KMK) and an envisaged specification aim at joining some kind of simplification but also at increasing the pressure to replace the old system with parallel tracks and degrees until 2010. The simplification is seen in that the distinction between application oriented and research oriented profiles shall no longer exist with the bachelor degree but only with the masters. All bachelor programmes have to strive for employability, and therefore a certain amount of practice and application orientation, and should not be developed as mere preparation for a continuing master programme. However, the Universities of Technologies in Germany continue to argue that the main destination of their educational offers should be the second cycle or master level degree with the bachelor as a pivot point for selecting an individually appropriate if not tailor made (through modularisation and a high amount of optional combinations) master programme. The Fachhochschulen (like similar Higher Education Institutions in many other European countries) may continue to focus on first cycle degrees with strong application orientation but have grasped the new opportunities and offer – at least in Germany – a big variety of master programmes, an increasing number of them of the continuing education type. Degrees now to be used in engineering are preferably Bachelor of Engineering and Master of Engineering or Master of Science. In these cases the specification of the engineering branch or the profile only appears in the Diploma Supplement, but not in the title.

In 2002 France has passed a new Law fostering to implement the Bologna Process type of cycles. But it looks like this will mainly affect the Universities and in Engineering probably the IUT/IUP programmes. The traditional Grandes Ecoles programmes towards an Ingénieur Diplomé based on 5 years of study including one or two years of classes preparatoires at special schools want to continue with their traditional programmes and in addition provide master programmes solely devoted to continuing and special additional education (for a comprehensive overlook of the state-of-the art in EE see the SEFI Portfolio on Bologna at http://www.sefi.be, in particular T. Hedberg (ed.), The implementation of the Bologna Declaration in Higher Engineering Education).

As a conclusion, with regard to various profiles in EE on each of the two levels, it can be stated that a great variety of different profiles (and in addition quality labels) is going to emerge at the second cycle and will leave a lot of options for curriculum development. As far as the first cycle programmes are concerned, a tendency of convergence can be observed throughout Europe with profiling of programmes and outcomes and the quality achieved more implicit and often based on the mission and merits of the respective programme providers. In order to make transparent the profiles and the quality of the programmes it is still necessary to have an appropriate common language of description of outcomes and a valid and reliable practice of assessment. E4 Activity 1 recommends that, for an appropriate description of profiles in certain branches of engineering, more than the usual 2 criteria application and theory orientation should be used.

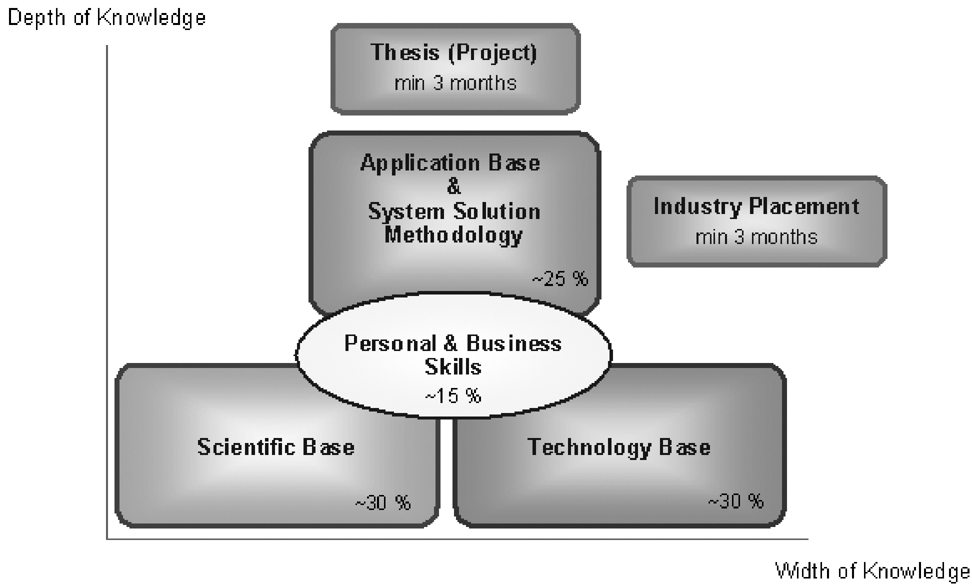
One possible solution which operates with 8 criteria and could be adapted to cover all competences of a certain profile including their intended levels of achievement is given by the following graph:



(Source: Majewski S., Rubinska B., Modernising of educational system at the Civil Engineering Faculty of the SUT in Gliwice, Poland, ppt presentation at a EUCEET seminar at Gliwice, 2002).

For curriculum development itself more detailed competence lists or intended learning outcomes should be used as described in the following chapters.

As profiles are strongly related to the breadth and depth of a programme and are sometimes discussed under the question of generalist versus specialist education a more traditional in-put oriented approach could be based on the different subjects or subject areas involved and the intended level of achievement. This approach is demonstrated e.g. by the Career Space Networkin its curriculum development guidelines for new ICT curricula (source: Careerspace: Curriculum Development Guidelines, New ICT curricula for the 21st century, 2001, for details see http ://www.careerspace.com.



5.3 The Professional Dimension: Employability, Threshold Standards and the Role of Initial and Continuing Professional Development

Engineering science as an academic discipline with rapidly evolving branches and subject areas is more or less strictly related to engineering as a profession. Achieving a certain kind of employability through the respective programmes of study was thus always a trivial aim of the education and training and the design of the curricula. However, the approaches have to be flexible and can be quite different depending on what kind and level of employability shall be achieved. This does not only apply to the extent employability refers to the demands from employers and society described in chapter 3. It also depends on more legal aspects of employability and of getting access and executing the profession: the right to carry a protected title or to register or get licensed as a professional engineer, the right to execute certain specialities of professional work or to start a business as a freelancer or consultant. Answers to these questions have an influence on the definition of threshold or access standards to the profession, on its application in accreditation or registration procedures and thereby also on the development of programmes and curricula.

The European Union has tried to regulate and to harmonise the access of higher education graduates to the European labour market and to ensure the appropriate recognition by various Special or General Directives and it is currently discussing a new comprehensive Directive. The engineering profession, although heavily striving for a Special Directive, has never succeeded as the architects did. Professional recognition in Europe, but meanwhile even globally, as one aspect of employability continues to be a crucial issue influencing the definition of threshold standards and programme development.

Without going into details here (for this purpose have a look at Volume D of this publication) and focusing only on some conditions for curriculum development, it can be stated that employability, not in the sense of getting a job, but in the sense of getting licensed or getting professional recognition, in more and more countries around the world, is based on achieving an accredited degree in engineering, based on certain standards and often a certain amount of an appropriate practical experience or Initial Professional Development (IPD). Wherever there are, like in the UK or in the USA, a registration, additional requirements on practical experience and additional exams or interviews, towards a professional engineer status, they influence, in some ways, the model of the initial education. For instance: practical experience during the initial education, a practice or research-oriented thesis work are often not required. On the contrary, many continental European countries just rely on the education and training as the only professional qualification, providing, like in Germany, the right to use the title of engineer after having received the appropriate degree. The absence of additional requirements after graduation and the lack of registration patterns have often led to the result that the Higher Education Institutions felt more committed to provide a comprehensive and professionally-oriented EE leading to a master level degree.

For the future, it can be expected that together with the demand for transnational or global professional recognition, registration patterns of professional bodies or chambers will also become a common feature, probably based on experiences already existing (e.g. the Engineering Council in the UK or FEANI in Europe) or on structures currently being established (like the Engineers Mobility Forum). This will at least result in tendencies to refer or agree on global threshold standards for the accreditation of first degree programmes, like already started with discussions in the context of the so called Washington Accord or by referring to existing standards like those of ABET[7]. Europe, with its traditional focus on second cycle or master level qualifications in engineering should contribute to the determination of these standards. Nevertheless, for the time

[7] Accreditation Board for Engineering and Technology.

being, it is hoped that there won't be any problem in surmounting existing standards by the traditional five-years programmes. In due course it should be remarked that also the first cycle qualifications achieve these standards, thus providing not just employability but full recognition and access to the profession. The orientation on comparable outcomes of the programmes now developed and offered under the Bologna scheme, in order to achieve substantial equivalence to internationally recognized programmes, will support this attempt. This seems to be possible even if the duration of studies is not 4 years, as usual at an international level, but 3 years, as often these three-years programmes are based on a more comprehensive and higher level of qualification from secondary school, as the required access level, e.g. compared to the USA.

5.4 Contents of Programmes versus Outcomes Orientation

Traditionally, curriculum development – not only in EE – used to be guided by some fairly vague programme specifications, but an often very detailed list of necessary subjects, contents and associated contact hours. If not totally prescribed by government bodies or fixed through approval or accreditation standards, this in-put driven approaches are at least based on compulsory core curricula with some variety of optional subjects to be developed and offered by a certain Higher Education Institution. It is mostly argued that a high degree of similarity would ensure quality, recognition and, thereby, mobility of students at least on a national level. Also with regard to comparability, on an international level, this approach claimed to be operational but, in the reality, it often failed when it came to detailed comparisons of outcomes and attainment levels. Similarities in the structure of engineering curricula, traditionally often based on two initial years of math and natural science plus foundations in an engineering branch, proved to be superficial with regard to outcomes. This happens as long as access requirements or selectivity of student intake has not been taken into account.

In addition, this kind of in-put related curriculum development, proved to be too much focused on teaching instead of learning. A shift from a so called teaching paradigm to a learning paradigm is sometimes demanded and advocated also for higher education and it is based on respective research results and better understanding of learning and learning styles. It is quite obvious that this orientation towards learning outcomes and performance is partly related to the public call for improved quality and accountability of higher education. But it also corresponds to the fact that with the increase of the number and heterogeneity of students, on one hand, and the differentiation of the demands of employers, on the other hand, different profiles or clusters of qualifications became useful and necessary. They should focus not only on academic knowledge and understanding but on a range of additional attributes and competences. Particularly in EE an emphasis on personal and social competences, or so called transferable or key skills, was claimed for different reasons. Even if implicitly the education of these skills and competences may have taken place to some extent in the traditionally in-put driven programmes, deficiencies were articulated by employers. Only if explicitly addressed in terms of respective learning objectives and intended learning outcomes an improvement of the results seems to be possible. It demands that appropriate teaching/learning arrangements are provided and that the achievement of intended outcomes is properly assessed on a differentiated and regular basis.

Still many countries implementing the two tier Bologna structure of programmes prefer regulations by in-put data as for instance Italy and Spain. Others shifted at least partly to outcomes orientation, manifested in accreditation standards and often combined with specifications of subjects or subject areas like UK and Germany.

CESAER and SEFI in their comments on the Bologna Process (see Annex 1) supported the outcomes-oriented approach towards programme development and specification of qualifications. Activity 1 of E4 strongly recommends to focus curriculum development on student learning and specified outcomes, even when curriculum development or revision starts from subjects or course units. The core profiles developed by A1 as points of reference for an agreement on minimum standards (see chapter 7) try to apply this approach listing the abilities graduates should achieve and demonstrate in certain common and branch related subjects. It was presented and discussed at the A1 workshop on outcomes orientation at Imperial College in 2002 and has been partly revised afterwards. At this workshop and also from discussions in the context of the Tuning Project and ESOEPE it became evident that still quite some differences exist with regard to:

- the respective language terms and the implicit concepts used to specify outcomes,
- the agreement on generic and specific outcomes curricula in EE should be based on,
- the necessity of levels related to specified outcomes, e.g. a distinction between a threshold and an advanced level.

As programme developers and providers should be aware of the respective frames or possible options, some of the approaches shall be quoted here. As regards the terms and concepts the Thematic Network H3E already 1998 has proposed to use a list of qualification attributes which then – in combination with different levels of attainment – can form the basis for describing qualification profiles as a set of intended learning outcomes, but also as record of the knowledge and understanding, the skills and attitudes achieved.

The so called EuroRecord Project financed by the Leonardo da Vinci Programme has determined an elaborated list of outcomes against which an individual graduate or engineer should be able to assess and record his or her personal qualification profile, achieved through initial education as well as work experience, continuing education and informal learning. The Socrates financed Tuning Project (Tuning Educational Structures in Europe) started its outcomes-oriented model from a concept based on competencies, applying somehow the attributes idea.

"By learning outcomes we mean the set of competences including knowledge, understanding and skills a learner is expected to know/understand/demonstrate after completion of a process of learning – short or long. They can be identified and related to whole programmes of study (first or second cycle) and for individual units of study (modules). Competences, can be divided into two types: generic competences, which in principle are independent from a subject, and competences which are specific for a subject. Competences are normally obtained during different course units and can, therefore, not be linked to one unit. It is however very important to identify which units teach the various competences in order to ensure that these are actually assessed and quality standards are met. It goes without saying that competences and learning outcomes should correspond to the final qualifications of a learning programme" (see the full report of the Tuning project, page 23 at www.relint.deusto.es/TuningProject/index.htm or www.let.rug.nl/TuningProject/index.htm).

Tuning has made a distinction between generic and subject specific competences.

"Competences represent a combination of attributes (with respect to knowledge and its application, attitudes, skills and responsibilities) that describe the level or degree to which a person is capable of performing them". (Tuning, op. cit., page 255).

Within the generic competences 30 items have been determined and used to identify demands and achievements through questionnaires distributed to employers, graduates and academic faculty:

Instrumental competences:

- Capacity for analysis and synthesis;
- Capacity for organisation and planning;
- Basic general knowledge;
- Grounding in basic knowledge of the profession;
- Oral and written communication in your native language;
- Knowledge of a second language;
- Elementary computing skills;
- Information management skills (ability to retrieve and analyze information from different sources);
- Problem solving;
- Decision-making.

Interpersonal competences:

- Critical and self-critical abilities;
- Teamwork;
- Interpersonal skills;
- Ability to work in an interdisciplinary team;

- Ability to communicate with experts in other fields;
- Appreciation of diversity and multiculturality;
- Ability to work in an international context;
- Ethical commitment.

Systemic competences:

- Capacity for applying knowledge in practice;
- Research skills;
- Capacity to learn;
- Capacity to adapt to new situations;
- Capacity for generating new ideas (creativity);
- Leadership;
- Understanding of cultures and customs of other countries;
- Ability to work autonomously;
- Project design and management;
- Initiative and entrepreneurial spirit;
- Concern for quality;
- Will to succeed.

The distinction of generic and subject specific competences adopted for analytical and also practical reasons, allowing cross disciplinary investigations and comparisons, are in some way misleading. In practice, and in cases were an academic subject or discipline and a profession are closely linked – like in engineering – many of the generic competences are essentially subject related and have to be seen as dimensions of complex engineering capabilities. For curriculum development as a synthesizing activity the specification of competences or intended learning outcomes should not lead to the assumption that these isolated competences have to be addressed by separate learning arrangements. Integrative approaches are necessary in the attempt to link so called generic competences or transferable skills with subject or profession related skills.

The subject benchmarking activities of the Quality Assurance Agency UK tried to do so, even more the UK Engineering Professors Council (EPC) Output-Standards. Attempting to identify standards of necessary learning outcomes for engineering besides mentioning at first the "ability to exercise key skills in the completion of engineering-related tasks" the EPC started from engineering design as the integrating and central engineering activity and derived from there 6 basic abilities encompassing altogether 26 different attributes:

(1) **Ability to exercise Key Skills** in the completion of engineering-related tasks at a level implied by the benchmarks associated with the following statements. Key Skills for engineering are Communication, IT, Application of Number, Working with Others, Problem Solving, Improving Own Learning and Performance.

(2) **Ability to transform existing systems into conceptual models**

This means the ability to:

a) Elicit and clarify client's true needs
b) Identify, classify and describe engineering systems
c) Define real target systems in terms of objective functions, performance specifications and other constraints (e.g., define the problem)
d) Take account of risk assessment, and social and environmental impacts, in the setting of constraints (including legal, and health and safety issues)
e) Select, review and experiment with existing engineering systems in order to obtain a database of knowledge and understanding that will contribute to the creation of specific real target systems
f) Resolve difficulties created by imperfect and incomplete information
g) Derive conceptual models of real target systems, identifying the key parameters

(3) **Ability to transform conceptual models into determinable models**

This means the ability to:

a) Construct determinable models over a range of complexity to suit a range of conceptual models
b) Use mathematics and computing skills to create determinable models by deriving appropriate constitutive equations and specifying appropriate boundary conditions
c) Use industry standard software tools and platforms to set up determinable models
d) Recognise the value of Determinable Models of different complexity and the limitations of their application

(4) **Ability to use determinable models to obtain system specifications in terms of parametric values**

This means the ability to:

a) Use mathematics and computing skills to manipulate and solve determinable models and use data sheets in an appropriate way to supplement solutions
b) Use industry standard software platforms and tools to solve determinable models
c) Carry out a parametric sensitivity analysis
d) Critically assess results and, if inadequate or invalid, improve knowledge database by further reference to existing systems, and/or improve performance of determinable models

(5) **Ability to select optimum specifications and create physical models**

This means the ability to:

a) Use objective functions and constraints to identify optimum specifications
b) Plan physical modelling studies, based on determinable modelling, in order to produce critical information
c) Test and collate results, feeding these back into determinable models

(6) **Ability to apply the results from physical models to create real target systems**
This means the ability to:
a) Write sufficiently detailed specifications of real target systems, including risk assessments and impact statements
b) Select production methods and write method statements
c) Implement production and deliver products fit for purpose, in a timely and efficient manner
d) Operate within relevant legislative frameworks

(7) **Ability to critically review real target systems and personal performance**
This means the ability to:
a) Test and evaluate real systems in service against specification and client needs
b) Recognise and make critical judgements about related environmental, social, ethical and professional issues
c) Identify professional, technical and personal development needs and undertake appropriate training and independent research

The quoted examples demonstrate that the terminology to identify or to describe necessary qualification attributes and derive learning objectives or outcomes for curriculum development is not harmonized and allow different preferences to be followed. All mentioned approaches are not prescriptive like to some extent accreditation standards are.

To present examples where outcomes oriented approaches have been agreed on and became requirements for curriculum development, one must indeed refer to accreditation standards more than to governmental regulations and frames. The most prominent example are the 11 outcomes required for the accreditation of engineering programmes leading to a bachelor degree by the ABET Criteria 2000 for USA (see http://www.abet.org):

- an ability to apply knowledge of mathematics to engineering problems;
- an ability to design and conduct experiments, as well as to analyse and interpret data;
- an ability to identify, formulate and solve engineering problems;
- an ability to design a system, component or process to meet desired or customers needs;
- an ability to use the techniques, skills and modern engineering tools necessary for practice;
- an understanding of ethical and professional responsibility;
- an ability to communicate effectively;
- an ability to cooperate in multidisciplinary and international teams;
- a recognition of the need for and the ability to engage in life long learning;
- a broad education necessary to understand the impact of engineering solutions in a societal, economical and global context;
- a knowledge of contemporary issues.

Programmes provided and curricula developed by USA Higher Education Institutions and applying for accreditation have to make evident that these outcomes are achieved. Europe is only at the beginning of a move from in-put standards (in terms of subjects, content lists and contact hours) towards outcomes based curricula and continuous outcomes assessment. However, some Accreditation Agencies, and also Universities and Colleges, already apply these approaches in order to improve the processes of curriculum development or revision and to raise quality. The Engineering Council (EC) and respectively the Engineering Institutions in charge of accreditation are going to amend their accreditation criteria according to the mentioned debate on outcomes orientation in the UK and in due course try to find a common terminology together with QAA and EPC. In Germany the Agency for Accreditation of Programmes in Engineering, Informatics and Natural Sciences (ASIIN) started from in-put oriented standards but, in addition, stresses the need to include (besides technical knowledge, understanding and skills) also interdisciplinary aspects and to educate a range of personal and social competences.

For the sake of an improved cooperation and comparability in Europe E4 A1 strongly recommends that the attempts to reach common approaches in terminology and standards for curriculum development and accreditation in EE throughout Europe should be intensified. The various Socrates Engineering Thematic Networks and University Networks, also National bodies, should contribute as well as FEANI and ESOEPE, the European Network of the National Accreditation Agencies dealing with engineering programmes. In addition, a clearly focused investigation and research project is urgently needed and should be funded by European or national sources. For the time being A1 instead of relying on competence lists has adopted the "ability to .." statements for learning outcomes specifications, in order to facilitate curriculum development and learning outcomes assessment (see chapter 7).

5.5 Structures and Delivery

Whereas in-put or outcome standards are normally issues of external determinations or recommendations manifested in accreditation criteria (or in prescribed catalogues of subjects and sometimes even contents), the shaping of the curricula itself, in particular the decision on appropriate teaching/learning arrangements and assessment procedures, is primarily in the hands of the Higher Education Institutions and not regulated by standards. Nevertheless, EE throughout Europe is characterized by a great extent of communality, without necessarily arriving at the same profiles or quality of outcomes.

In order to improve comparability and convergence, activities have been strengthened to also influence the structuring of curricula and the modes of delivery and assessment by external regulations or recommendations. In this context only one approach shall be discussed in some detail: the introduction of the European Credit Transfer System (ECTS) and, subsequently, the modularisation of programmes.

ECTS was introduced through an EU financed pilot experiment in the 90s to facilitate mobility of students. To ease the recognition of studies and grades achieved by exchange students at a foreign Higher Education Institution (HEI), a common scheme of 60 credits per year of full-time study should be used in connection with learning contracts and a comparable grading scheme. Every participating HEI or department had to provide a course catalogue with the appropriate ECTS credits attached to each course. As meanwhile well known the amount of credits required in the participating programmes had to be limited to 60 per year. Countries or Universities with different credit systems already in place developed special factors to arrive at ECTS credits. Meanwhile, the introduction of ECTS throughout Europe as a Transfer, as well as Accumulation System, has become a central issue in the Bologna Process. The already mentioned Tuning Project was and still is in its continuation (2003 to 2004) to a great deal focused on the question how ECTS can be improved to really make the respective credits a kind of common European "currency" in higher education. Measures have been taken to introduce the system also in continuing and vocational education.

What are the advantages and challenges of ECTS and how do they affect curriculum development?

Differently from the USA credit system, which is normally based on contact hours, and therefore primarily on teaching activities, ECTS is explicitely based on student workload and therefore on learning activities. One credit should be equivalent to about 25 to 30 hours of learning encompassing all respective activities and amounting to 1500 respectively 1800 hours per year. This concept realises the shift from teaching to learning and corresponds to the introduction of outcomes orientation in curriculum design. Whereas outcomes orientation stresses the qualitative dimension, ECTS add the quantitative dimension. Curriculum developers are forced to think in categories of student learning and calculate which amount of student workload, on average, may be induced by certain intended learning outcomes or teaching/learning arrangements. Usual courses with 3 or 4 contact hours per week can arrive at quite different amount of student workload, and therefore credits, caused by different requirements on students self-study activities including preparations of exams.

As credits can only be earned by successful completion of a course unit or module, and not just by attending a course, the implementation of a credit system like ECTS also affects the examination and assessment patterns. Whereas still many programmes in Europe are based on intermediate and final exams the Credit system, in its accumulation function, strengthens a formative assessment approach with continuous feedback on learning achievements. Final exams – maybe except the defense of a final project or thesis – become obsolete and are replaced by the accumulation of the required number (and quality) of credits. Curriculum designers will have to decide in which relations student workload should be devoted to different subjects and learning activities and quality levels. They also need to develop appropriate assessment concepts and must try to avoid that by continuous assessment the student learning becomes entirely examination driven. This can be the case if students are exposed to a great number of different courses per term or semester. One solution is to integrate existing courses to greater modules or develop new modules.

During the pilot phase of ECTS, with the focus on credit transfer, the participating HEI and departments usually did not change their curricula but – based on negotiations and agreements between the partners – they just assigned appropriate numbers of credits to existing courses. With the extension of ECTS to an accumulation system, affecting not only students studying for some time abroad but the entire student population, the mentioned problems became more evident.
In Germany it was therefore decided that ECTS should be implemented but, in due course, linked to a modularisation of the programmes. For the new bachelor/ master programmes this is a compulsory requirement, for the existing traditional programmes it is recommended only. Thus, modularisation in some way became an additional driving force for curriculum development, besides the implementation of bachelor/master programmes, supporting also a shift towards competence and outcomes orientation. As modules are understood as comprehensive teaching/learning units encompassing different courses and learning activities explicit descriptions of the respective learning objectives, the contents and the intended learning outcomes are required. Similar approaches, like the German ones, started much earlier in the UK. One crucial question usually relates to the size of modules in terms of credits, especially when they should add up to 30 credits per semester as required by ECTS. The biggest impact on curriculum and course development stems from approaches which rely on modules all of the same size, like implemented e.g. at many Universities of Applied Sciences in Germany, but also at various Universities in the UK and at the Danish University of Technology Lyngby. Mainly, semester modules of either 5 or 6 credits, are recommended, and could sometimes take the form of double modules of 10 or 12 credits (e.g. if projects have to be covered by a certain module size). As a result, students would have to enrol for 6 or 5 or even less modules per semester. With a prescribed module size constituting the structure of a curriculum course, providers are forced to fit there contents and learning requirements into a certain frame, determined by credits, and consequently by student learning time available (Ahrens 2001).

The full potentials of modularised curricula can be exploited if students get a variety of options to select modules and design their own individualized curricula. This approach is quite in contrast to the existing curricula in EE which tend to be very closed and compulsory, at least in the first and second year. However, a growing number of innovative programmes require only a certain amount of compulsory core modules and for completion provide a range of optional modules where students can choose from. Sometimes these kind of electives are even provided within certain modules if they are big ones encompassing a number of courses.

Modularisation of curricula also corresponds favourably to Open and Distant Learning and to the provisions of Virtual Universities as e.g. the experiences of the UK Open University proves. The innovativeness of these approaches for curriculum development is grounded in its flexibility but, increasingly, also in the way how the modules developed use the possibilities of multi-media and of the new ICT technologies in general. In combination with a harmonised and qualified credit system, which facilitates the recognition of modules and credits gained by ODL, also the flexibility of traditional programmes could be enriched. A future prospect is that nationally developed but internationally recognized modules or modules, developed by networks of Higher Education Institutions (e.g. as part of joint programmes), will contribute favourably to harmonisation, student mobility and the internationalisation of programmes.

A crucial problem, which remains to be solved, is the question how the quantitative aspects of student workload, expressed by credits, and the qualitative aspects of learning outcomes of certain modules, as well as the assessment and grading systems, can be linked and harmonised so that recognition can become more automatic and formal instead of requiring tailor-made solutions for every student. The approach favoured by A1 is to relate credits in terms of workloads to outcome levels or to competences or capabilities achieved.

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6. Curriculum Development and Components of Innovative Curricula

6.1 Innovative Methods of Curriculum and Course Design

Curriculum development or revision in practice seems to be much more a bargaining process in a certain prescribed frame, or on the basis of existing experiences and facilities, than a scientifically based systematic approach to achieve a certain goal or product. The balance of interests or the degree of satisfaction of the involved faculty achieved through such a bargaining process should not be underestimated in its effects. However, the attempt to employ a systematic problem solving process should always be made.

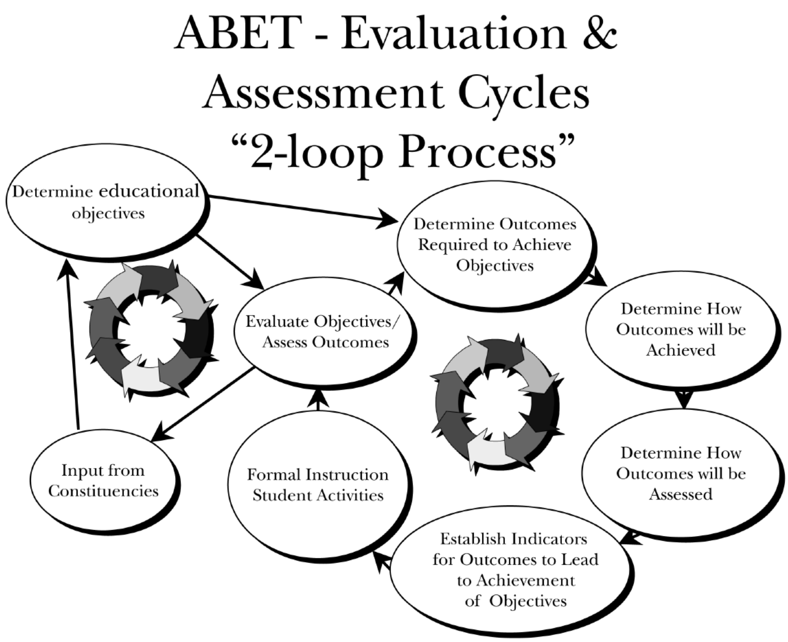
In practice curriculum development from scratch is the exemption, associated with the creation of completely new programmes. Predominant are two other situations:

- continuously and iteratively redesigning existing programmes;
- restructuring programmes on the background of new frame conditions and demands.

The implementation of two tier programmes implementing the Bologna recommendations is mostly not perceived as curriculum development from scratch but primarily as a restructuring exercise. The E4 A1 state-of-the-art investigations indicate that the majority of programme providers try to handle the challenges by regrouping existing course offers instead of grasping the chance of innovative changes. The latter approach would require the adoption of a more systematic approach and not just the development of some new elements. It would also encompass a strategy how changes can be comprehensively and effectively managed to achieve the envisaged targets and how sustainability can be gained, e.g. through continuous quality assessment and, if proved to be necessary, programme revision.

Less the requirement for new curricula in the Bologna Process context but the paradigm shift to outcomes orientation and student learning have recently fostered the use of systematic and comprehensive approaches. Pressures on programme providers and faculty have been caused by respective accreditation or external quality evaluation demands. A good example is the two-loop-feedback-model, used and recommended by ABET for the ABET 2000 accreditation procedures.

It does not only illustrate the link between the "outside world" and the internal programme development and quality assurance process, but determines clearly the subsequent steps to be taken when designing or evaluating a certain programme:



Source: http://www.abet.org

Corresponding to the already mentioned UK QAA activities concerning subject benchmarking and the requirement for programme specifications a vivid debate on comprehensive approaches of curriculum and module design has been promoted by the recently established "Learning and Teaching Support Network" (LTSN), in particular by the LTSN Generic Centre. Based on proposals of John Biggs from 1996 the concept of "constructive alignment" was elaborated and discussed in a Conference in 2002. Even more than in the "two-loop-model" the design of curricula and modules in this concept starts from student learning. Biggs explained the concept in the following way:

"The 'constructive' aspect refers to what the learner does, which is to construct meaning through relevant learning activities. The 'alignment' aspect refers to what the teacher does, which is to set up a learning environment that support the learning activities appropriate to achieving the desired learning outcomes. The key is that the components in the teaching system, especially the teaching methods used and the assessment tasks, are aligned to the learning activities assumed in the intended outcomes" (Biggs 1996).

In practice the alignment process can encompass more dimensions than learning outcomes, teaching activities and assessment, as for instance the alignment to a certain learning culture, the alignment to students interests and abilities, the alignment to facilities, the alignment of teachers and student perceptions, the alignment of approaches taken by different faculty members.

Particularly, the last issue was felt an important point in a good practice example of developing a project centred curriculum in EE at the University Catholique of Louvain (UC) in Belgium. The group in charge stated:
"Adopting a theory of learning is necessary to provide a common reference to discuss issues and make motivated choices. Without an agreed upon theory, everything goes or, putting it differently, intuition rules without bounds. The theory which turned out to be most appealing to the group in charge of the design of the new curriculum is called socio-constructivism (Jonnaert, Vander Borght, 1999), which we combined with the notion of situated learning" (Milgrom 2002, see also on the web site of UCL under UCL: new_eng_curriculum.pdf).

This approach points to the fact that the "curriculum as planned" is not yet the "curriculum as implemented" and will for sure differ later on from the "curriculum as experienced by students and staff". The successful implementation of a comprehensively and systematically planned new or revised curriculum requires to a certain extent an organizational development and a change of action and behaviour of the persons involved. This can be favourably supported by trying to agree in advance on a common approach and basic "philosophy" guiding the changes.

The integrative and rational approach to curriculum design, strongly recommended and supported by E4 Activity 1, also applies in principle to the design of courses or modules or even course units where, usually, an individual faculty member is responsible and has his/her degree of freedom. Limitations may be caused by the fact that courses or modules are mostly not entirely free in their objectives and contents but have to contribute to the goals or specifications of a certain programme.

In practice the 'alignment' approach with regard to modules is implicitly pushed and reflected in the requirements of the German Conference of Ministers of Cultural Affairs (KMK) for the description of modules. These descriptions should not just mentione the courses involved but encompass learning objectives and contents, teaching/learning arrangements, assessment procedures and requirements for achieving credits, number of credits and grading patterns, distribution of the expected workload with regard to different learning activities, the match to certain programmes (KMK 2000).

In the following paragraphs we shall not expose and recommend complete curricula, e.g. as reference points for a harmonisation in Europe, but describe components of "innovative curricula" illustrated by good practice which E4 A1 got to know and found worthwhile to quote. The paragraphs reflect the main aspects which have to be aligned: learning objectives and outcomes, appropriate teaching/learning arrangements and student learning assessment.

6.2 Specification of Learning Objectives and Intended Learning Outcomes

Programme specification and innovative curriculum design start from decisions on overall goals, learning objectives and intended learning outcomes. The previously quoted, and partly described, lists of competences and abilities, knowledge and skills or subject benchmarking considerations are reference points. This applies even to situations where prescribed threshold standards have to be realized by the curricula to be developed. Programme providers have to determine their particular qualification profile and set of qualification attributes. They will normally go beyond the required minimum and focus on special aspects.

As pointed out, no common language or international standards exist. It turned out that just referring or mentioning a range of competences which have to be achieved accompanied by lists of subjects and contents is not enough. Intended learning outcomes have to be specified much more operational in terms of knowledge and understanding, know how, abilities, skills and attitudes, which can be demonstrated by the student or performed in appropriate situations and finally assessed in order to evaluate or measure the degree of achievement.

A good example for a specially profiled curriculum development project, starting from requirements to learning objectives and learning outcomes, is represented by the so called CDIO concept. The abbreviation stands for Conceive, Design, Implement and Operate. It is derived from the overall goal that graduating engineers should be able to conceive, design, implement and operate complex value-added engineering systems in a modern, team-based environment.

Since October 2000, Chalmers University of Technology (Chalmers), the Royal Institute ofTechnology (KTH), Linköping University (LiU), all in Sweden, and Massachusetts Institute of Technology (MIT), MA, USA and recently in addition the Danish Technical University at Lyngby are running a joint four-year programme aimed at developing a new model for EE, focusing on CDIO skills. The concept is characterized by a curriculum organised around the various disciplines while emphasizing that engineering is about projects, a pedagogic model that supports active, experiential group learning, a varied learning environment with classrooms, workshops and the outside world as well as a continuous improvement process.

As the concept should be applicable to different engineering branches it does not go into detail regarding the subject specific engineering knowledge and skills but concentrate on personal, interpersonal and CDIO skills. This is shown in the following table.

The CDIO Syllabus (condensed)

1 TECHNICAL KNOWLEDGE AND REASONING
- 1.1. *Knowledge of Underlying Sciences*
- 1.2. *Core Engineering Fundamental Knowledge*
- 1.3. *Advanced Engineering Fundamental Knowledge*

2 PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES
- 2.1. *Engineering Peasoning and Problem Solving*
  - 2.1.1. Problem Identification and Formulation
  - 2.1.2. Modeling
  - 2.1.3. Estimation and Qualitative Analysis
  - 2.1.4. Analysis with Uncertainty
  - 2.1.5. Solution and Recommendation
- 2.2. *Experimentation and Knowledge Discovery*
  - 2.2.1. Hypothesis Formulation
  - 2.2.2. Survey of Print and Electronic Literature
  - 2.2.3. Experimental Inquiry
  - 2.2.4. Hypothesis Test, and Defense
- 2.3. *System Thinking*
  - 2.3.1. Thinking Holistically
  - 2.3.2. Emergence and Interactions in Systems
  - 2.3.3. Prioritization and Focus
  - 2.3.4. Tradeoffs, Judgment and Balance in Resolution
- 2.4. *Personal Skills and Attitudes*
  - 2.4.1. Initiative and Willingness to Take Risks
  - 2.4.2. Perseverance and Flexibility
  - 2.4.3. Creative Thinking
  - 2.4.4. Critical Thinking
  - 2.4.5. Awareness of One's Personal Knowledge, Skills and Attitudes
  - 2.4.6. Curiosity and Lifelong Learning
  - 2.4.7. Time and Resource Management
- 2.5. *Professional Skills and Attitudes*
  - 2.5.1. Professional Ethics, Integrity, Responsibility and Accountability
  - 2.5.2. Professional Behavior
  - 2.5.3. Proactively Planning for One's Career
  - 2.5.4. Staying Current on World of Engineer

3 INTERPERSONAL SKILLS: TEAMWORK AND COMMUNICATION
- 3.1. *Teamwork*
  - 3.1.1. Forming Effective Teams
  - 3.1.2. Team Operation
  - 3.1.3. Team Growth and Evolution
  - 3.1.4. Leadership
  - 3.1.5. Technical Teaming
- 3.2. *Communication*
  - 3.2.1. Communication Strategy
  - 3.2.2. Communication Structure
  - 3.2.3. Written Communication
  - 3.2.4. Electronic/Multimedia Communication
  - 3.2.5. Graphical Communication
  - 3.2.6. Oral Presentation and Interpersonal Communication

4 CONCEIVING, DESIGNING, IMPLEMENTING AND OPERATING SYSTEMS IN THE ENTERPRISE AND SOCIETAL CONTEXT
- 4.1. *External and Societal Context*
  - 4.1.1. Roles and Responsibility of Engineers
  - 4.1.2. The Impact of Engineering on Society
  - 4.1.3. Society's Regulation of Engineering
  - 4.1.4. The Historical and Cultural Context
  - 4.1.5. Contemporary Issues and Values
  - 4.1.6. Developing a Global Perspective
- 4.2. *Enterprise and Business Context*
  - 4.2.1. Appreciating Different Enterprise Cultures
  - 4.2.2. Enterprise Strategy, Goals and Planning
  - 4.2.3. Technical Entrepreneurship
  - 4.2.4. Working Successfully in Organizations
- 4.3. *Conceiving and Engineering Systems*
  - 4.3.1. Setting System Goals and Requirements
  - 4.3.2. Defining Function, Concept and Architecture
  - 4.3.3. Modeling of System and Ensuring Goals Can Be Met
  - 4.3.4. Development Project Management
- 4.4. *Designing*
  - 4.4.1. The Design Process
  - 4.4.2. The Design Process Phasing and Approaches
  - 4.4.3. Utilization of Knowledge in Design
  - 4.4.4. Disciplinary Design
  - 4.4.5. Multidisciplinary Design
  - 4.4.6. Multi-objective Design
- 4.5. *Implementing*
  - 4.5.1. Designing the Implementation Process
  - 4.5.2. Hardware Manufacturing Process
  - 4.5.3. Software Implementing Process
  - 4.5.4. Hardware Software Integration
  - 4.5.5. Test, Verification, Validation and Certification
  - 4.5.6. Implementation Management
- 4.6. *Operating*
  - 4.6.1. Designing and Optimizing Operations
  - 4.6.2. Training and Operations
  - 4.6.3. Supporting the System Lifecycle
  - 4.6.4. System Improvement and Evolution
  - 4.6.5. Disposal and Life-End Issues
  - 4.6.6. Operations Management

The condensed version of the CDIO addresses only qualification attributes, on three levels of detail. The complete version contains 5 levels with the fourth level representing learning objectives and the fifth intended learning outcomes. To arrive at learning objectives and outcomes the partner universities tried to find out by a survey among different groups of stakeholders what kind of proficiency level for each topic on the level 2 attributes should be achieved by using a five point proficiency-scale:

- to have experienced or been exposed to,
- to be able to participate in and contribute to,
- to be able to understand and explain,
- to be skilled in the practice or implementation of,
- to be lead or innovate in.

Meanwhile the CDIO syllabus is used by the 5 universities and departments involved for redesigning curricula and shaping appropriate modules or courses. As it is assumed that the CDIO concept can in general contribute to the enhancement of EE and as it is still perceived as a draft, the EE community is invited to make use of it and comment on it (see http://www.cdio.org).

6.3 Promoting Active and Experiental Learning: Project Centred Curricula and Problem-based Learning

The majority of the increasingly demanded key and transferable skills and competences, as well as complex engineering capabilities, can only be acquired if appropriate teaching/learning arrangements are provided to exercise and achieve them. As a possible solution in higher education since the late 60s and the already quoted call for a "paradigm shift from teaching to learning" the proposal was made to move from discipline and subject dominated curricula to problem and project centred curricula and learning provisions. Aalborg and Roskilde in Denmark, the that time new University of Bremen in Germany and the Worcester Polytechnic in USA can be mentioned as examples where this concept has been consequently applied in different disciplines including engineering and to all programmes offered. A guiding principle was that students starting from the beginning of their studies should learn and work in teams and on projects, trying to solve more or less complex, open-ended, often interdisciplinary real-life or research problems. The project work covers most of the learning activities of the students and is supported by project related courses or courses-on-demand and only a few project independent courses of the traditional type. At Aalborg University, where since the beginning in 1974 all programmes have been "project-organised", the overall share of project work is about 50%, plus 30% for project related and 20% for project independent courses, with relations changing to some extent throughout the years of study (Kjerstam 2002). SEFI, the European Society of Engineering Education, already in one of their first Annual Conferences at Manchester in 1974 addressed the theme: Projects in Engineering Education and the

Curriculum Development Working Group (CDWG) since 1993 in various seminars promoted the concept of project-organized curricula (SEFI 1993).

Starting from restructuring programmes of study in medicine in Canada and, somehow independent and in parallel to the implementation of project-orientation of curricula, the concept of problem-based-learning (PBL) was developed. In Europe it achieved first popularity in the Netherlands, at the beginning in medicine (Maastricht), later on also in EE (Delft University of Technology). Despite some overlap compared to project orientation the PBL-concept was of limited scope. It can be also applied without basically changing the curricular structures just within a course in a certain subject area. Learning is organised through a chain of small problems. Like in more complex projects students work in teams and learn to solve problems, primarily teacher defined, searching themselves for knowledge and methods needed, supported on demand by the teacher in his role as tutor and expert adviser.

Engineering educators occasionally have argued that there is nothing new in project- and problem-based learning as always practical assignments and design projects formed a significant part of engineering curricula. The fundamental difference is that these activities use to be based on the concept of applying previously gained knowledge and understanding. Curricula are respectively organised with an emphasis, in particular in the early years of study, on the teaching of the fundamentals in mathematics, natural sciences and basic engineering subjects. The disadvantages of this curricular structure became more and more evident, not only with regard to the mentioned demand on generic transferable skills and synthesizing engineering capabilities but also because of a lack of attraction for students to start engineering studies or continue to stay.

Obviously for these reasons problem-based learning and project orientation of curricula – based on the experiences already gained by the pioneer universities and colleges – started to spread out in Europe since the 90ties with many innovative applications arriving in recent years and quite some potentials still not used. Let's mention some of the developments based on good practice of Aalborg University and the Engineering Colleges Copenhagen and Odense in Denmark, the Universities of Technology Twente, Eindhoven and Delft in the Netherlands and some of the Hogescholen, the National Technical University of Norway at Trondheim, the UCL Louvain in Belgium, the Technical Universities Berlin and Darmstadt in Germany, the University of Bath in UK:

- project work more often starts in the first semester and is present throughout the whole curriculum but the projects are less complex. They are more planned in the aspects they focus on and the learning outcomes they should achieve in a certain semester or term of the programme (Ponsen 2002);
- real-life problems constitute projects organised in cooperation with industry or structure internship activities as part of the curriculum;
- projects often do not only integrate different subject areas or disciplines but em-

brace virtual cooperation, even on international scale, and international team work;
- problem-based learning or working on “mini- projects” within a certain subject and more time consuming work on complex, sometimes interdisciplinary projects are combined in the structuring of curricula and the provision of active learning arrangements (Gibson 2003);
- project work is more and more supported by ICT facilities;
- independent student projects or undergraduate research projects are encouraged and often credited;
- providing appropriate learning environments and preparing staff for their changing role in project- and problem-based learning is increasingly perceived as a problem and dealt with through various means;
- assessment problems in project and teamwork, often preventing its implementation, are better and better solved by the development of a variety of assessment methods.

Recently, project orientation and problem-based learning have experienced a strong push forward by the role which engineering design and new product and systems development have gained as a structuring feature of educating engineers. It is expected that a comprehensive education in engineering design and project management will enhance the employability of young graduates. It also contributes favourably to entrepreneurship education, a very actual focus of innovative curriculum development which is coupled with the expectation that engineering graduates can and should more actively support economic growth and competitiveness. Engineering design and product development have always been a genuine linking point to problem-based learning and project work, encouraging individual teachers in their courses to start respective activities, the “solo-run” actions as it was phrased by Gibson from the University of Technology in Galway, Ireland (Gibson 2003). Not surprisingly also, project orientation from the very beginning of its raise in the 70s and with the claim for interdisciplinary approaches was promoted by programmes in architecture and construction engineering as well as in regional and town planning.

Interesting recent changes stem from initiatives where engineering design and/or product development became the central and guiding philosophy to completely restructure the curricula, involve the whole faculty providing a programme and even arrive at new and comprehensive learning environments in terms of physical and virtual space. This is basically the expectation connected with the quoted EPC concept of Out-put standards. It applies, in practice, to many recent curriculum changes in Europe mentioned above. In USA the undergraduate design and undergraduate research movement, initiated and promoted to a great deal by the NSF (National Science Foundation), funded so called Coalitions like in particular Gateway, Succeed and Excel as well as the Worcester Polytechnic approach and the E4 project of Drexel University have caused remarkable revisions of curricula in the freshmen and sophomore years of study.

The quoted CDIO syllabus may have similar far reaching results including even the reengineering of the learning environment as reported by the MIT (Crawley 2002, see also http://www.cdio.org). It is based on the CDIO philosophy and an approach to structure the curricula and the students learning process in a way that all available types of (primarily active) learning are provided or facilitated by respective learning environments. In a systems approach to curriculum development and the construction of appropriate educational environments more than 20 different "learning modes" have been identified. A majority of them will find a respective curricular frame and support by physical or virtual facilities.

Finally, project orientation and problem-based learning seems to be the most promising strategy to achieve a proper EE and satisfactory employability by the new three years programmes to a bachelors degree, envisaged by the first cycle of European Higher Education, as recommended by the Bologna Declaration. This will in particular be the case if internship requirements and international project work will be included like practiced by many of the application oriented Higher Education Institutions in Europe. At Universities with 5 years integrated programmes to a master level degree it proved to be quite easy to arrive at a three years bachelor degree with good employability perspectives when the curricula, already from the first year of study, have been project centred or project oriented (Ponsen 2003). A new bachelor/master programme in mechanical engineering, offered by the TU Darmstadt, Germany, adopted this kind of project orientation and received recently a good practice award for innovative curriculum development (see http://www.tu-darmstadt.de).

6.4 Innovative Curricula for "Global" Engineering Education

Internationalisation, besides of other demands, has become a main challenge and driving force not only for restructuring the Higher Education System and competing on a global educational market but also for revising curricula and providing teaching/learning facilities which promote an EE with an explicit international profile. The traditional approaches to internationally oriented education are student exchange and study abroad phases obtained through the decision of individual students to take part. As stressed and reported by Activity 4 of E4 (see Volume E) the focus is primarily on foreign language training and gaining intercultural experiences. Funded European Union exchange programmes like Erasmus have in addition strongly insisted that study abroad activities should be fully recognized with regard to the subject specific learning outcomes and grades achieved and therefore have launched the ECTS.

In this context more recent approaches are of interest where by respective curricular structures, or by provisions of appropriate learning environments, more or less all students of a certain programme are forced to acquire a kind of "global" education. The reasons to do so are quite obvious. Besides of the general values of promoting intercultural understanding and collaboration it is the increasing need to prepare graduates for the global labour market. In engineering, in particular, it is the additional requirement to educate and train students for globally distributed work environments. Graduates who may never leave their home country will be increasingly forced to collaborate in internationally oriented virtual environments or to act on global product markets or serve clients of foreign countries.

Different approaches on the curriculum level are available and have been experienced to deal with these demands e.g.:

- by integrating transnational and intercultural issues in the programme and course offers;
- by providing project work in internationally mixed teams of students;
- by inserting study abroad or internship phases or thesis abroad opportunities into the curriculum;
- by collaborating on a bi- or multilateral basis with Higher Education Institutions in foreign countries on joint programmes.

6.4.1 Internationally Oriented Programme and Course Offers

In EE, since recently programmes have been developed with international orientation as a generic feature like Global Production and Manufacturing Engineering or Export Engineering. Without necessarily sending students abroad – even if favourable and recommended – these programmes consist of a significant share of courses addressing intercultural and global issues or requiring foreign language training as compulsory part of the curriculum and providing course offers in engineering in a foreign language. Apart from these kind of specially focused programmes, also the course offers for the traditional programmes can embrace optional or compulsory modules to let students acquire intercultural competences. It can be limited to narrow technical and professional topics like international law issues, standards and norms, technical foreign language training. It may also take the form of comprehensive modules dealing in depth with intercultural dimensions in the development of technology, work environments, economics and society.

6.4.2 Working on Projects by International Student Teams

Besides gaining experiences, joining international student teams on an optional and often not credited basis during vacation periods, like e.g. the so called JEEP (Joint European Engineering Project Teams) reported in Volume E of the E4 final publication – increasing efforts can be observed to provide international project work for all students of a certain programme. Collaboration with foreign Higher Education Institutions is essential but has been facilitated dramatically by the provision of more and more improved ICT tools and at partly also decreasing costs. The project work is often focused on small research or design assignments and can be executed in entirely virtual environments or in an entirely face-to- face mode. The predominant approach is a mix of meetings, distant courses and collaboration on the web. Recent examples of good practice have been reported by a project on global production development in

Mechanical Engineering at TU Berlin with a three month collaboration on product design of students from Seoul, Michigan Ann Arbor and Berlin, mainly via Internet but also one week of face-to-face meeting at the beginning and at the end.

6.4.3 Study Abroad or Internships in a Foreign Country

An increasing number of programmes demand a semester or even a year of study abroad or internship abroad phases. If not required it can be at least done on an optional basis. To be fully recognised, cooperation with foreign higher education institutions or companies in a foreign country is normally needed but must not arrive at common curricula or modules. These kind of bi- or multilateral agreements must not necessarily result in an exchange programme for students but often do. The advantage of this approach is that international experiences are firmly anchored in the curricula of a certain programme provider.

6.4.4 Joint Degree Programmes

A much more demanding approach from the curriculum development point of view are joint degree programmes, strongly advocated within the Bologna process and recently confirmed at the Bologna-Berlin Conference as a step towards Internationalisation. The European Commission recently started the new Programme of Erasmus Mundi by which European Joint Master programmes, offered by two or more European Universities, shall be developed and offered on a global market.
Even if many Universities still hesitate to get involved and take the necessary activities, quite a range of double degree programmes are already in existence, also in EE. In a survey of the European University Association it is stated that an agreed definition of joint degrees in Europe is still lacking. Sometimes it is just used for programmes where two different subject areas or disciplines have to be studied. Rauhvargers as the author of the survey has however tried to list some main characteristics:
"Joint degrees are normally awarded after study programmes that correspond to all or at least some of the following characteristics:

- the programmes are developed and/or approved jointly by several institutions;
- students of each participating institution study part of the programme at other institutions;
- the students stays at the participating institutions are of comparable length;
- periods of study and exams passed at the partner institution(s) are recognised fully and automatically;
- professors of each participating institution also teach at the other institutions, work out the curriculum jointly and form joint commissions for admission and examinations;
- after completion of the full programme, the student either obtains the national degrees of each participating institution or a degree (in fact usually an unofficial "certificate" or "diploma") awarded jointly by them" (Tauch C., Rauhvargers A. 2002, page 29).

6.5 Outcomes Based Curricula and Outcomes Assessment

As repeatedly stressed a comprehensive innovative curriculum based on specified learning objectives and intended learning outcomes has to be aligned to an appropriate concept of programme respectively learning outcomes assessment. It has to serve student examination and grading functions but even more feedback functions in general in order to prove that and to what extent intended outcomes of programmes or courses/modules have been achieved. In the USA elaborated plans and a variety of methods of outcomes assessment form a significant part of accreditation procedures.

The shift from teaching to learning and from in-put to out-put oriented curricula will facilitate the assessment of student learning outcomes. In order to achieve this target it is essential that programme as well as course/module objectives are clearly determined, preferably in terms of measurable outcomes. As illustrated, different approaches have been developed and applied recently to specify programme and respectively course or module objectives in a way that the outcomes can be more easily observed or measured and assessed. Students must be challenged and put into the situation to prove or demonstrate that they have achieved the envisaged competences or abilities.

With regard to individual courses or modules the predominating oral and written exams focussing on knowledge and understanding do not allow a satisfactory assessment of an enhanced range of learning objectives specified in terms of competences or skills and abilities. In particular for the so called “soft-skills” like e.g. teamwork abilities more formative assessment approaches to outcomes assessment should be applied. Even student self-assessment based on reports, questionnaires, diaries or portfolios can contribute to it. Usually a variety of assessment procedures should be used but without increasing the tendency to mainly exam and assessment driven curricula and patterns of learning.
With regard to programmes at the whole it is recommended to develop and implement a comprehensive plan (e.g. in a matrix format) by which all provided courses/ modules or teaching/learning arrangements are reflected against the list of intended outcomes of the programme, with the envisaged outcomes indicators and assessment procedures connotated to it. (see e.g. Felder R., Brent R. 2003).

Outcomes assessment has to perceived as an integral part of curriculum development. It should not be left entirely to the individual course or module provider. Therefore it is recommended to involve the whole faculty and draft a strategy of implementing comprehensive concepts of outcomes assessment (McGourty J. 1999).

(Activity 1 of E4 together with the Curriculum Developed Working Group of the European Association of Engineering Education – SEFI – has organised a seminar on assessment issues in 2003. The publication of the proceedings is not integrated into this report but will be provided separately as a SEFI Document by November 2003 (see http://www.sefi.be). Also available there the SEFI Document No. 23 of a previous seminar on assessment topics. Finally, a special volume of the European Journal of Engineering Education edited by the A1 group member Otto Rompelman is in preparation and will be published in 2004).

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7. Guidelines for Core Profiles of Two Tier Curricula

7.1 Introduction

These guidelines or reference points for core profiles of EE in Europe are referring to two already elaborated main factors of influence:

- the implication of the Bologna Declaration with an expressed policy of shaping the education systems in a such a way that increased student migration, cooperation and interchanges will become a natural aspect of European integration;
- the increasing complexity of the engineering world with rapid technical development, new emerging branches and internationalisation of research, development, business and production.

These factors have already had some influence on the education systems. University planners may benefit from analysing current processes and estimate which changes or improvements that will or should take place over the coming years. With such an approach in mind, this proposals are trying to display some common factors and criteria that should be considered when shaping European engineers of the future – typically year 2010. Some considerations and assumptions have to be taken into account:

European integration (Bologna Declaration)
The 3 + 2 tier system appears to be generally recognised, even though there are differences and exceptions. It is reasonable to assume that the 3 + 2 system will be the dominant engineering course structure, and that student migration should be adapted to such a system. For the purpose of this paper a 3 + 2 tier system will be assumed for the Bachelor and Master level courses. The Ph.D. level as such is not included in the discussions. One agreed aim is to facilitate student movement. In recognition of practical obstacles to such movement some basic requirements must be met:

- the academic levels of courses must correspond to each other,
- the knowledge base must cover identical or corresponding areas,
- students must be able to communicate in their environment,
- institutions must remove formal obstacles to student migration,
- degrees awarded must be recognised in all European countries,

Internet education
The Internet will increase in importance and will form the base for new and enhanced teaching methods as well as new types of courses and new ways of obtaining degrees. This proposals do not analyse these trends in depth, but recognise the importance of considering the possibilities and effects that

Internet will have in the future. Students and institutions will be required to master the challenges of the Internet.

Language communication
Language discussions are sometimes difficult, and have a tendency to trigger national feelings, historical attitudes, and policies. Internationally there is, however, a very clear trend of accepting English as the universal language of education. Developments in the computer world, the world of publications, international conferences, international industry and business also show a factor common to all of them: English is accepted as the only common world language. Recognising this as a fact, educators should evaluate which consequence this will have for EE. One obvious conclusion is that all engineers must be able to use English as a working language. Another question is whether all engineering courses should be conducted using English as a common language.

New areas of education
Industry and companies require an increasing degree of specialisation. The traditional engineering fields have given birth to a multitude of new areas such as: environmental engineering, micro system engineering, bioengineering, product development engineering, marine engineering, nuclear engineering, etc. Another trend is to combine and/or supplement EE with other fields of study like business, product development, export engineering, human resource development, and international relations. These trends will most likely continue, and will represent new challenges and possibilities for the educational systems.

7.2 Purpose of the Core Profile Guidelines

In order to form a common basis for European engineering this proposal presents "*guidelines for engineering core profiles*". The profiles describe the qualities that we expect a European engineer of 2010 to represent, and the requirements that his or her educators should use as a base for the formation. The profile does NOT give a detailed list of subjects, hours, etcetera in the traditional way of describing a curriculum, but try to follow an learning outcomes approach by stating which qualities and academic abilities the student should possess at the end of certain courses respectively the degree programme. The student is at the centre of the discussions. How courses are organised and conducted is left to each institution, as long as the student fulfils the requirements at the end. The core profile forms a basis for improved awareness and a reference, but it is also a recommendation. The following factors are considered:

University planning
The core profile is a reference for university planners. The acceptance of the core profile will contribute to shape the curricula in accordance with the in-

tentions of the Bologna Declaration. There will, however, still be ample room for different approaches and national differences, which are still desired. The aim is to create a path for student migration with as few obstacles as possible.

Life-long learning
Engineers of tomorrow will face an increasing demand on their ability to adjust to new technology, new environments, and new types of jobs. This could be described as an ability and an acceptance that life long learning is a natural course of events. Hence the core profile must prepare the student for this aspect of his future career.

Accreditation of the curricula
Accreditation will be carried out by different bodies, and in different ways. The core profile is intended to form a common reference for accreditation bodies. Even though it does not cover any full course program, it should be used as a basic reference that must be met by all courses. Accreditation should be carried out by the national education and engineering authorities, but international agreement should be reached as a basis to the recognition of university degrees in all countries.

Core profile definition
In the context of this paper the core profile is the complexity of courses and knowledge that forms the professional profile of the student. The core courses and requirements must show the difference between engineering and non-engineering studies in the first place, and between various engineering specialisations in the second place. Hence the core should consist of some general requirements needed to define EE and some detailed requirements enough to distinguish between particular specialities. The core courses should be provided by each University as parts of its curricula.

7.3 Engineering Profiles

Tradionally different types of engineers have received their education in institutions giving them different **profiles.** One such clear distinction can be drawn between the "Fachhochschule" and Universities in Germany, and between previous "Polytechnics" and Universities in the UK. Other countries have similar arrangements.

This proposal does not address the differences inherent in such profiles. A true core must be common for all profiles, but must leave space for the diversity that will be and should be part of the institutional characteristics. The core is a reference for a threshold or minimum level which should be fulfilled by all profiles of EE.

Some institutions incorporate periods of practical training as part of the university courses. One may question for example if a 4 year course is really a full 4 years, if several months or even one year are allocated to practical training or internship. However, it may contribute in a significant way to the outcomes and the profile of a degree. This document does not define the workload, duration or contents of a university year of study. With reference to the 3 + 2 years used in the text, these are years of study defined as such by any university in accordance with the Bologna declaration. According to the proposals specified in the Bologna process this would encompass a minimum of 180 ECTS credits for the first cycle degree and additional 120 ECTS credits for the achievement of a second cycle degree.

7.4 Core Requirements

As promoted and agreed on in the E4 A1 group specifications in this document are **outcomes oriented,** and focus on the skills, abilities, potentials and personality of the graduate. Teaching/Learning arrangements and methods provided to generate these kind of outcomes are the responsibility of the university institution and can be based on an increasing range of innovative approaches as already described in previous parts of this volume.
The proposed core does therefore **not** contain:

- a detailed list of subjects and topics which must be taught,
- a specification of how many hours must be devoted to different subjects,
- a specification of how the university should arrange its inputs to the students.

7.4.1 Core Requirement for all Engineering Areas

All Engineers should have a minimum of engineering-related skills, knowledge, and abilities in order to function in an engineering environment. The indicated requirements are hence common for all fields of engineering, but are split into two sections in order to differentiate between the first cycle degree (Bachelor) after 3 years, and the second cycle degree (Master) after additional two years.

The core requirements are divided into two sections: **Personal** and **Academic.** The basis for this division is the increased claim for transferable skills and qualities of the engineers personality in addition to engineering related factual knowledge and understanding and the ability to demonstrate academic performance. The personal dimension aggregates most of the individual and social competences and attributes described in some detail in previous chapters.

The Bachelor level requirements are given in some degree of detail, while the Master level requirements are of a more general nature. This different approach is due to the increased specialisation and diversity on the Master level, and it would be counterproductive to limit the dynamics of the system by narrowing and limiting the possibilities of separate solutions. The basis for student migration is for most practical purposes coupled to the Bachelor level education.

7.4.2 Institutional Requirements

Criteria for accreditation will be part of national and international arrangements, and are not addressed in detail.

In general institutions providing EE of the future must develop beyond some of the traditions of the last century. Some requirements are[8]:

- Students must learn and be able to develop and apply practical skills through project oriented teaching and learning arrangements.
- Institutions must have a satisfactory amount of laboratories and technical facilities relevant to the engineering fields offered.
- Academic staff must focus on student involvement, activities and learning methods.
- Learning methods must stimulate student activity and leave room for student participation in course planning and quality work.
- Courses must be framed under a pattern of the ECTS standard.

[8] The "*Center for Engineering Educational Development", at the Technical University of Denmark, DTU, is expressing a general requirement as:*
The engineer shall be capable of interpreting complex problem situations and of translating them into technical or non-technical solvable problems. The engineer shall be able to draw up criteria for the selection of solutions, taking into consideration technical as well as non-technical facts and conditions.

7.4.3 Personal Requirements for all Programmes at:

Bachelor level (3 years):

The graduate should be able to:
communicate information, ideas, problems, and solutions to both specialist and non-specialist audiences
adapt himself to a changing technology and new techniques as part of a life long learning process
function efficiently in project groups and teamwork
understand the interaction process between people working in teams, and be able to adapt himself to the requirements of his working environment
display an understanding of the influence of engineering activity on all life and the environment, and demonstrate a high moral and ethical approach to engineering tasks
apply his learning ability to undertake appropriate further training of a professional or academic nature
critically evaluate arguments, assumptions, abstract concepts and data, in order to make judgements and to contribute to the solution of complex issues in a creative process
show an appreciation of the uncertainty, ambiguity and limitations of knowledge

7.4.4 Additional Personal Requirements for all Programmes at:

Master level (+ 2 years)

The graduate should be able to:
assume an analytical approach to work based on broad and in-depth scientific knowledge
function in leading roles, including management roles, in companies and research organisations, and to contribute to innovation
plan, supervise and carry out research and development projects
explain his ideas and projects to the team of co-workers
find a solution of particular technical and human problems arising in the working environment
apply skills and qualities necessary for employment requiring personal responsibility and decision-making
work in an international environment with appropriate consideration for differences in culture, language, and social and economic factors
communicate information, ideas, problems and solutions to both specialists and non specialists
accept accountability for related decision-making including use of supervision
show awareness and relate to connections with other disciplines and engage in interdisciplinary work

7.4.5 Academic Requirements for all Programmes at:

Bachelor level (3 years)

General. The graduate should be able to:
apply knowledge of mathematics, science and engineering appropriate to his discipline
design and conduct experiments, analyse and interpret data
identify, formulate and solve engineering problems
recognise the interaction between engineering activities and design, fabrication, marketing, user requirements, and product destruction
Computer Science/Informatics. The graduate should be able to:
use common computer tools to produce documents, make presentations, carry out calculations and simulations
design and maintain an Internet presentation of his work
carry out computer based tasks using object oriented programming and expert systems
use professional computer codes to prepare data, and obtain reasonable results from calculations
Mathematics. The graduate should be able to:
construct a mathematical model of a given problem using differential calculus
apply the technique used for setting up definite integrals
classify, set up for solution and solve a selection of ordinary differential equations
use mathematical tools to report the results of his work
use intelligent software tools applied to the solution of mathematical problems
understand and use the concept of sets and classes and be familiar with Boolean algebra
manipulate complex numbers in Cartesian and polar form
use Matrix algebra and its application in solving systems of linear equations
understand the concepts of vectors representing lines and planes in 3-D space
explain topics like Fourier series and Laplace-transforms and their applications in problem solving
apply linear transformations
understand and interpret information in statistical information
use statistical methods for planning, control, interpretation and decisions
Physics. The graduate should be able to:
use the relevant laws of kinematics and dynamics to solve problems of rotational and lateral movement
explain harmonic oscillations, damped oscillations and forced oscillations and treat such oscillations mathematically
describe waves mathematically and explain the concept of wave lore
explain the first and second law of thermodynamics and solve problems applying these laws

explain the principles of electric and magnetic fields and apply the basic laws of electric circuits
explain the basic priciples of quantum theory
Chemistry. The graduate should be able to:
display basic knowledge of general chemistry, organic and inorganic chemistry
assess the environmental influence and use this knowledge in solving technical problems
Environment. The graduate should be able to:
understand the influence of technical activities or processes on the environment, and outline possible ways of reducing such influence
display a clear understanding of the interaction between environmental issues and technological issues and on the basis of this knowledge be able to make independent recommendations on topics of work environment

7.4.6 Additional Academic Requirements for all Programmes at:

Master level (+ 2 years)

The graduate should be able to:
demonstrate an in-depth understanding of his subject area as part of a general engineering technology
demonstrate in-depth knowledge and understanding of a specialised area related to his field of study
plan, supervise and carry out research in his specialised field
Mathematics: The graduate should be able to: formulate mathematically and to solve practical problems related to designing and exploitation of a real technical systems
Computer Science/Informatics. The graduate should be able to: understand the algorithms of professional codes, their limitations and requirements, to prepare the data for the code in the proper way and to analyse obtained results of calculations

7.5 Specific Core Requirements for Particular Subject Areas

In addition to the general core requirements the student must fulfil requirements that are related to his particular field of study. The following sections describe these requirements for main and some selected engineering areas. A large proportion of the several hundred different engineering courses in Europe will have a related or similar academic structure, and should be able to benefit from this core reference.

7.5.1 Chemical Engineering

Bachelor level (3 years)

The graduate should be able to:
understand the processes in organic and inorganic chemistry
analyse the chemical composition of industrial raw materials and products
make the energy and mass balance for chemical installation
assess the quality of the product of chemical installation
understand and apply the basic technological processes in industrial practice
understand the safety problems and the risk of environment pollution by chemical processes
understand the basics of biotechnology

Chemical Engineering
Master level (+2 years)

The graduate should be able to:
apply differential equations for calculation of processes in chemical reactors
design chemical reactors of various types and sizes
assess the influence of chemical installation on the environment
analyse the system of waste management in chemical industry

7.5.2 Civil Engineering

Bachelor level (3 years)

The graduate should be able to:
design buildings and constructions on a basic level
carry out independent project management and supervision of small civil engineering projects
apply static calculations to dimension structures of metals, concrete and wood
take part in planning work related to water supply, drainage and sewer, communications, and mapping
Assume the role of responsible engineer in sub-projects as part of large construction works, in fields like roads, bridges, tunnels, harbours, buildings and landscaping

Civil Engineering
Master level (+2 years)

The graduate should be able to:
show in-depth understanding of general phenomena and problems relating to civil engineering
learn how to increase insight into civil engineering problems and how to find acceptable solutions, in connection with other sciences, taking into account given or anticipated preconditions
apply skills for designing, realizing and maintaining civil engineering constructions and systems from the point of view of strength, stability, safety, environment and costs
explain the social aspects of civil engineering and the social context in which civil engineering projects are realised
use his general knowledge, acquired scientific attitude and designing skills regarding the above objectives
show insight into and proficiency in the area of one of the major fields. After a training period, the recently graduated civil engineer has to be capable of bearing responsibility for the tasks which he/she performs at an academic level in the area in which he/she majored
use the skills required for recognizing, formulating, applying and analysing problems in the area of civil engineering in order to find one or more acceptable solutions. To this end the Civil Engineering student has to be enabled to obtain knowledge of and insight into the developments and methods of scientific and applied scientific research, particularly in the area in which the student majored

7.5.3 Computer Engineering

Bachelor level (3 years)

The graduate should be able to:
install, use, and maintain common operating systems, programs and hardware
carry out object oriented programming
apply 2-dimensional and 3-dimensional computer graphics and modelling
develop graphical and dialogue based user interface
configure and apply standard properties and functions in data base systems
program microcontrollers in assembly and high level languages like C
create and maintain Internet web presentations using standard editing tools and web functions
implement i/o-programming with standard protocols and bus systems applied to control systems
install and maintain operating systems
design basic digital circuits and systems using off-the-shelf components
take part in the development of large computer programs
explain the principles of digital signal processing
explain processes and mechanisms in computer networking and assume the role of network supervisor

Computer Engineering
Master level (+2 years)

The graduate should be able to:
assume the role of engineering supervisor of large computer networks
design and establish computer based communication systems
develop advance intelligent computer applications
plan and implement computer based solutions in engineering projects and technical applications
estimate social, economic, and environmental impacts of computer applications

7.5.4 Electrical Engineering

Bachelor level (3 years)

The graduate should be able to:
apply the basic laws of electrical theory to RCL networks
calculate dimensions of electrical distribution systems
explain principles and systems for power generation and distribution
display knowledge of rules and regulations relating to distribution of electrical power and installation of power systems
take part in planning and implementation of private and professional electricity systems
work with basic analogue and digital components as part of larger systems
plan, install and maintain basic control systems

Electrical Engineering
Master level (+2 years)

The graduate should be able to:
take part in the design of large electrical installations
assume a responsible role in supervision of large electrical systems
explain economical, social and environmental aspects of power generation and distribution
explain safety criteria in electrical systems

7.5.5 Electronic Engineering

Bachelor level (3 years)

The graduate should be able to:
carry out electric network analysis and calculations
explain the theory of electric and magnetic fields, and carry out simple calculations
carry out calculations on RCL circuits using differential equations
carry out calculations on AC circuits using vector analysis and complex algebra
explain the operation of circuits based on digital semiconductors
explain the principles of operation of common analogue semiconductors and other parts
use Boolean algebra in the analysis and design of circuits
use computer simulation tools in designing electronic circuits
explain the principles of operation of microprocessors and carry out simple microprocessor programming
use common laboratory equipment for test, design and development purposes
explain the principles of electromagnetic transmissions

Electronic Engineering
Master level (+2 years)

The graduate should be able to:
use advanced mathematical methods in research and design
carry out independent research and development project in a specialised field
display in-depth knowledge of state-of-the-art electronic technology
plan and supervise quality assurance for electronic systems
explain the impact on environment from electronic engineering

7.5.6 Energy Engineering

Bachelor level (3 years)

The graduate should be able to:
explain the basis of flow and mass transfer processes
explain processes and systems for energy transformation
explain the principles of electricity generating plants and electric systems and common appliances
carry out simple design and calculation of main elements of energy plants and systems
use measuring equipment to control parameters of energy systems
carry out simple design and calculation of main elements of energy plants and systems
characterise the factors governing sustainability in energy systems
evaluate direct energy costs of technical processes, services and everyday life activities
perform simple calculations of total costs of energy

Energy Engineering
Master level (+2 years)

The graduate should be able to:
formulate equations involved in complex energy systems
design energy plants and systems
carry out detailed measurements and experiments on energy systems
perform environmental impact assessments of energy plants
design multivariable optimisation analysis of energy systems
explain and evaluate integrated energy planning

7.5.7 Environmental Engineering

Bachelor level (3 years)

The graduate should be able to:
display knowledge the environmental law and regulations in his country and in EU
explain chemical interactions between elements of environment: atmosphere, soil and water
analyse the data regarding the pollution of all elements of the environment
explain the way pollution is transported in the atmosphere, in water and in the soil
assess the cost of environment pollution and calculate relevant fees
explain the influence of industry on all elements of the environment
explain the technologies of removal of harmful substances from gas, water and soil in industrial systems
apply the basics of environmental management in a work situation
supervise the system of waste management in the industrial enterprise and in inhabited area

Environmental Engineering
Master level (+2 years)

The graduate should be able to:
perform measurements of environment pollution using typical methods
calculate the pollution concentration in the atmosphere as a result of particular emission
make the energy balance and mass balance for industrial installation
design the gas cleaning system and water cleaning system
create the system of waste management in the industry and in inhabited area
determine costs of pollution of the environment and suggest way of its minimisation

7.5.8 Mechanical Engineering

Bachelor level (3 years)

The graduate should be able to:
explain the basics of mechanics and fluid mechanics
explain the basics of material science and stress of materials
explain the basics of thermal science: thermodynamics and heat transfer
carry out designing of elements of machines and mechanical systems using computer aided design codes
explain the principles of operation of common machines: pumps, ventilators, turbines, engines
perform calculations of parameters of hydraulic and gaseous systems, and to choose characteristics of commercially produced machines
calculate the mass balance, energy balance and efficiency of power systems
use common measuring equipment to control the existing power and mechanical system
explain the impact of materials use and machine engineering on the environment

Mechanical Engineering
Master level (+2 years)

The graduate should be able to:
apply the differential equation and formula of fluid mechanics and thermal processes and their solutions
carry out evaluation of advanced stresses phenomena
design mechanical and power machines and systems
carry out detailed measurement of parameters of mechanical and thermal systems
assess the impact of machines and systems on the environment
explain economics relations in designing and exploitation of machines and systems
explain the basics of operation and maintenance of mechanical systems

7.5.9 Mining and Geological Engineering

Bachelor level (3 years)

The student should be able to:
explain the geological processes of formation of the rock structure
analyse the chemical and morphological composition of rocks
explain the basics of mining geology and geochemistry
supervise the methods of rock exploitation
apply the safety procedures in mining industry
supervise the ventilation system in the mine
understand the impact of mining process on the environment
understand the technology of enrichment of excavated material and its preparation for industrial use
supervise the waste material utilisation

Mining and Geological Engineering
Master level (+2 years)

The student should be able to:
design the elements of mining technology and systems: pits, excavations and other
apply the proper materials for mining technology and construction
assess the thread of possible dangerous incidents in the mining technology
assess the impact of the mining process on underground water, earth surface and atmosphere
apply the technology of underground water quality control and pumping system
explain the procedures of ventilation and air quality control
apply the technology of waste material management and earth surface conservation

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The references to be found on the following web page and also included in the reference list of this volume complement the core curriculum, and can be used to cast light on areas not covered in detail, or to compare with other ways of specifying educational systems, processes or requirements.

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8. Conclusions

The work of Activity 1 of E4 on curriculum development issues has been guided by the intention to contribute to the establishment of a European Higher Education Area by addressing crucial aspects of harmonisation, compatibility and comparability. In due course the activities aspired to contribute to the enhancement of EE by encouraging diversity and innovative solutions to deal with a range of changing demands. Creative competitiveness and the strive for specific profiles of engineering qualifications on a high level of quality must be accompanied by the attempt to make diversity and quality transparent based on common terms. Thematic Networks can contribute to these challenges but from time frame, participation and money provided they are not prepared to implement practical changes and collect the respective experiences with pilot projects. However, they can develop or promote innovative approaches and prove by collecting of and referring to good practice how implementation works and experiences are. This was the approach which A1 has taken and would advocate to strengthen in the future, maybe with a focus on special aspects of curriculum development, provision of innovative teaching/learning arrangements and recognition of qualifications handled by smaller special interest groups.

From the experiences gained it would be also very helpful if this kind of focused and coordinated activities could – at least with regard to some issues – be supported and extended through respective research projects executed by full time staff and funded by either European or diverse national sources. A Network and working group infrastructure which provides the staff and facilities to apply for it seems necessary. Increased cooperation of the engineering related networks in the future may ensure that more generic and general aspects of curriculum development are applied in the context of certain branches of engineering, that the wheel has not always be reinvented again and synergy effects are obtained and that a comprehensive structure for dissemination and reflection is provided.

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Annex 1

Communication of CESAER and SEFI on the Bologna Declaration

Based on the joint seminar organized at
Helsinki University of Technology
February 2003

Taking into account the viewpoints of industry, national and EU administrations, as well as those of engineering associations/networks such as BEST, CLAIU, FEANI, CLUSTER, IAESTE, TN SOCRATES – "E4", TIME and the EUA

The Role of CESAER and SEFI

CESAER – The Conference of European Schools for Advanced Engineering Education and Research – is a multinational association of some 50 leading European universities and schools specialised in engineering education and research. These institutions exert a powerful influence on technological growth and workforce development, and ultimately on the viability of the European economy.

SEFI – The European Society for Engineering Education – founded in 1973, is an international non-profit organization linking together 480 members amongst which ones 250 European universities and institutions of higher engineering education (38 countries). Through its network and its numerous activities and services offered to its members, SEFI has a serious expertise relating to the situation of higher engineering education in Europe. SEFI contributes to the development and improvement of HEE, to the improvement of exchanges between teachers, researchers and students, and of industry with the academics.

CESAER and SEFI both have wide representational roles in the field of European Engineering Education. They have been engaged in and have supported the Bologna Process since its inception. In addition, they have been very active in organising debate and investigations into the future of European engineering education. They remain committed to playing a constructive role in the creation of the European Higher Education Area. They have produced this communication in order to present to the wider Higher Education community and to political decision-makers their views on particular issues in the debate on the Bologna Process.

CESAER and SEFI strongly support the idea of the creation of a European Higher Education Area.

In particular,

- CESAER and SEFI share the opinion of the Ministers concerning the need for a system of easily readable and comparable degrees, through a Diploma Supplement or otherwise,
- CESAER and SEFI support a wider use of the ECTS system as a proper means to promote student mobility,
- CESAER and SEFI are convinced of the importance of increased mobility for students, teachers, researchers and administrative staff and it does in many ways promote such mobility,
- CESAER and SEFI are already, by statutes, committed to the idea of developing the European dimension in Education,
- CESAER and SEFI share the opinion of the European Ministers concerning the importance of European cooperation in quality assurance and accreditation. In certain countries in Europe, Engineering Education programmes are already accredited by competent bodies. We welcome any initiative leading to a common reflection, aiming at a deeper understanding and cooperation between these agencies. CESAER and SEFI are fully prepared to pursue actions in this area, in cooperation with these accreditation agencies and other organizations.

Recommendations of CESAER and SEFI

Recognition of Special Factors that Affect Engineering

The supply of highly qualified engineers is of vital importance to the future economic and societal development of Europe, particularly to the aim of making Europe the most competitive and dynamic knowledge-based economy in the world. Thus, the Higher Engineering Institutions producing such engineering graduates form a crucial sector in European Higher Education which should be specifically represented in the discussions and strategies that constitute the Bologna Process. They should be given a voice in the debate.
The implementation of the Bologna objectives must make clear provision for the special factors that apply to advanced engineering education. There is need to ensure that the competences required for engineering graduates are recognized and are not compromised by developments directed to the whole of Higher Education.

Recommendation 1
The special role and features of engineering must be taken into account in the Bologna Process.

Second degree as goal for scientifically oriented programmes

In the Bologna Declaration the Ministers commit themselves to the adoption of a higher education system based on two main cycles, undergraduate and graduate, where the first cycle shall in itself be relevant to the labour market and where the second should lead to a Master's degree. Basically CESAER and SEFI support this approach provided that the specific needs of engineering education are properly taken into account. More precisely, today, in Europe two distinct types of engineering curricula are offered, one longer, more scientifically oriented and the other shorter, more application or vocationally oriented. Both have been developed to respond to particular needs and are well accepted by the job market.

In the context of the new structure of first and second cycle degrees, the engineering community in Europe agrees that in order to attain high level scientifically oriented competences, engineering graduates need to be educated to a level corresponding to second cycle Masters level degrees. It is thus important that any new procedures and regulations do not compromise the number and quality of such graduates. In particular, there must continue to be provision for an integrated route through to Masters level as this preserves the coherence and efficiency of the formation. This implies that where structures include the award of a first cycle (Bachelors) degree, that stage should be regarded mainly as a pivot-point rather than a normal finishing point. The pivot-point allows choice of specialization and also of mobility between first and second cycles but it is important that financial and regulatory barriers do not impede the continuation to the second cycle stage.

The introduction of a larger number of second cycle (Master's) degree programmes, building on first cycle (Bachelor's) degrees, will no doubt make European Engineering Education more attractive for non-European students, especially if the programmes are run entirely or partly in English. It will also facilitate student mobility within Europe. CESAER and SEFI therefore welcome a large-scale introduction of separate 1-2 year Master's Programmes in Engineering.

Most European countries also have various forms of shorter Engineering Education. The length and character of these curricula may vary slightly from country to country but they have normally two factors in common; they are more vocationally oriented, or application-oriented, than the longer programmes and they will typically lead to a first cycle degree. Even if they are not primarily designed as a first part of a two-tier system, bridges to second cycle degree programs should be provided. Graduates of these programs play an important role, particularly in small and medium-sized enterprises.

CESAER and SEFI are convinced that this existing European system for Engineering Education has much merit, that the system is quite compatible with the vision of a European Higher Education Area and that it should not be sacrificed. The cultural diversity of Europe is also a source of richness and changes in the architecture of Engineering Education must not be allowed to destroy this richness.

Also, it should be stressed that engineers have a continuing need for up-dating courses and professional development and to participate in lifelong learning. CESAER and SEFI reaffirm, that lifelong learning could become one of the most important features of the European Higher Education Area.

Recommendation 2
In the scientifically oriented programmes the students should normally be educated to the level of the second degree. There must continue to be provision for an integrated route through to second cycle Masters level.

Recommendation 3
The specific qualities of the presently existing, application oriented first cycle degrees must be recognized and safe-guarded with bridges to second cycle programmes being provided

Research and the doctorate

University education has to be strongly based on original and relevant research. The confluence of the European Higher Education Area and the European Research Area is vital not only for a high quality of both sides but also for the achievement of a globally competitive economy. Universities and other higher engineering institutions are the major contributors in Europe to research both by carrying out the bulk of fundamental and strategic research and also through the training of professional researchers on doctoral programmes. This is particularly true in engineering.

It is therefore necessary to create stronger links between the European Higher Education Area and the European Research Area. More specifically it will be necessary to strengthen the latter, e.g. by creating a European Research Council, with the primary goals to strengthen research quality in Europe, to develop capacity across the continent and to promote the best research through competition at European level. This competition has to be based on merits and on quality and the independence of the funding agencies (at national and at European level) must be safeguarded.

Research has to be carried out primarily at Institutions of higher learning thus automatically leading to the desired effect of strengthening the interaction between research and teaching. Doctoral students play a crucial role in research and they play a particular role in inter-linking teaching and research. Hence strengthening research and its ties to teaching will also mean creating additional doctoral position in the framework of networks of highly qualified research groups and even more importantly promoting joint programmes for doctoral studies. However, doctoral programmes are intimately related to universities' research organization and activities. Excessive interference in this would harm the output as research is by its nature a highly creative process in which the freedom to develop new ideas and approaches is at a premium. Thus, doctoral studies should not be brought into the ambit of the Bologna Process. There is already wide agreement across Europe on the criteria for successful doctoral programmes.

Recommendation 4
The European Research Area and its links to the Higher Education Area have to be strengthened. Competition for support has to be based on merits and on quality. Joint Programmes for doctoral studies should be supported, but the doctoral level as such should not be brought into the Bologna process.

Steering by Output Parameters

Engineers need high level competences in areas such as design, problem-solving and innovation, particularly related to the advancement of technology; there is a strong scientific basis to their work and they have particular responsibilities to society as a whole. Thus, it is natural and important that the primary criteria for determining the level reached by engineering degree programs are expressed in learning outcomes which relate to these competences rather than criteria which are expressed mainly by student work-load. This competence based approach also leads to greater transparency and improved comparability internationally. It enables allowance to be made for differences in national educational traditions in areas such as student selection and teaching methods.

Recommendation 5
Criteria for degrees in engineering should be based on learning outcome and on competence rather than solely on student work-load.

Excellence and distinctive profiles of institutions

It is vital that Higher Engineering Education Institutions are enabled to compete in the global market place for students and staff and for the employment of their graduates. To do this effectively they need to develop their own strengths and particular profiles.

In particular they need to make their own decisions regarding the balance of their activities and how these relate to both global and regional needs. This requires institutional autonomy. Excessive regulation in matters such as admission policy and the balance between different degree cycles would be counterproductive. Any political steering of universities should be based on objectively defined and mutually agreed output parameters. There should be no external interference with operational aspects and no artificially imposed uniformity of mission and structures. For example, separate Masters degrees, intended mainly for international students, may become an important part of the provision of some engineering institutions.

Recommendation 6
Higher education institutions need to strive for quality and for excellence. Their governance structures and decision-making processes must support these goals.

Quality Assurance

The production of world-class engineering graduates depends both on the provision of world-class resources and also on good management. Quality assurance is an important aspect of this. Higher education institutions themselves have the primary responsibility for the quality assurance of their own programmes. External accountability and guidelines for best practice can be provided by national quality assurance agencies. The European dimension of quality assurance is best developed (a) by networks of universities in Europe working together to produce similar procedures and sharing expertise, and (b) through liaison between national quality agencies directed to the adoption of common approaches and standards. Centralized European control of quality assurance is likely to be counter productive and will lead to an excessively bureaucratic approach.

Recommendation 7
Higher education institutions themselves have the primary responsibility for the quality assurance of their own programmes. Networking of Universities and liaison between national quality agencies could create added value, centralized European control has to be avoided.

Accreditation and Professional Recognition

In certain European countries, engineering education programs are already accredited by competent bodies. We welcome any initiatives leading to a common reflection aiming at a deeper understanding and cooperation between these agencies. CESAER and SEFI are fully prepared to pursue constructive actions in this area in cooperation with accreditation agencies.
Comparable degree structures and cooperation between accreditation agencies must pave the way to transnational recognition at professional level.

Recommendation 8
Transnational recognition of Engineering degrees at professional level has to be a primary goal.

Summary of the recommendations of CESAER and SEFI

In view of the European University Aassociation (EUA) Graz Conference, May 2003, and of the European Education Ministers Summit, Berlin, September 2003:

1. The special role and features of engineering must be taken into account in the Bologna Process.

2. In the scientifically oriented programmes the students should normally be educated to the level of the second degree. There must continue to be provision for an integrated route through to second cycle Masters level.

3. The specific qualities of the presently existing, vocationally oriented first cycle degrees must be recognized and safe-guarded with bridges to second cycle programmes being provided.

4. The European Research Area and its links to the Higher Education Area have to be strengthened. Competition for support has to be based on merits and on quality. Joint Programmes for doctoral studies should be supported, but the doctoral level as such should not be brought into the Bologna process.

5. Criteria for degrees in engineering should be based on learning outcome and on competence rather than solely on student work-load.

6. Higher education institutions need to strive for quality and for excellence. Their governance structures and decision-making processes must support these goals.

7. Higher education institutions themselves have the primary responsibility for the quality assurance of their own programmes. Networking of Universities and liaison between national quality agencies could create added value, centralized European control has to be avoided.

8. Transnational recognition of engineering degrees at professional level has to be a primary goal.

and

CESAER and SEFI believe that any attempt to harmonize the National academic calendars and to promote foreign languages within the higher engineering education curricula, would certainly represent important initiatives to overcome too frequent obstacles to the mobility of students, professors and researchers.

Approved by the members of the CESAER/SEFI Bologna Working Group:

Prof. Hans Kaiser (chair)
Prof. Konrad Osterwalder
Prof. Tor-Ulf Weck
Prof. Torbjörn Hedberg
Prof. Gareth Jones
Prof. Johann-Dietrich Wörner
Dr. Tom Phillips
Prof. Günter Heitmann
Prof. Marinela Garcia
Mrs. Françoise Côme
Mr. Jan Graafmans

Annex 2

Activity 1 – Active Participants

NAME	AFFILIATION
Jean Michel Alaverdov	Ecole des Mines d'Albi
Aris Avdelas	Aristotle University of Thessaloniki
Françoise Côme	SEFI Secretary General
Urbano Dominguez Garrido	University of Valladolid
Günter Heitmann	TU Berlin
Tiit Kaps	Talinn Technical University
Anne Kari B. Jahre	Vestfold College
Oddvin Arne	Vestfold College
Iacint Manoliu	Technical University Bucharest
Andre Morel	ESTP Paris
Jan Nadziakiewicz	Silesian University of Technology, Gliwice
Carlo Noè	Universita Cattaneo – LIUC – Castellanza
Otto Rompelman	Delft University of Technology SEFI Curriculum Dev. WG
Laszlo Szentirmai	University of Miskolc
Algirdas V. Valiulis	Vilnius Technical University
Ulrich Wagner	University of Hannover

Stampato da:

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VOLUME D

Activity 2

Quality Assessment and Transparency for Enhanced Mobility and Trans-European Recognition

Giuliano Augusti, Muzio Gola, Alfredo Soeiro

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PART 1

Accreditation and Recognition in Engineering Education

Rapporteur Giuliano Augusti

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1. Introduction

This document describes the accreditation and recognition procedures of engineering degrees in 23 European countries[1]. The national Chapters have been prepared (and signed) by individual contributors to E4 Activity 2; the Chapters without a signature are reproduced from the final version (July 1999) of Chap. 3 "Accreditation and Recognition" of the State-of-the-art Report of Working Group no. 2 "Quality and Recognition in Engineering Education" of the Thematic Network H3E – Higher Engineering Education for Europe. Since these Chapters were each contributed by different individuals, they may differ from each other in style and length.

In accord with the E4 "Glossary", "Recognition" is identified in this document with "Academic Recognition" (i.e. the mutual recognition of degrees within the Higher Education system), while "Accreditation" is the acceptance of a specific degree or educational programme as giving the graduate sufficient preparation to start on a career as a professional engineer: one or the other is usually a prerequisite for "Professional Recognition" of the holder of a "recognized" or "accredited" degree. In practice, it is often difficult to distinguish between recognition and accreditation: in principle, recognition should refer to each individual, and accreditation (to an educational programme, and therefore should always be connected with a process of quality assurance, which however may sometimes be in actuality merely formal.

Recognition and accreditation procedures of Engineering degrees in each European country depend very much, on one side on the educational system, on the other side on how the engineering profession is organized. While a few years ago "accreditation" procedures were established in few European countries, in these last few years, the need of "accrediting" degrees (in particular, newly established degrees and degrees of new-born Universities) has rapidly spread throughout Europe.

As well known, the European Union has established a legal framework for the mutual recognition of professional qualifications. In particular, Directive 89/48/EEC established *a general system for the recognition of higher-education diplomas awarded on completion of professional education and training of at least three years' duration,* for all regulated professions that are not subject to a specific directive, including engineering, while specific procedures have been defined for certain professions, for example, the medical professions, architects, and lawyers. A new unified Directive, aimed at collecting, harmonising and, hopefully, simplifying all existing regulations in order to "introduce a more uniform, transparent and flexible regime for the recognition of qualifications

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[1] It was not possible to include the following EU and EFTA countries: Estonia, Iceland, Latvia, Malta, Norway, Romania and Slovakia.

in the regulated professions", has been proposed in 2002 to the European Parliament but its approval is apparently facing serious obstacles, while an effort is being made again to obtain specific rules for engineers.

Thus, the situation remains fluid, while a true trans-national accreditation system on the European scale does not exist yet, although some bi- and multi-country agreements have recently been established (e.g. among the "Nordic" countries) and schemes for this purposes have been set up by the two main European Associations of Professional Engineers, FEANI and CLAIU, namely:

- FEANI gives the title of EurIng to individual applicants who fulfil a certain formula which takes into account Academic education in an accredited Institution, training and professional experience; as long as an applicant fulfils the quoted formula, no distinction is made between "long-cycle" and "short-cycle" graduates; "exceptional cases" are also possible, but must be approved by a specific process. The list of Accredited Institutions is published and kept up-to-date by FEANI: new Degrees can be included only after a visit by an *ad hoc* Committee.
- The CLAIU approach is based directly on mutual trust between its Member Associations. In fact, each member of a CLAIU-Member Professional Association has the right to be considered as a member of all other Associations. Also CLAIU publishes a list of accredited Educational Institutions, and this is the list of the Institution accredited by the single Member Associations.

In order to understand the variety of the present national systems of recognition/accreditation of Engineering Degrees, one should recall first that in most European countries the right to award Engineering Degrees is limited to specific Education Institutions, and recognition is practically automatic, at least within each country: difficulties can arise more from the dual educational system of most European countries.

In some countries (AT, DK, DE, FI, IT, GR, SE) a National Authority (or a semi-official representative body like a "Rectors' Conference") fixes compulsory or voluntary rules to which each degree course conforms. In this case, some form of (*de jure* or *de facto*) accreditation is practically automatic; this automatism is being relaxed in DE, where "accreditation" is spreading, and it is to be expected that will soon become compulsory.

In other countries (FR, UK, BE, NL, IE, PT), degrees are accredited (and/or accreditation is confirmed at periodic intervals) through an "a posteriori" evaluation process. In some countries (UK, IE, PT) the accreditation process is run by the professional association, sometimes in a indirect way (GR), in others (FR, NL, BE) by a Government-appointed body.

Engineering Profession is regulated by law in four European countries: IT, GR, ES, PT. Among these, IT and GR require not only an accredited degree, but also a formal examination before admittance to the Professional Association; PT requires such exam only from graduates holding a non-accredited degree.

In UK and IE, the engineering profession is formally free, but only membership of a Professional Institute gives the right to the title of Chartered or Incorporated Engineer, thence it is in practice compulsory and “regulated”.

It is to be noted that the validity of both the 1989 Directive and the proposed is limited to the “regulated professions”: for the engineering profession, they therefore apply only in a minority of states (although UK and IE are explicitly included in the draft Directive).

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2. Country Description

AUSTRIA (AT)

General regulations on university studies are established by Austrian Federal Law: The University Studies Act (Universitäts-Studiengesetz – UniStG, BGBl. I Nr. 48/1997). The University Studies Act regulates the requirements of degree programmes and the Federal Ministry for Education, Science and Culture establishes the study regulations for individual degree programmes.

At department level, study commissions (Studienkommissionen) articulate the course requirements (content, structure and volume of studies as well as the sequence of examinations and the allocation of ECTS-credits to the course units)for degree programmes.

It is also possible to establish new study plans or to change existing plans together with foreign universities (e.g. within ERASMUS).

1. Admission to University Studies

Competent body: Rector

- Austrian students, who want to register at Austrian universities have to document their abilities by the general university entrance qualification, the so called Reifezeugnis. Foreign equivalents have to be approved by the Ministry. Furthermore, foreign candidates have to fulfil all requirements which are obligatory for them to register at their home universities.

Additional examinations of the German language (for foreigners) or special certificates for some fields of studies (e.g. Descriptive Geometry for Technical Studies) can be required.

- Foreign students who do part of their studies in Austria and complete their studies at home enrol as regular degree students in Austria, but are advised to inform themselves in advance about the regulations about foreign studies in their home country.
- Foreign students who want to complete their studies in Austria.

Competent body: Head of the Study Commissions

Students enrol as regular degree students. They must submit an application to the head of the study commission in order to have acknowledged their previous studies towards Austrian degree programme requirements.

2. Recognition

- Austrian students, who do part of their studies abroad and complete their studies in Austria.

Competent body: Study Commission/Head of Study Commission

Studies which have been completed abroad successfully are recognised, if their thematic contents and length is equivalent to those in Austria. The study commission can set up a written general regulation, which declares the recognition of certain courses, when completed successfully at the host institution (e.g. regulations concerning double degrees).
It is also possible, that co-operating universities sign general agreements about mutual recognition. If students fulfil those criteria, studies are recognised without approval of individual applications.
Another possibility is the recognition of studies prior to their complexion abroad (e.g. ERASMUS). In this case the head of the study commission has to examine the requirements of the study abroad programme before the student leaves.

- Foreign/Austrian students who finished their studies abroad and register for PhD studies in Austria.

Competent body: Study commission

Graduates have to document that their degree corresponds to the Austrian degree in terms of course work, examinations and written work. If academic degrees do not correspond sufficiently, additional examinations may be required.

The topic of the PhD thesis has to correspond with parts of the previous studies.

- Foreign graduates who are applying for jobs in Austria which are bound to academic degrees (e.g. lawer) – Recognition of Foreign Degrees ("Nostrifizierung").

Competent body: Dean of Studies

Foreign graduates have to have recognised their foreign degrees by the Dean of Studies (Studiendekan). If academic degrees do not correspond sufficiently, additional examinations may be required.

3. Tools according to Bologna Declaration

- Development of study organisation in Austria is more and more orientated towards objectives in international integration. For instance when creating new curricula a lot of attention is paid upon the possibility of student mobility. Courses and lectures in English language are being integrated in the curricula.

- Austria is sharing the development of the European Course Credit Transfer Systems (ECTS) which provides a way of measuring and comparing learning achievements, and transferring them from one institution to another. It offers security within the acts of recognition for the study commissions as well as for students. In Austria the University Studies Act requires compulsory ECTS-implementation for new bachelor- and master-courses, as well as for existing diploma- and master courses from the study year 2002/2003 onwards.
- Austria also takes part in the development (which was started off by UNESCO, the Council of Europe and the European Commission) of the Diploma Supplement, in order to facilitate transparency and recognition of qualifications for academic and professional purposes. Furthermore Austria is a member of ENIC (European Network of Information Centres) since 1982, which has been developed by the Council of Europe and the UNESCO as well as of NARIC (within the European Commission).

4. Special regulations for the Fachhochschule-Sektor

In 1993 a new type of post-secundary education was established by the "Federal Act on Fachhochschule Programmes" (Fachhochschulstudiengesetz FHStG). "Fachhochschule programmes" (Fachhochschulstudiengänge) are application-oriented university level study programmes of at least four years duration (including work on the diploma thesis and a mandatory career-oriented practical training) with vocational-technical orientation. Institutions that offer at least two "Fachhochschule Programmes" that meet legally prescribed organisational requirements are granted the status "Fachhochschule". Until now more than 90 "Fachhochschule Programmes" in the fields of economics, tourism, technology, telecommunications, design and management are offered. From the winter semester 2002 onwards all "Fachhochschule Programmes" will have established ECTS in their curricula.

The application of accreditation of a "Fachhochschule Programme" has to be submitted to a specially established accreditation council, the "Fachhochschule Council" (Fachhochschulrat) for approval. It examines the scientific, educational and didactic quality of a programme. The maximum period of recognition as a "Fachhochschule Programme" is five years. After this period has expired, the programme has to go in for a process of internal and external evaluation and has to apply for an extended approval. The extension depends on the results of the evaluation.

(Hans Kaiser, 23/07/2002)

BELGIUM (BE)

Two types ("filières") of engineering curricula are offered in Belgium:

- a 5 year curriculum leading to the degree "ingénieur civil/burgerlijk ingenieur" at a Faculty of Applied Sciences of a University;
- a 4 year curriculum leading to the degree "ingénieur industriel/industrieel ingenieur" at the Higher Industrial Schools (Institut Supérieur Industriel/Industriële Hogeschool).

The kind (final speciality, discipline) of curriculum that may be offered is determined by law. The curriculum itself is set up by the university/higher school. For both "filières" of engineering an interuniversity or interschool council supervises the quality assessment procedure. Every 5 years a nation-wide visiting committee (half academics, half industrialists) evaluates a particular discipline, e.g. EE, ME, etc. For Flanders (Northern Belgium) visiting committees are often in common with the Netherlands. These committees work along the lines of procedure used by the Dutch VSNU:

- every faculty/school visited establishes a self-study,
- the committee visits every faculty/school for two to three days,
- an evaluation report is written and made publicly available,
- a follow-up procedure exists to check if committee suggestions have been taken care of.

BULGARIA (BG)

1. Structure and degrees in the higher technical education

The evolution of the legal framework governing the higher education area followed the changes in the social and political life in the country. Important steps were the enforcement of the Academic Autonomy Law (1990), Higher Education Act (1995) and a number of regulations, amendments and additions to the Higher Education Act. The most important change in the Higher Education Act was the creation of the National Evaluation and Accreditation Agency. It was created under a two-year project financed by EU's PHARE Programme.

The Higher Education Act calls for a new structure in the degrees. According to it, the two level structure (Bachelor and Master) is compulsory for all higher education institutions, except for the so-called regulated professions/specialties, where a direct route to the Master degree is compulsory.

2. Provisions for accreditation. Types, procedures and duration

After the National Evaluation and Accreditation Agency was constituted, procedures for evaluation of universities were started. There are two types of accreditation in Bulgaria: **institutional** and **programme level** accreditation. Generally speaking, institutional accreditation emphasises the governance of the university and its management (both financial and academic) and evaluates activities and their priorities. The institutional accreditation is a pre-requisite for programme level accreditation. The programme evaluation focuses on one faculty and its programme degrees and looks more deeply upon teaching and learning.

The successful accreditation gives a university a status of recognition and licence to operate for a definite period of time (the period depends on the assessment mark given and can vary from 3 to 5 years).

3. Academic and professional recognition

The Ministry of education and science has appointed a special commission which is in charge for the academic recognition of higher education diplomas/degrees awarded by foreign universities and institutes. The professional recognition for some but not all engineering fields will be carried out by the currently being established Chamber of the architects and design engineers.

4. Expected/forthcoming changes

The Higher Education Act is expected to undergo a serious modification and update which is planned for the autumn of this year (2003). The programme level accreditation will not be required anymore according to the foreseen changes.

(Zdravko Bonev, 22/04/2003)

CZECH REPUBLIC (CZ)

Law establishes general regulations on university studies. The Higher Education Act regulates activities of universities and non-university higher education institutions. Two types of engineering curricula are offered in Czech Republic:

- So-called "long programs" 5 or 5-and-half year curriculum leading to the degree "Ing." – engineer at Technical and Economical Universities.
- So-called "structured programs" – 3 or 4 year curriculum of bachelor degree leading to the degree "Bc.". That could be possibly but not obligatory continued by 2 year master degree program (master degree in engineering "Ing.").

Currently, there are five technical universities in the Czech Republic. Until 1992 all of these schools taught students in masters degree courses of five or five-and-a-half years. The law of 1992 allowed changing the educational structure at universities, and bachelor's degree courses of two types were created.

The so-called parallel programs were intended for bachelor students generally undertaking three or four years of study. These graduates were trained for technical professions and entrepreneurial jobs. Students were always allowed to transfer to master's degree courses subject to various conditions, such as the entering of a lower grade in a five-year course, or taking part in an individually designed equivalency program.

In addition, "serial type" bachelors degree programs were instituted. These programs merely consisted of parts of the original programs and divided them into two stages. A bachelor's degree was thus awarded to graduates with an "incomplete" course of study. Such graduates generally continued their study rather than took up a practical job. At some universities the Accreditation Commission scrutinized these study programs, but the commission did not restrict the programs to any major extent. Traditional universities enjoy great authority and the Accreditation Commission was aware that the quality standard would always be maintained, particularly because the methodologies and syllabus used at that time did not change substantially.

The existing law amended in early 2001 mandates a structured study program with a mandatory bachelors degree. As part of this plan it is required that bachelors degree programs form a closed stage of higher learning and, concurrently, a sufficient preparatory stage for a masters degree program. It calls for deep restructuring of study programs at all schools of higher learning. The Accreditation Commission will need to evaluate the process and grant its consent to each school for the transition to study programs so designed.

1. Accreditation Commission – members and membership

The Accreditation Commission consists of 21 members. The Government upon a nomination by the Minister appoints the Chair, vice-chair and members of the Accreditation Commission. Prior to making a nomination, the Minister shall request references from the representation of higher education institutions, the Governmental Board of the Czech Republic for Research and Development and the Academy of Sciences of the Czech Republic and discuss the nomination with these institutions.

Members of the Accreditation Commission are appointed for a six-year term; they can be appointed for the maximum of two terms of office. They represent irreproachable persons enjoying general authority as experts. A member of the Accreditation Commission may be dismissed only in case of losing one's integrity, long-term non-participation in the work of the Accreditation Commission, or upon his/her own request. They are provided with reimbursement of travel expenses as per special regulations and may be provided with recompense. Membership in the Accreditation Commission is incompatible with the duties of Rector, Vice-rector and Dean.

Members of the Accreditation Commission perform their duties independently. Activity of the Accreditation Commission members is deemed an act in the interests of the public. Submissions to the Accreditation Commission are made via the Ministry.

2. Accreditation Commission – responsibilities

The Accreditation Commission takes care of the quality of higher education and performs comprehensive evaluation of educational, scholarly, research, developmental, artistic or other creative activity of higher education institutions.

In order to achieve these objectives, it must perform the following:

- Evaluate activities pursued by higher education institutions and the quality of accredited activities and publish the results of such evaluations.
- Assess other issues concerning the system of higher education presented to it by the Minister and express its standpoints over these issues.

The Commission collect written applications for study programme accreditation and written applications for accreditation of procedures for obtaining "venium docenti" (habilitation) or procedures for appointment of professors in a given field.

The Commission is authorized to decide over the following:

- Applications for accreditation of study programs.
- Applications for accreditation of procedures for obtaining "venium docenti" (habilitation) or procedures for appointment of professors.
- Establishment, merger, amalgamation, splitting or dissolution of a faculty of public or state higher education institution.
- Granting the state permission for a legal entity desiring to operate as a private higher education institution.
- Determining the type of a higher education institution.

The Commission is authorized to establish work groups:

- The permanent work groups for judging the applications of institutions.
- The special work groups, which are established only for the period of evaluation of chosen institution or institutions.
- In the area of professional fields that are not represented in the Commission, the Commission may authorise also a person who is not its member to present the proposal to establish work group.

The Commission may appoint as a Chair of a work group even a person who is not its member.

3. Applications for study programs

Contents of Application:

- Study program title.
- Titles and characteristics of study branches in case those studies program are divided into study branches, feasible combinations of the latter included.
- Objectives of studies related to the entire study program as well as specific objectives of individual study branches in case that study program is divided into these.
- Profile of a study branch graduate, which comprises: Specification of acquired general, professional and particular knowledge and abilities. Characteristics of professions which graduate should be prepared to exercise as well as of other possibilities of their employment and characteristics of employers where graduates could use the acquired education.
- Conditions that must be met by students within the framework of their studies and upon its completion.
- Evidence of study programme provision.
- Objectives and motivations of study programme.

An accreditation of a study program is awarded for at most double of the standard length of study. The validity of an accreditation can be extended repeatedly: while providing an accredited study program, the higher education institution may request an accreditation of its extension.

An accreditation of a study program may be requested by legal entities with domicile in the Czech Republic undertaking educational, scholarly, research, developmental, artistic or other creative activity. Such a request is made together with a higher education institution.

(Jan Uhlir, 19/10/2002)

DENMARK (DK)

The engineering degree courses are regulated by a common set of regulations (Bye-Law) produced by the Danish Ministry of Education[2].

Graduates of the *diplomingenioer* programme (3½ year) may continue studying for two further years to obtain the *civilingenioer* degree (5 year). Thus, obtaining *both* degrees takes half a year extra. The two systems are not totally harmonized to a one string system, but a compromise between tradition and internationalism.

Even though the degrees are regulated by the same Bye-Law, there are major differences between the schools, e.g. some engineering schools have combined modules into groups and have project work in these groups of modules. Up to 50% of the entire curriculum may be project-organized, thus emphasizing the integration of theory and practice.

Some other schools prefer a more classic discipline-oriented approach.

Both the *diplomingenioer* and *civilingenioer* degrees give the right to become a member of *The Society of Danish Engineers*, IDA without any further requirement. Also the "Export engineer" title (see Chapter 1) gives the right to become a member of IDA.

IDA is a combination of a trade union and a learned society, taking care of its members' technical and financial interests. IDA was formed in 1995 by the merger of the two previous societies. IDA is now the only engineering society in Denmark – and is also a member of *FEANI*.

[2] *Order on the Engineering Degree Courses,* The Danish Ministry of Education Order No. 681 of 5 July 1996. (Available in English from the Danish Ministry of Education).

FINLAND (FI)

According the degree regulations in technical education, the first degrees are Master of Science in Technology (diplomi-insinööri), or Master of Architecture (arkkitehti) or Master of Landscape Architecture (maisema-arkkitehti), and the higher degrees are those of Licentiate in Technology (tekniikan lisensiaatti) and Doctor of Technology (tekniikan tohtori).

The education leading to the master's degree in technology, architecture or landscape architecture, is designed and planned to lead to a particular profession, a certain field of technological expertise and its development.

The curricula for master's degree is for five years. The average time of study for the MSc in Technology e.g. at the Helsinki University of Technology has been 6.3 years and for the degree of architecture the average study time has been more than eight years.

Universities of Technologies in Finland does not have programmes leading to BSc degree. On the other hand new polytechnics (ammattikorkeakoulut), which are former institutes of technologies, have set up four year curricula and this degree (AMK-insinööri) has been recognized as a BSc in Technology by some foreign universities. Finnish universities or the Finnish Ministry of Education does not recognize a AMK-degree as a BSc degree.

Universities are supervised by the Ministry of Education. The contents of the degrees are labelled by the ministry. This means that the framework and the basis are the same. The ministry can control all degrees in general.

Universities of technology in Finland are Helsinki University of Technology, Tampere University of Technology, Lappeenranta University of Technology, Oulu University Faculty of Technology and Abo Akademi Faculty of Technology.

Degrees of Technology are not accredited or legally protected in Finland. Only for certain positions as a state officer a degree of Master in Technology is compulsory. Just as an example, if a defective bridge has been build and collapsed, the responsibility lays not with the design engineer but with the company which accepted the calculations and constructed the bridge.

FRANCE (FR)

In France, the title of “Ingénieur diplômé” is protected by law, and only Schools accredited by a national “Commission des Titres d’Ingénieur” (CTI) are allowed to award it.

CTI has been created by law as early as 1934, with a triple mission:
i. Accredit all new engineering programs,
ii. Assess the quality of existing engineering curricula, and take the initiative of any enquiry within accredited schools and universities,
iii. Take part to any study related to the strategy and/or development of engineering education.

CTI is composed by 32 members appointed for 4 years (and renewable for a second 4-year term),

- half of them representing institutions of all kinds (public “Grandes Ecoles”, other public or private schools of engineering, universities of technology, etc.) awarding an engineering degree,
- half of them representing industry managers, the associations and trade unions of engineers.

This twofold composition is much appreciated, since it involves all people interested in the training of engineers, and it has remained unchanged since the very creation of the Commission.

The secretariat and material support of the Commission is devoted to the Ministry of Higher Education.

First accreditation – or assessment – visits are decided by the plenary Commission, who appoints a team of at least 2 members or experts belonging to two different categories, the size of the team being related to the size of the visited institution. Recently, the Commission decided jointly with the ministry of higher education that, instead of non systematic “inspections”, every curriculum would be assessed, and its accreditation renewed on a six year basis. In addition, a small report on the implementations of the requirements of CTI, and on the new events occurred inside the institution, is provided on a 2 year basis. Thus CTI is in charge of reviewing periodically over 300 different curricula, and the work load of the Commission has strongly increased, so that a “college” of 32 experts has been appointed by the Commission to participate to assessment visits.

The criteria used by evaluators are made public through a periodic publication of CTI named “Références et Orientations” so that any institution is aware of the requirements. Briefly speaking, the evaluators should examine:

- the global education environment of the school or department, with particular attention to its links with the employment market,
- the general philosophy of the curriculum, specialities chosen, originality and/or credibility of the education project, etc.
- detailed organisation of studies, scientific and technical programs, tutorials, lab. work, industrial internships, language studies, economic and managerial formation, assessment procedures of courses by students, etc.
- student recruitment procedures, presence of foreign students according to exchange agreements, possible access to adults in continuing education ...
- number and quality of scientific staff,
- research activity and production, links of research with undergraduate students' education,
- finance, premises, etc.

All reports are presented to a plenary session, and after discussion, either the institution is a public one, and the report is transmitted to the appropriate minister, who usually decides according to the suggestions of the commission, or the institution is private, and the decisions of the commission are directly applicable.

An article of the founding law states that the Commission can assess curricula, whenever requested, awarded by foreign institutions, and recognise to their degrees an equivalence as regards French regulations. This disposition has been ineffective for a long time, but is now used by some neighbouring institutions.

GERMANY (DE)

1. Historical Development

In the traditional German engineering education no formal procedure of accreditation does exist, neither in the academic nor in the professional world. The title 'engineer' is protected by law. Only the Technical Universities (TU), Gesamthochschulen (Comprehensive Universities – GH)) and Fachhochschulen (Universities of Applied Sciences – UAS) are entitled to award the degree 'Diplom-Ingenieur', in case of the Fachhochschulen in some States supplemented by (FH) in parenthesis.

The recognition of private institutions of higher education by the respective State Minister of Education and Cultural Affairs implicitly can be interpreted as a kind of accreditation in the academic world; it includes the permission to award the degree 'Diplom-Ingenieur'. In engineering this applies only to very few private institutions, however. The permission will be given only if the study programmes (and also the necessary facilities) satisfy the requirements which the public Universities and Universities of Applied Sciences have to fulfil.

The general principles and foundations of the system of higher education are set by the 'Hochschulrahmengesetz' ('Federal Higher Education Framework Act'). The Federal Framework Act is mirrored in the respective Higher Education Acts of the States (a total of 16 States following unification). Some States parliaments passed a single common law for the system of higher education, others passed up to four (slightly different) laws for Universities, Universities of Applied Sciences, Academies of Art and Music and Colleges of Education, respectively.

In order to achieve the necessary harmonisation of academic studies within the Federal Republic so-called 'Rahmenprüfungsordnungen' ('Framework Regulations for Academic Studies and Examinations') have been approved by the 'Association of Universities and other Higher Education Institutions in Germany' (formerly Hochschulrektorenkonferenz [HRK] – 'Conference of Rectors of Higher Education Institutions') and the 'Kultusministerkonferenz' [KMK] ('Standing Conference of the State Ministers of Education and Cultural Affairs in the FRG'). These framework regulations are based mainly on the recommendations of the 'Fakultätentage' ('Federal Assemblies of Faculties'). These are non-governmental assemblies of faculties and departments from the same subject area (i.e. 'mechanical engineering' and 'electrical engineering'). In addition the views of professional associations are considered, i.e. in engineering the 'Verein Deutscher Ingenieure [VDI]' ('Association of German Engineers' and the 'Verband der Elektrotechnik Elektronik Informationstechnik e.V. [VDE]' (Association for Electrical, Electronic, & Information Technologies). Industrial organisations contribute and comment as well, i.e. in engineering 'Verband Deutscher Maschinen- und Anlagenbau e.V. [VDMA]' ('German Machinery & Plant Manufacturers'), Zentralverband der Elektrotechnik- & Elektronikindustrie [ZVEI]' ('The German Electrical & Electronic Manufacturers' Association') and the 'Deutsche Kommission für Ingenieurausbildung' ('German Commission for Engineering Education').

The German institutions of higher education are autonomous, self-governing bodies, which means that they develop courses and study regulations ('Studien- und Prüfungsordnungen') according to their own priorities and strategies. These regulations have to be upward compatible to the respective State laws and regulations and have to be approved by the State Minister in charge. The described Framework Regulations for study and examinations are only recommendations and must not be implemented in every detail. However, they guaranteed in the past a specified common content and thus accepted standards and mutual recognition in Germany, especially in the first two years of study, allowing students to change nationwide from one institution of higher education to another one.

The academic degrees awarded by German institutions of higher education are protected by law against abuse. Academic degrees open immediate access to the professions in Germany according to the respective Higher Education Acts of the individual Federal States. The mentioned associations of engineers like VDI or VDE are not entitled to deliver additional titles or permissions as the British institutions do with the chartered engineer.

At present his traditional system is changing dramatically. As a result of the amended Framework Act for Higher Education (HRG) of 20 August, 1998 German higher education institutions were granted the right to introduce degree programmes leading to Bachelor's and Master's (BA/MA) degrees. Internationally these degrees are well established and accepted According to the resolution of the Association of Universities and Other Higher Education Institutions in Germany [HRK] of 6 July, 1998 it is aimed to enlarge the creative scope of the higher education institutions, to improve the international compatibility of German university degrees, to enhance the student mobility and to increase the quotas of foreign applicants for a place at university.

This internationalisation of the education of engineers in general and the introduction of Bachelor and Master degree courses requires new measures. In November 1998 a position paper was passed by the Association of German Engineers [VDI] 'Recommendations of Accreditation of Bachelors' and Masters' Study Courses in Engineering'; it states the need for accreditation procedures to ensure the comparability and quality of teaching, studies, and degrees awarded via an accreditation transcending the borders of the federal states as a consequence of the realisation of Bachelors' and Masters' study courses. In July 1998 the German Rectors Conference [HRK] passed a resolution on the accreditation procedure which was submitted to the Standing Conference of the State Ministers of Education and Cultural Affairs [KMK]. Accreditation, however, is completely independent from the legal admission of those new courses by the respective State ministry. In December 1998 the final outcome was a decision of the KMK to found for a transition period of three years a 'Federal Council of Accreditation' administered by an office affiliated with the HRK. This was financed mainly by the 'Stifterverband für die Deutsche Wissenschaft' ('Donor's Association for the Promotion of Sciences and Humanities in Germany'). The Accreditation Council is designed to be the umbrella organisation governing, co-ordinating, and organising accreditation procedures which are conducted by independent and to be appointed agencies. These are the already existing evaluation agencies (Federal or State level), expanding their expertise to the field of accreditation, as well as in the meantime newly founded boards. The described accreditation procedure is compulsory for all newly established Bachelor and Master degree courses, the diploma degree courses are not affected yet. However, any newly designed course of study yielding a Diploma or Magister degree, respectively, has to be accredited if no framework regulations for academic studies and examinations exist or are no longer valid.

After the three-year starting period the accreditation system in Germany has become permanent on the basis of two resolutions of the Kultusministerkonferenz (KMK – Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany): "Künftige Entwicklung der länder- und hochschulübergreifenden Qualitätssicherung in Deutschland" (Further development of the cross-Länder quality assurance for all kinds of higher education in Germany), adopted on 01 March, 2002 and "Statut für ein länder- und hochschulübergreifendes Akkreditierungsverfahren" (Statute of a cross-Länder accreditation procedure for all kinds of higher education), adopted on 24 May, 2002.

The statute came into effect commencing 1 January, 2003. The Accreditation Council is affiliated to the Kultusministerkonferenz (KMK). The Accreditation Council is now fully operational and old and new accreditation agencies are in business.

2. Akkreditierungsrat (Accreditation Council)

Task and function

To ensure quality in higher education teaching and study and to provide reliable orientation and enhance transparency for students, employers and higher education institutions alike, the Accreditation Council has been set up in accordance with the resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the States in the Federal Republic of Germany (Kultusministerkonferenz – KMK) adopted on 03 December, 1998 and on 24 May, 2002, respectively. Its power is to authorise agencies to accredit new Bachelor/Bakkalaureus and Master/Magister degree programmes. Such agencies as well as degree programmes accredited by them do bear the quality label of the Accreditation Council. As an independent institution the Accreditation Council is made up of 16 members, who are representatives of the Länder (4), higher education institutions (4), professional practice (4) (on behalf of both employer and employee organisations), students (2) and foreign experts (2).

International co-ordination

Internationally, the Accreditation Council co-ordinates its actions and policies with accreditation institutions performing comparable functions and responsibilities in other countries. At present, these are the Österreichischer Akkreditierungsrat (Austria) [Austrian Accreditation Council], the Schweizerisches Organ für Akkreditierung und Qualitätssicherung (Switzerland) (OAQ) [Center of Accreditation and Quality Assurance of the Swiss Universities], the Hungarian Accreditation Council (HAC) and the Council for Higher Education Accreditation (CHEA) in the United States. Accreditation Council's memberships include the International Network for Quality Assurance Agencies in Higher Education (INQAAHE) and the European Network for Quality Assurance in Higher Education (ENQA).

Authorisation of accreditation agencies

The Accreditation Council is responsible for authorising accreditation agencies to accredit degree course programmes. Additionally, the Accreditation Council will act as a co-ordinator and critical observer of the work carried out by the accreditation agencies and will also function as a central documentation office to guarantee transparency with respect to compatibility and equivalency of study courses.

For further details compare to the home page of the Accreditation Council
http://www.acrreditation-council.de

3. Akkreditierungsagenturen (Accreditation Agencies)

Accreditation of degree courses

The Accreditation Agencies are responsible for the accreditation of degree courses. Accreditation is based on the principles of assuring quality, verifying the feasibility of study courses, facilitating diversity and enhancing transparency. The review process carried out on the basis of specialist-content criteria aims to address the question of whether a degree course provides a logical and coherent picture as far as the goals are concerned which have been set and are to be achieved.

German Accreditation Agencies

At present the following Agencies are authorised by the Accreditation Council to provide accreditation of study programmes:

- **ZEvA** **Z**entrale **Ev**aluations- und **A**kkreditierungsagentur Hannover.
  (Central Evaluation and Accreditation Agency of Hanover)

Established in 1995 by the State University Conference (Landes-Hochschul-Konferenz – LHK) as Central Evaluation Agency of the Lower Saxon Universities (ZEvA). Renamed in 2000 to Central Evaluation and Accreditation Agency of Hanover (ZEvA) after establishing an organisational independent division of accreditation. ZEvA is a common institution of all Lower Saxon institutions of higher education.

Internet:	http://www.zeva.uni-hannover.de
Founded:	1994
Authorised:	04 February, 2000
Re-authorised:	05 February, 2003
Expiring date:	04 February, 2006
Profile of agency:	Accreditation of Bachelor and Master degree courses in all fields of study. Accreditation of newly designed courses of study yielding a Diploma or Magister degree, respectively, if no framework regulations for academic studies and examinations do exist or are no longer valid.

- **FIBAA** **F**oundation for **I**nternational **B**usiness **A**dministration **A**ccreditation.

Internet:	http://www.fibaa.de
Founded:	1995
Authorised:	13 April, 2000
Re-authorised:	14 March, 2002 (one conditional requirement)
Expiring date:	14 March, 2007
Profile of agency:	Accreditation of Bachelor and Master degree courses in fields of study Business Administration and related fields. Accreditation of newly designed courses of study yielding a Diploma or Magister degree, respectively, if no framework regulations for academic studies and examinations do exist or are no longer valid.

- **ASIIN** **A**kkreditierungsagentur für **S**tudiengänge der **I**ngenieurwissenschaften, der **I**nformatik, der **N**aturwissenschaften und der Mathematik. (Accreditation Agency for Courses of Study in Engineering, Information Technology, Natural Sciences, and Mathematics).

ASIIN was founded on 19 September, 2002 by amalgamating two former accreditation agencies: ASII (in the fields of Engineering and Information Technology) and A-CBC (in the fields of Chemistry, Biochemistry, and Chemical Engineering) as well as expanding to all fields of study in natural sciences and mathematics. This extension facilitates the accreditation of interdisciplinary study programs merging two fields of studies in engineering and science (double degree courses or 'hyphenated' study programmes).

Internet:	http;//asiin.de (for time being use http://asii.de)
Founded:	2002 (amalgamating ASII and A-ABC)
Authorised:	12 December, 2002 (one conditional requirement)
Expiring date:	11 December, 2007
Profile of agency:	accreditation of Bachelor and Master degree courses in fields of study of engineering, information technology, natural sciences, and mathematics. Accreditation of newly designed courses of study yielding a Diploma or Magister degree, respectively, if no framework regulations for academic studies and examinations do exist or are no longer valid.

The ASIIN is a member of ESOEPE (European Standing Observatory for the Engineering Profession and Education) to enhance mutual international recognition.

The two agencies merged into ASIIN were

- **ASII** **A**kkreditierungsagentur für **S**tudiengänge der **I**ngenieurwissenschaften und der **I**nformatik (Accreditation Agency for Courses of Study in Engineering and Information Technology).

Founded:	1999
Authorised:	05 June, 2000
Expiring date:	05 June, 2003
Profile of agency:	Accreditation of Bachelor and Master degree courses in fields of study of chemistry engineering and information technology.

The ASII was a founding member of ESOEPE (European Standing Observatory for the Engineering Profession and Education).

- **A-CBC** **A**kkreditierungsagentur für die Studiengänge **C**hemie, **B**iochemie und **C**hemieingenieurwesen an Universitäten und Fachhochschulen. (Accreditation Agency for Courses of Study in Chemistry, Biochemistry and Chemical Engineering at Universities and Universities of Applied Sciences).

Internet:	http://www.a-cbc.de
Founded:	2000
Authorised:	11 December, 2000
Expiring date:	11 December, 2002
Profile of agency:	Accreditation of Bachelor and Master degree courses in fields of study of chemistry, biochemistry and chemical engineering.

- **ACQUIN** **A**kkreditierungs-, **C**ertifizierungs- und **Qu**alitätssicherungs-**In**stitut. (Accreditation, Certification and Quality Assurance Institute).

Internet:	http:/www.acquin.de
Founded:	2001
Authorised:	22 March, 2001
Expiring date:	22 March, 2006
Profile of agency:	Accreditation of Bachelor and Master degree courses in all fields of study. Accreditation of newly designed courses of study yielding a Diploma or Magister degree, respectively, if no framework regulations for academic studies and examinations do exist or are no longer valid.

- **AHPGS** **A**kkreditierungsagentur für Studiengänge in Bereich **H**eilpädagogik, **P**flege, **G**esundheit und **S**oziale Arbeit e.V. (Accreditation agency for study programs in special needs education, care, health and social work Ltd).

Internet:	http:/www.ahpgs.de
Founded:	2001
Authorised:	17 December, 2001
Expiring date:	17 September, 2004.
Profile of agency:	Accreditation of Bachelor and Master degree courses study programs in special needs education, care, health and social work. Accreditation of newly designed courses of study yielding a Diploma or Magister degree, respectively, if no framework regulations for academic studies and examinations do exist or are no longer valid.

- **AQAS** **A**gentur für **Q**ualitätssicherung durch **A**kkreditierung von **S**tudiengängen (Agency for Quality Assurance by Accreditation of Study Programs).

Internet:	http:/www.aqas.de
Founded:	2002
Authorised:	14 March, 2002
Expiring date:	14 March, 2007
Profile of agency:	Accreditation of Bachelor and Master degree courses in all fields of study. Accreditation of newly designed courses of study yielding a Diploma or Magister degree, respectively, if no framework regulations for academic studies and examinations do exist or are no longer valid.

4. Useful links

Some useful links and short descriptions of institutions / agencies / bodies concerned with Quality Assurance /Evaluation / Accreditation are given below.

Hochschulrektorenkonferenz – HRK – Association of Universities and other Higher Education Institutions in Germany Internet: http://www.hrk.de

The HRK hosted the **'The Quality Assurance Project'** (cross-regional exchange of experiences of quality improvement in higher education) [1998-2000] – Länderübergreifender Erfahrungsaustausch bei der Verbesserung der Qualität der Lehre – (supported by the Bund-Länder Commission for Educational Planning and Research Promotion – BLK). The coordination project is continueing for another three years period (2001-2003). A report on the first three-years period and a preview of the tasks of the upcoming three years are published as "Bilanz und Ausblick zur Arbeit des Referates Q" (Review and future aspects of the quality assurance project).
Internet:
http://evanet.his.de/evanet/PDF/Pdf_dok/ReferateQ_Bilanz_Ausblick.pdf

A list of publications of the Quality Assurance Project (mainly proceeding of meetings and seminars) is available under:
http://evanet.his.de/evanet/knowhow/kh.grund/kh.literatur.html#Tagungsband

Any ongoing activities are disseminated and commented in a newly established newsletter 'EvaNet' published in co-operation with the **Hochschul-Informations-System** – HIS GmbH (Higher Education Information System Ltd).
Internet: http://www.his.de
The **EvaNet Newsletter** is available via Internet: http://www.evanet.his.de

Centrum für Hochschulentwicklung – CHE – Centre of Higher Education Development (founded 1994 by the Bertelsmann Publishing Company Foundation and the HRK to initiate and to support reform of Higher Education).
Internet: http://www.che.de

Verbund norddeutscher Hochschulen 'Nordverbund' – Association of Northern German Universities (Bremen, Greifswald, Hamburg, Kiel, Oldenburg, and Rostock) established in 1994; Internet: http://www.uni-nordverbund.de

Central Evaluation Agency North Rhine Westfalia: administration offices for Universities and Universities of Applied Sciences, respectively.

> Geschäftsstelle Evaluation der Universitäten NRW – Administration Office 'Evaluation of Universities in North Rhine Westfalia' (c/o University of Dortmund).

Geschäftsstelle Evaluation der Fachhochschulen NRW – Administration Office of Universities of Applied Sciences in North Rhine Westfalia (NRW) (c/o FH Gelsenkirchen).
Internet: http://www.fh-ge.de/evalutation-fh-geschaeftsstelle-nrw

Stiftung Evaluationsagentur Baden-Württemberg – EVALAG – Foundation Evaluation Agency State of Baden-Württemberg; founded 01 August, 2000.
Internet: http://www.evalag.de
Lehrevaluation der Universitätspartnerschaft – LEU – Agreement for a self-organised joint evaluation initiative of the Universities of Halle-Wittenberg, Jena and Leipzig. Signed on 24 May, 2000 by the rectors of the three partner universities.

Interdisziplinäres Zentrum für Hochschuldidaktik – IZHD – Interdisciplinary Centre for Research and Development in Higher Education, University of Bielefeld; (pilot project 'Quality of Teaching' at institutions of higher learning in the State of North Rhine Westfalia).
Internet: http://www.uni-bielefeld.de/(en)ZIF

IDEA League: a collaboration on strategic policy issues between **I**mperial College London, **D**elft University of Technology, **E**idgenössische Technische Hochschule Zürich (ETH), and Rheinisch-Westfälische Technische Hochschule **A**achen (RWTH). A memorandum of understanding was signed on 6 October, 1999.
Main aims: (1) quality management; developing a system of quality procedures to be applied in a similar way in each of the partner universities; (2) reviewing the degree system to permit mutual recognition in the future.

(G. Kurz, G. Heitmann, K. Hernaut; Last Update: 06/04/2003)

GREECE (GR)

In Greece the engineering academic title “Graduated Engineer” (Diplomatouchos Michanicos) followed by the respective specialization is protected by the law no. 1477/1938; only an Engineering Department belonging to one of the Technical Universities or Faculties of Engineering in Universities (AEI) are allowed to award this title.

The equivalence of foreign academic titles with the previous title of Graduate Engineer is granted by DIKATSA (Inter-university Centre for the Recognition of Foreign Titles of Studies) being the competent authority for the recognition of diplomas of foreign Universities.

The accreditation and admission to the profession of engineer in Greece is responsibility of the Technical Chamber of Greece (TEE), established to “advance the education and training of engineers and to promote the science of and practice of engineering for the public benefit”. TEE has the right and the duty to evaluate the adequacy of the graduate’s preparation to start on a professional career.

To this effect, it awards the “Permission of Exercising the Profession of Engineer” under the fulfilment of two prerequisites:

- a “Graduated Engineer” diploma, obtained (as previously explained) after a 5-year engineering curriculum or an equivalent foreign title;
- an examination organized and run by the TEE. During this exam, a panel composed usually of three engineers (a University Professor, an engineer from a construction or industrial firm and an engineer from a design office) checks the applicant’s Diploma Thesis and his ability to confront several professional problems, and investigates his knowledge on three topics chosen by himself. After passing successfully this exam, the applicant is enrolled to the TEE.

Once the “Permission of Exercising the Profession of Engineer” is granted to a graduate engineer, this remains valid for his whole professional life.

It is to be noted that no similar examination procedure and acceptance exists till now for graduates from the short-cycle (3 years) engineering curricula provided by the Technological Institutes (TEI), a fact that leads to lack of established “professional rights” for these graduates.

(C. Baniotopoulos, Updated 26/03/2003)

HUNGARY (HU)

The accreditation system in Hungary is classified into the categories of respective Faculty accreditation and new programme accreditations. Ministry of Education established a Hungarian Accreditation Committee (HAC) that has permanent members and invited experts regarding the engineering fields concerned. HAC submits its recommendation to the Minister who makes the decision that is usually in harmony with the submission with few exemptions (e.g. the respective committee has some different arguments and the recommendation is not clear).

(i) **Engineering Faculty accreditation** takes place usually in every 5^{th} year at individual academic, Department and Faculty levels.

a) At least six months before the appointed sub Committee will start with the investigation each respective academic has to prepare the list of publications in the past 5 to 6 years, the courses (full-time, part-time, etc.) taught indicating briefly the theory, practice, hours per week, nature of examination (oral, written test or both, laboratory performance), participation in the supervision of students' projects, final examinations, then the output of research activity, memberships in national and international education/scientific bodies, participation in national/international conferences/symposiums/workshops/seminars and the nature of participation (session chairperson, poster/paper presentation, etc.).

b) At Department level the reports of individual academic staff members will be integrated and as an introduction the activities of the Department are described in the fields of education, scientific research, national and international projects, industry-academia link development, new programmes introduction and running, staff development, teaching methods applied, new significant equipment purchased, the Department's role in the respective national and international area, demonstration of various activities in addition to the undergraduate and graduate levels (with PhD programmes inclusive) like continuing education, organisation of national-international events and other facts presenting the vivid link between the Department and professional organisations, companies, agencies, societies both in Hungary and abroad. Great emphasise should put on the international recognition and its demonstration. In similar disciplines two or more Departments are integrated into an Institute. In such case the Institute integrates the reports of its Departments in such a way as described above. The full reports of the Departments and/or the Institutes are submitted to the Dean of the Faculty.

c) At Faculty level the reports are integrated with the introduction of the Faculty activities how they are serving the long-term strategy of the University and the intentions of the government. This report having roughly 1,000 pages are sent to the HAC for consideration. At least 6-months time is needed for the respective HAC members to study thoroughly the full report.

d) Respective HAC sub-committee investigates on how the report and reality are in harmony by meetings with the Vice Chancellor, its Deputies if needed, the Dean, Directors of the Institutes and the Departments plus groups of academics and students. Informal interviews, observation of lecture presentations, laboratory practice, projects, etc. provide a clear picture to the Committee. Such a visit takes place for three days as an average and after the completion of the visit the Committee prepares its evaluation report and submits it to the Minister. Feedback will come back from the Minister with recommendations which areas should be developed in more efficient and more successful way. If serious lacks are observed the accreditation can be received after the implementation of all recommendations.

(ii) **New programme accreditation** is due to rapid technological development and the proposal is submitted by the Vice Chancellor to the Minister and to the HAC.

a) The reasons for the introduction of the new programme(s) should be based on industry, company, organisation requests giving arguments for the need of graduates in this new field and their approximate numbers per annum.
b) The Faculty in co-operation with the Institutes/Departments prepares the curriculum, brief syllabi with the objectives of the programme, available staff, premises, equipment, infrastructure needed for implementation.
c) Priority is given to those new programmes introduced by two or more higher engineering education institutions bearing in mind that such a programme will facilitate both academic staff and students' activities.
d) Special Committee of HAC is investigating the proposal and if needed envisages interviews with University leaders and high-ranking industry personnel as well in order to clarify the future of the new programme. International experts are invited particularly for new PhD programme initiation.
e) If HAC will recommend additional information e.g. recommended teaching materials, laboratory equipment, the information flow will be effective. If all required prerequisites are available the new programme will have green light.

(iii) In 2001 HAC evaluated the first time **the applications for the new full-time professor positions**. Its recommendations initiated long debates because the Universities had the idea that their autonomy was broken. In the coming years the whole procedure for the evaluation of new professor-candidates is still open.

(Laszlo Szentirmai, 20/12/2001)

IRELAND (IE)

All Engineering Degrees are awarded either by Universities or the National Council for Educational Awards (NCEA). Each of those awarding bodies has their own procedures for academic recognition and accreditation of courses. The Government has also recently granted Degree awarding powers to several Institutes of Technology.

External Examiners are appointed to all engineering examinations by the universities, Institutes of Technology or the NCEA, as appropriate. They are obliged under contract to ensure adequacy of standards in examinations. They also often act as advisers on course design.

The statutory body for the professional accreditation of Engineering Degrees in Ireland is the Institution of Engineers of Ireland (IEI). Government legislation has decreed that only the IEI may award the title of Chartered Engineer.

All Engineering Degrees, which are to be considered eligible for Chartered Engineer status are subject to the accreditation of the IEI. This generally takes place every 5 years and consists of a detailed evaluation of such Degrees by Assessors of the Institution. These Assessors are taken from Universities both in Ireland and abroad together with representatives of industry.

(Ivan Gibson, 31/03/2003)

ITALY (IT)

In Italy, University degrees and curricula are fixed by national rules, to within limits that have been much relaxed by recent laws but are still rather strict if compared to other European countries. These rules applies to the public and private Universities, and all University degrees have the same “legal” status: therefore, mutual recognition of degrees by Universities is compulsory, and no need for “accreditation” was, until recently, felt.

A law of May 1997 applied very schematically in Italy the “Bologna Declaration” approach by introducing a rigid structure of degrees in series (the so called “3+2” structure) throughout all university education: it is compulsory since academic year 2001-2002, but it had been introduced one or two years earlier by some engineering faculties. According to this law, all university students should obtain first a “Laurea” after a three-year course of study; only afterwards they may apply for two further years of study, leading to a “Laurea Specialistica”. Only disciplines for which there exist special European Community Directives (i.e. Medicine and Architecture – and consequently Architectural Engineering) are not obliged to follow this pattern.

“Lauree” and “lauree specialistiche” are divided into “classes” (e.g. Civil Engineering, Industrial Engineering, etc.): the general minimum requirements of each class is fixed by a Ministerial decree.

No quality assurance or accreditation system has yet been established to guarantee that these minimum requirements are actually satisfied. A pilot project, called “Campus One” is currently run by the Italian University Rectors’ Conference (CRUI): it concerns a number of educational programmes in all disciplines, including different engineering branches.

A formal compulsory “accreditation” has been introduced into Italian Higher Education by a Legislative Decree of May 2003 with regard to degrees provided by distance teaching: if accredited, such degrees will have the same legal status as any other University degree. The practical application and consequences of this Decree are not yet known.

Engineering profession is regulated by law: engineers must be members of the “Ordine degli Ingegneri” of the Province of residence (the compulsory membership is often already eluded by engineers employed by Industry, who do not have to “sign” any professional document). Until very recently, the “Albo degli Ingegneri” (i.e. the list of Professional Engineers kept by each “Ordine”) was still unique, notwithstanding the strong curricular differences (and professional tasks) between the engineering branches. After the general reform of the University degrees, the “Albo degli Ingegneri” has been divided into two “Sections”: Section B for people holding a three-year Laurea (who will be called “Ingegneri Junior”) and Section A for people holding a “Laurea specialistica” (who will be called “Ingegneri”); with the occasion, each Section has been also subdivided into three “Sectors”: Civil and Environmental Engineers, Industrial Engineers, Information Engineers. The current members of the “Albo” will be included into the Section A, in one or more Sectors of their choice.

The right to be admitted into either Section of the “Ordine” is gained by passing a “State Professional Examination”, that can be sustained soon after the award of the respective University degree.

(Giuliano Augusti, 25/06/2003)

LITHUANIA (LT)

The procedure for accreditation of higher education programmes in Lithuania has been approved by the Minister of education and Science in 2001.

The procedure regulates adopting a resolution on how the higher education study programme (further on referred to as Programme) complies with the requirements of legal acts and how the programmes are accredited.

The Programmes are valuated in compliance with the valuation rules prescribed by the institutions of Science and Studies.

The resolution in the form of an order is adopted by the Minister of Education and Science on the proposal of the Study Department under the Ministry of Education and Science (further on referred to as Department). The draft resolution is presented by the Department with reference to the conclusions made by the experts of the Centre for Quality Assessment in Higher Education.

Adoption of resolution

1. On evaluation of the programme one of the following resolutions for the national accreditation of the programme can be adopted:

- to accredit a programme;
- to accredit a programme provisionally, i.e. setting the term of provisional accreditation not exceeding the period of 2 years;
- not to accredit a programme.

2. The resolution to accredit a programme is adopted if the programme and its execution are in compliance with the provisions of Consecutive Studies (further on Provisions) and requirements of the regulations of the relevant branch of studies (further on Regulations). The accreditation is valid until the next outside valuation on the programme.

3. The resolution for provisional accreditation is adopted if the programme or its execution are not in compliance with a part of the requirements prescribed by Provisions and Regulations, but the institution has been taking measures to improve the quality of the study programme. Six months prior to the expiry of the provisional accreditation term the institution shall present the updated programme for the repeated valuation to the Centre for Quality Assessment in Higher Education. If the programme is not presented for the repeated valuation within the period as provided in this clause, the Programme is considered as not complying with the requirements prescribed by Provisions and Regulations and the resolution con be adopted as provided in clause 4.

4. The resolution not to accredit the programme is adopted:

- If the programme or its execution do not comply with most of the requirements prescribed by Provisions and Regulations, and the measures taken to improve the quality of study programme have not been efficient.
- If the provisionally accredited programme does not comply with the requirements of the Provisions and Regulations and on the expiry of the term of provisional accreditation.5. The resolution of non-accreditation should include the procedure of the study programme termination.

The procedure should provide:

- prohibition to admit new students following the resolution of non-accreditation;
- further opportunities for the students of this programme to continue studies;
- obligatory reference that the programme is not accredited in giving any information about the programme;
- the programme elimination date from the Register of Study and Educational Programmes.

Information on the resolution

On preparing a draft resolution on whether or not the accreditation of the programme is granted, the Department shall present the draft and relevant argumentation to the educational institution. The institution is entitled to declare remarks on the draft and present them to the Minister of Education.

After the Minister issues an order subject to the accredited programme, the Department:

- shall send out the copies of the order to all higher schools and the Centre for Quality Assessment in Higher Education;
- has the order published in the newspaper “Valstybės žinios”.

On the basis of the order the Register Department of the Ministry of Education and Science shall make an entry in the Register of Study and Educational Programmes that the relevant programme is “accredited” or “provisionally accredited until (the term as written in the order)” and the date and number of the order.

(Daiva Dumciuviene, 29/04/2003)

LUXEMBOURG (LU)

The law for the protection of titles dates from 1963. It protects the title of University Engineers (on the basis of a minimum of 4 years of University-level education) and since the reform of 1996 also the title of «Ingénieur industriel» awarded by the Institut Supérieur de Technologie.

(Albert Retter, 22/07/1999)

NETHERLANDS (NL)

In the Netherlands, University-level engineering programmes are offered at three Universities of Technology, in Delft (the oldest, largest and broadest), in Eindhoven and in Twente (Enschede). Some specializations are also possible at a few other universities, e.g. bioprocess technology and food technology at the Agricultural University of Wageningen and Applied Chemistry, Applied Physics and Applied Mathematics at the University of Groningen.

Passing the final examination ("doctoraal examen") leads to the title of "ir." (*"ingenieur"*), equivalent to a Master of Science in Engineering. This academic education is a prerequisite for those wishing to take a course leading to a doctorate and for some postgraduate programmes. Without further professional requirements, it entitles the holder to academic positions in industry, institutions, government, etc. Also, Universities of Technology have a legal right to grant doctorates.

The Professional Higher Education (in engineering), HBO, takes place at the "Technische Hogescholen". There are 26 such institutions in the Netherlands. After completion, the successful candidate is entitled to the title "ing."(also "*ingenieur*"), equivalent to the Bachelor of Science in Engineering. Although this is not a formal university degree, under certain conditions the "ing." may continue his/her studies to obtain an MSc or doctorate at a University of Technology. (HBO institutions do not have the right to grant Doctoral degrees). Professionally, the HBO diploma is a highly appreciated qualification for medium to higher jobs, offering good prospects as regards higher positions for the better students.

POLAND (PL)

Various schools according to broad areas of disciplines provide Higher Education in Poland at university level. Engineering education is offered both by the state Universities of Technology ("Politechnika") and by the non-state schools.

Up to 10 years ago mostly "long-cycle" or "monolithic" programs were offered in engineering education by UT's awarding in 5 years the academic degree of Master of Science in Engineering ("magister inżynier"). The Higher Schools of Engineering ("Wyższa Szkoła Inżynierska") offered the "short-cycle programs" leading in 3-4 years to the degree of Engineer ("inżynier").

Today, the majorities of Universities of Technology are offering the two-tier programs leading to the degree of Bachelor in Engineering or BSc) in 3-4 years and Master degree (MSc) in 1.5-2 further years. In parallel, the uniform 5-year programs, leading directly to the Master degree are also offered. Many of non-state educational institutions (almost 220 such institutions exists in Poland now) offering the "short-cycle" programs – typically of a vocational type, leading in 3-4 years to the degree of engineer (or licentiate). Some of them also offer an additional 2-year program leading to the master degree or the uniform 5-year master programs.

The HEI's are controlled by the Ministry of National Education and Sport while the kind of discipline that may be offered are determined by law. The curricula themselves are developed by the autonomous Universities of Technology. For the non-state HEI's the curricula need to be approved by the Central Council of Higher Education (RGSzW) and Accreditation Commission for Higher Vocational Schools (KAWSZ) – till 1.1.2002.

On June 22, 2001, the Polish Parliament passed an act that has changed some regulations in the Act on Higher Education and some other acts concerning higher education. The most relevant new regulation was the establishment of the State Accreditation Commission (before, the only state-controlled accreditation body was the Accreditation Commission for Higher Vocational Schools). According to the new law, the State Accreditation Commission advises the Minister and present recommendations with regard to:

- the establishment of a new institution of higher education or a branch of an existing HEI and granting an institution the rights to offer a study program in a given field;
- assessment of teaching quality, including verification of requirements for delivery of the study programs.

Members of the State Accreditation Commission are nominated by the Minister from the candidates recommended by various bodies representing the academic community.

As the issue of quality is of key importance, the latest legal regulations – establishment of the State Accreditation Commission – have been complemented by an initiative of CRASP (Conference of Rectors of Academic Schools in Poland), to set up the CRASP Accreditation Commission. This Commission is thought of as a forum of cooperation for the already existing accreditation bodies (established by the conferences of rectors of particular types of academic schools i.e: universities /UKA/, technical universities /KAUT/, HEIs of economics, etc.). The CRASP Accreditation Commission is not meant as a duplication of the State Accreditation Commission – it is a complementary body.

The subject of the accreditation is the organizational unit within the university, i.e. faculty (or department) but not the university as the whole. The procedure itself is described in detail in the appropriate documents and it comprises preparation of the self-evaluation report and site visits with several meetings (with rector, faculty staff, students, etc.). Teaching and assessment methods are the subject of investigation.

This accreditation process is voluntary and peer, and its positive outcome is a recognition of a high level of a particular study program, whereas the main purpose of the accreditation process by the State Accreditation Commission is to check whether or not a particular study program offered by an HEI satisfies minimal requirements as stated by law.

The above described dual accreditation system was formed in Poland relatively late and this created an opportunity to take into account the experiences of other more advanced countries in developing a system that met precisely the specific needs of the Polish Higher Education.

(Bohdan Macukow, 03/01/2002)

PORTUGAL (PT)

There were long cycle courses in engineering education, lasting for six years that were shortened to five years in 1972. The completion of these courses granted the academic degree and automatically the professional title of “Engenheiro”. More recently, there are also short-cycle (3 years) courses leading to the professional title of “Engenheiro Tecnico” have started. In short, “Engenheiro” is essentially characterized by having an education of broader scope and “Engenheiro Tecnico” is considered possessing an education of vocational type.

Ordem dos Engenheiros (www.ordeng.pt) is the professional association of engineers and is the official body that is responsible for the professional accreditation process of engineering courses. There is also CNAVES (http://168.144.195.227/cnaves1/) that is responsible for the academic recognition and evaluation of all courses in the higher education sector. These are two quality assurance systems independent of each other. One of the consequences of the professional accreditation is that only Ordem dos Engenheiros is empowered to grant the professional title of “Engenheiro”. If a particular course is duly accredited by Ordem dos Engenheiros, the graduates from this course can automatically be granted the professional title of “Engenheiro”. Otherwise the candidate has to pass an Admission Examination.

The accreditation is granted to individual courses in the different major branches of engineering, which are offered by the higher education sector, and is valid for periods no longer than 6 years.

The first step in the accreditation process is the submission of an information package describing:

- The engineering course and its integration in the Institution.
- A detailed description of curricular contents including complete samples of examination handouts and final year project reports.
- The structure of the academic unit directly responsible for the course.
- The characterization of the teaching and academic staff.
- The portrayal of student body.
- Description of facilities like libraries, computing centres and laboratories.

Then, a committee appointed by Ordem dos Engenheiros carries the evaluation that includes a visit to the institution. During the visit several separate meetings take place involving representatives from the academic unit in charge of the program, representatives of the teaching staff and representatives of the student body.

In a similar, but independent, manner the short-cycle courses are provided by the Polytechnic Institutes that grant the academic degree of “Bacharel”. Parallel with the Ordem dos Engenheiros there is a similar Institution called the APET – Associação Portuguesa dos Engenheiros Tecnicos (www.aspoente.com) – that has implemented its own accreditation procedures to grant the professional title of “Engenheiro Tecnico”. APET has developed, in co-operation with Ordem dos Engenheiros an accreditation system similar in form to the accreditation system for Engenheiros. APET has also links with FEANI and a substantial number of the short cycle courses are now registered in the EurIng index.

(Alfredo Soeiro, Updated 13/06/2003)

RUSSIA (RU)

Higher Education in Russia is provided by public (federal, regional, municipal) and private higher education institutions (HEIs). Higher education is under the jurisdiction of the Ministry of Education of the Russian Federation, which is responsible for the state licensing and accreditation of HEIs and for developing and maintaining state educational standards. In 1992 two tier system was introduced: basic higher education (notional learning time is 4 years) leading to the Bakalavr's (Bachelor's) degree and the Magistr's (Master's) degree after 2 years following upon the Bakalavr's degree. Nevertheless, many HEIs continue to teach specialists within 5-year educational programs that lead to Specialist's diploma omitting the Bakalavr's degree. There are two doctoral degrees: Kandidat Nauk degree and Doktor Nauk degree (highest level). According to 2002 data there are 655 state (633 federal, 18 regional, 14 municipal) HEIs and 471 accredited private (non-state) HEIs in Russia. About 3000 vocational institutions (technikum, uchilishche and college) are functioning on a non-university level.

Both state and public professional accreditation constitute the basis for the Russian accreditation system. The state institutional accreditation system is presented by the integrated assessment of HEI. The purpose of the integrated assessment of HEI is to conduct comprehensive analysis of hei activities. It includes three procedures for licensing, attestation, and state accreditation, respectively.

Licensing is an identification of the facilities, financial support and resources including information ones of educational institutions to meet the state requirements.The aim of licensing is to establish the right of HEI to provide educational services.

Attestation is the establishment of equivalency between the content, level, and quality of the education offered and the requirements set by national educational standards. The first attestation of the newly established educational institution may be conducted after the first graduation of students but not earlier than three years after the license has been granted, and only if the final attestation of no fewer than half of its graduates is positive (Federal Law, "On Education", 1996).
The Certificate of State Accreditation is issued for a five-year period and confirms the status of HEIs (academy, institute, university) (Federal Law "On Education", 1996). Its awarding grants to the HEI the right of issuing state standard documents of higher education.

As a result of the reforms that have been underway in Russia in all areas, including education, the system of public professional accreditation began to develop. According to the federal law on education, professional accreditation lies within the responsibility of public organizations. The system of public professional accreditation aims at determining the priorities of higher education in Russia. While the state accreditation is an institutional one, the public professional accreditation focuses on the educational programs content. It sets the accreditation criteria, which are to be higher than the state educational standards.

The Russian Association for Engineering Education (RAEE) is developing the system of public accreditation in engineering and technology. The Association was established in 1992. For the time being, this public organization is comprised of professors, engineers, researchers, businessmen and other people eager to contribute to the advancement of engineering education in Russia. The main objectives of the RAEE include promotion of engineering education and practice; establishing the links between society, industry and science; improvement of technical education quality and enhancement of its prestige; establishing the system of engineering education quality assurance consistent with the world standards.

The RAEE was one of the founding members of the so-called the Independent Accreditation Center (IAC), which was the first non-governmental agency for evaluation of educational programs. Thirty-four engineering programs of technical universities were accredited by IAC.

In 2001, the RAEE initiated the revision of the accreditation criteria and procedures to make them consistent with the world experience in quality assurance in higher education. The Association's activity in the development of independent accreditation system is supported by the Ministry of Education of the Russian Federation and by a number of public and professional organizations including the Russian Academy of Science, and the Association for Technical Universities, the Foundation for International Accreditation and Certification Assistance. The agreement on cooperation between the Ministry of Education of the Russian Federation and the RAEE signed on October 21, 2002 concerns the enhancement of engineering education quality. The RAEE has approved new criteria and procedures for the public accreditation of engineering programs. At the same time, the IAC was re-established as the Accreditation Center of the RAEE. Unlike IAC, the Accreditation Center is responsible for accreditation of engineering programs only (for further details see www.ac-raee.ru). The revised criteria are implemented for engineering programs accreditation since 2003.

(Oleg V Boev, 08/05/2003)

SLOVENIA (SI)

Higher education as well as professional and academic titles are regulated in Slovenia by two acts, the Higher education Act (No. 602-04/92-14/4), issued 7 December 1993, and the Professional and Academic Title Act (No. 602-04/91-7/12) from 12 June 1998. The first act regulates Institutions of Higher Education, which are universities, faculties, academies of art, and professional colleges (Higher Professional Schools), the second act regulates professional and academic titles awarded by higher education institutions after a completed state approved course of undergraduate or graduate studies.

The legislative background of higher education regulates the mean feature of the Study Programs, Duration of Studies, Academic Year and Course Load, Admission Requirements, whereas the titles are regulated by the Professional and Academic Title Act.

Two types of engineering curricula are offered in Slovenia:

- Programs leading to a professional higher education degree, lasting 3.5 to 4 years, awarded with the title dipl. inz (diplomirani inzenir).
- Programs leading to an university degree, lasting 4.5 to 5 years, awarded with the title univ. dipl. inz (univerzitetni diplomirani inzenir).

The admission requirement for undergraduate programs of the university type is a Matura examination (a final examination before 1 June 1995). After 2001/2002, a vocational Matura examination (poklicna matura) and an additional examination has been an alternative requirement also granting admission to this type of programs. Programs, as a rule, end with the diploma examination (defence of a diploma thesis). The diploma conferred after a successful completion of studies specifies the professional title naming the field of study. A university diploma enables graduates to start work or continue their studies at the post-graduate level. The admission requirement for undergraduate programs of the professional type is either a Matura, vocational Matura or final examination after the completion of a four-year secondary education programme or its equivalent. Professional higher education programs end with the defence of a diploma thesis. The diploma conferred after a successful completion of studies specifies the professional title naming the field of study. Graduates can either enter the labour market or continue their studies in programs leading to specialisation or even to Master of Science.

Transfers between professional and university type of programs are possible in both directions provided that certain conditions are met.

Professional education in engineering courses as well as university engineering courses are provided by two universities, University of Ljubljana and University of Maribor and by the free-standing higher educational institution Polytechnic Nova Gorica.

The credit transfer system (ECTS) is being gradually implemented at all engineering undergraduate levels, especially to be able to participate in the Erasmus-Socrates exchange program.

Accreditation of Engineering Study Programs

The Criteria and Procedures on Accreditation of Study Programs are applied by the Council for Higher Education of the Republic of Slovenia in performing its tasks defined by the Higher Education Act. The Council is composed of top experts in the field of higher education, science and technology, industry and social activities in such a manner that scientific, art and professional fields are represented in it.

A president and eleven members are appointed by the Government; six thereof are university professors and scientists nominated by institutions of higher education; university rectors and the president of the Slovene Academy of Science and Arts are ex officio also members. The president and members are appointed for four years. The Council forms commissions and independent groups of experts for individual fields of its activities.

Engineering programs, prepared by the Study Commissions of corresponding Faculties and approved by there Senates and by the Senate of the University or Polytechnic are submitted in the accreditation procedure to the Commission of Natural-Technical Sciences. The commission has a chairman, who is member of the Council, and six expert members. They are preparing a report for the Council of the appropriateness of the program in regard to following criteria:

1. the appropriateness of the research foundation of the study program (basic and applied research and development) as well as human and material resources for its implemen-tation,
2. the appropriateness of the program's formal structure,
3. the appropriateness of the program's composition with regard to its content (especially its consistency with disciplinary principles, up-to-date content and conformity of the content with the program objectives),
4. the appropriateness of the manner and form of studies,
5. the appropriateness of learning resources,
6. the appropriateness of student assessment and grading methods,
7. the appropriateness of requirements for academic progress and graduation,
8. the appropriateness of the professional, academic and scientific title, respectively,
9. the appropriateness of the program evaluation procedures (the evaluation shall be based on a comparison of the institution's study program with two or three recognised foreign programs included in the appendix),
10. the appropriateness of the program for providing the knowledge demanded by the economy and employers, respectively,
11. the employment opportunities of graduates,
12. an approximate estimation of financial resources needed for program implementation and anticipated sources.

The Council gives or denies then its approval; in addition it gives one of the following ratings on the program: highly recommended, recommended, not recommended, recommendation denied.

(Valter Dolecek, 18/06/2003)

SPAIN (ES)

There are two different types of educational institutions where engineering studies can be followed: (i) "Escuelas Técnicas Superiores de Ingenieria" (Higher Technical Schools: ETS), that offer five- or six-years degree programmes addressed to the future professionals for R+D or in fact industry management and direction, and (ii) "Escuelas Universitarias" (University Colleges) that offer three-year programmes addressed to future industry middle staff and technicians. The law (Ley 12/1986) regulates the professional competences of the respective graduates, who are called "Ingenieros" and "Ingenieros Tecnicos".

A University can teach an engineering programme (or any other higher education programme) only if the Government approves the curriculum after its has been examined and "recognized" by the "Consejo de Universidades". According to the framework law 11/1983 "Ley de Reforma Universitaria", each University and Engineering College can define up to 70% of the curriculum. The other 30% is defined by Government by suggestion of "Consejo de Universidades".

To practice profession, engineers must be members of the appropriate "Colegio de Ingenieros" or "Colegio de Ingenieros Tecnicos" in the Province of residence: the only requirement needed for admission to the Colegio is to be a graduate of a recognised and approved programme. The engineers who do not have to sign any professional document often elude membership of the "Colegio".

SWEDEN (SE)

The title of Engineer (*civilingenjör* for the longer, 4.5 year, education and *högskoleingenjör* for the shorter one) is not legally protected in Sweden and has no legal status. There can therefore of course be no *de jure* recognition of non-Swedish degrees. There is a *de facto* recognition in the sense that many companies, universities and other public authorities quite extensively hire engineers carrying degrees from foreign universities.

A certain government authority, the National Agency for Higher Education, *Högskoleverket (HSV)* among other things supervises the universities. It has the authority to grant universities and colleges the right to confer certain degrees. Five comprehensive universities (Lund, Linköping, Uppsala and Umeå) and the three specialised institutions (The Royal Institute of Technology in Stockholm, Chalmers University of Technology in Göteborg and Luleå University of Technology) has thus had the right to confer the degree of *civilingenjör* for many years. To this list the *HSV* recently added the University of Karlstad, The Mälardalen University College and Blekinge Institute of Technology. It also has granted a longer list of institutions of higher learning the right to confer the title of *högskoleingenjör*. This list not only includes those listed above but also a number of smaller institutions, usually in English called "University Colleges".

HSV has not only the authority to grant certain examination rights but also to withdraw them. It may thus as the result of a quality audit decide that a certain university should lose its right to confer the degree *civilingenjör*. The main role of the HSV in this context has however in the past been to decide whether or not it should satisfy demands for extended examinations rights coming mainly from the university colleges. In January 2001 the government instructed the HSV to develop its activities and asked the HSV to examine all Swedish curricula over a six-year period and judge whether they satisfy certain minimum criteria. According to the plan all *civilingenjör* curricula will be examined during the year 2005 and all *högskoleingenjör* curricula during 2002. The audits will most certainly be performed by groups of experts and be based upon a combination of site visits and self-evaluation reports. For more information see: www.hsv.se/english/agency/publ/right/index.html.

The HSV claims that this new system "bears all the international hallmarks of accreditation" (HSV 2001:10R).

(Torbjörn Hedberg, 23/01/2002)

SWITZERLAND (CH)

An Office of Accreditation and Quality Assessment (OAQ : www.oaq.ch) has been set up a few years ago. It will be in charge of the procedures leading to accreditation of educational institutions. Accreditation is a political decision which has to be taken by political authorities (in the Swiss case: the C.U.S for "Conférence Universitaire Suisse": www.cus.ch).

In principle all academic institutions and the curricula they offer will have to be accredited. Efforts are made to have procedures which are close to the best current practices. The Federal Institutes of Technology in Lausanne (EPFL: www.epfl.ch) and Zürich (ETHZ: www.ethz.ch) have a long experience in this area. The general rules which are being defined for evaluation and quality assessment will be close to the practices of these Institutes.

Since the Bachelor/Master system is being introduced in every university, accreditation processes will be really effective when the new curricula will be offered. For the moment a simplified set of rules is under discussion for the existing academic institutions.

(Dominique de Werra, 17/06/2003)

UNITED KINGDOM (UK)

The quality of all UK degrees, including engineering degrees, is assessed by the Quality Assurance Agency for Higher Education (QAA). In the UK, Accreditation is seen as something related to, but different from Quality Assurance: it is a judgement as to whether the graduate is adequately prepared to undertake a period of professional development in order to obtain engineering competence prior to registering as a professional engineer. The accreditation standards and process are therefore the responsibility of the Engineering Council, a body established by Royal Charter in 1981 to advance the education and training of engineers and technologists and to promote the science and practice of engineering for the public benefit.

Individual engineering disciplines have their own professional bodies (Institution of Electrical Engineers, Institution of Mechanical Engineers etc.), many of which have a long history. In practice the business of accrediting individual degrees is sub-contracted by the Engineering Council to these individual institutions.

The qualification which denotes the professional engineer in the UK is not an engineering degree, but the title of CEng (Chartered Engineer), which is awarded by the Engineering Council. Another level of qualification as engineer exists, also awarded by the Engineering Council, namely the IEng (Incorporated Engineer); while at a lower level there is the Technician (Eng Tech).

Three elements are required in order to be admitted to the engineer levels of the register:

1. An accredited engineering degree;
2. A few years of approved engineering training and experience after obtaining the degree, referred to as Initial Professional Development (IPD);
3. A Professional Review including an interview.

It is therefore very important to the engineering student that the degree which he/she obtains is accredited. In order to obtain accreditation for a degree, it is first necessary to send a large amount of information to the appropriate engineering institution. This information will include, for instance:

- entry requirements for students
- the structure of the course
- syllabuses
- samples of examination papers
- external examiners' reports
- teaching timetables
- pass lists and failure rates
- information on qualifications of teaching and technical staff in the department
- information on the management structure of the department

- a statement on the aims and objectives of the course being taught
- information on the research in the department

The Institution then appoints a panel to study this documentation and to visit the department for one or two days. During the visit, they interview staff to clarify issues which they have identified from the documentation and inspect the facilities in the department, such as laboratories and lecture rooms. They also meet technical staff and representatives of the student body. Judgements are made by the panel of the academic standard and of the relevance of what is being taught. At the end of the visit, there is a meeting with the staff of the department, during which the Chair of the panel outlines those things which the panel liked and those which it did not. Normally accreditation, if given, is for a period of between three and five years, at the end of which a further visit will be required if the course is to retain its accredited status.

Accredited engineering degrees in the UK are normally called BEng (three-year degree) and MEng (four-year degree). An engineering degree which is not accredited is called BSc.

According to the Engineering Council's 3rd edition of the regulatory document SARTOR (Standards and Routes to Registration), published in 1997, the MEng (four-year degree) is normally accredited as meeting the educational base required of a Chartered engineer. BEng(Hons) and BSc(Hons) (three-year degrees) are increasingly being accredited as meeting the educational base required of an Incorporated Engineer. Graduates with a BEng will need a further year's education (perhaps, by completing a one-year MSc) to be eligible for CEng.

SARTOR at present is undergoing revision and the new version is expected to be published in the Autumn of 2003.

(Updated by G. Augusti from notes by Jack Levy, 31/03/2003, and Melvyn Dodridge, 05/06/2003)

PART 2

Quality Assurance in Engineering Education on a National and European Scale

Rapporteur Muzio Gola

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1. Introduction

University programmes can be considered particular examples of public actions. The evaluation of public actions is, in general, a cognitive activity aimed at providing an "informed judgement" performed following rigorous and codified procedures with the intention of producing outside effects.

This always involves:

- a subject or an organisation that implements the action starting from the recognition of the needs to be satisfied,
- establishing general and partial objectives to satisfy them, with any reference standards,
- adopting modalities and resources to satisfy them,
- setting up instruments to analyse the results and their distance from the objectives.

Policies for evaluation and accreditation should not remain scaled down to local perspectives or to threshold requirements; on the contrary, they should help higher education establishments acquire recognition or accreditation for their programmes on an international scale.

The approach adopted here is a "fitness for purpose & fitness of purpose" one, with a special focus on the "transformation" of the student. The "efficiency" criterion or, in other words, the cost awareness, is seen as a constraint affecting the implementation of the policy, not as a policy in itself.

Part 1 explores the horizon of evaluation, and briefly summarises evaluation mandate, focus and procedures in the light of quality and quality assurance, accreditation, responsibility, with particular reference to higher education.

Part 2 explores the ideas from a number of European evaluation models for higher education, and shows that their contents can be read in the frame of four fundamental "aspects" or "dimensions" of quality:

- Requirements, Objectives
- Teaching, Learning, Assessment
- Learning Resources
- Monitoring, Analysis, Improvement

Part 3 underlines that a Programme should be evaluated on the basis of its ability to put into effect a policy focusing – clearly and distinctly – on the external and internal efficacy of the learning process: specify worthwhile learning goals and enable most students to achieve the established objectives. The set of “aspects” examined in part 2 is expanded into a minimum set of “factors”, that the Programme should address in a stable manner before it is submitted to an external evaluation.

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2. The Horizon

The evaluation of university programmes was born from the rib of a broader evaluation horizon, from the juridical one to the one that supports decision-making.

This latter, particularly, includes all the decision-making aids that the policy-maker has available for the selection and control activity of public actions in which a wide range of problems are involved. These problems are related first of all to the economic and social context (local, national or international) and then to the activity closely connected to the realisation of the projects themselves, and to their direct consequences.

2.1 Evaluation

In the general sense, evaluation is the expression of an "informed judgement", for the most varied purposes. At a deeper level, an evaluation is thought as a useful device to build up an informed dialogue between actors, or a way to represent and communicate a project.

Since evaluation takes place in the context of interactions among different subjects, it always needs a system of values to apply and rules of reference; moreover, depending on the object to be evaluated and the paradigm that is appropriate for it, it may need, in a very variable way, numerical data, predetermined indicators, shared or agreed reference models.

> An example is **the judicial paradigm** on which the work of Courts and inquiry commissions is based and according to which the truth emerges from the confrontation of points of view: instances, stripped of their prejudices, and cross-examinations can lead to the ascertainment of the truth or to decisions.
> An opposite example is the **logical paradigm**, which uses demonstration as its tool, in particular, to determine whether a solution is optimal (cost-benefit analyses) or is satisfactory (multi-criteria analyses); along this line the estimate comes from mathematical instruments (such as the effect score matrix, the weight vector given to the preferences, ...).
> Another example is the **paradigm of the quality management system**, according to which evaluation denotes a process leading to judgements/recommendations regarding quality. The quality management system is an organizational/managerial tool centred on monitoring/controlling the processes having a direct impact on the quality of a product or of a service, on a clear definition of responsibilities, on providing adequate resources in order to forestall critical situations and to assure conformity to the customer's requirements, on continuous improvement as a response to the need for a competitive presence on the market.

Evaluation is widely used to express a judgement on the potentials or on the effects of public actions (political, economic, investments, planning, infrastructure projects ...).

In such cases the reasons for evaluating are:

- *definition of the needs*: verify if the action intends to satisfy needs or solve social and economic problems, verify the real existence of these problems;
- *improvement of the actions*: observe the impact and the results of the actions to understand if and how the actions function: this leads to improvements of varied significance, from simple corrective actions during the work processes to the reformulation of the strategies;
- *accountability*: produce reports for political authorities and public managers on the results obtained and on the proper use of the allocated resources, explain to citizens where public funds were spent, what effects it produced and how the spending is justified.

This always involves:

- a subject or an organisation that implements the action starting from the recognition of the needs to be satisfied,
- establishing general and partial objectives to satisfy them, with any reference standards,
- adopting modalities and resources to satisfy them,
- setting up instruments to analyse the results and their distance from the objectives.

From this, a more rigorous definition of evaluation is born: (a) *a cognitive activity* aimed at *providing a judgement on an action* (or a complex of coordinated actions) performed following (b) *rigorous and codified procedures* with the intention of (c) *producing outside effects.*

In greater detail:

a) an intervention or a series of interventions that enable us to know what is necessary to express a judgement (qualitative or quantitative) on one or more characteristics or properties of the evaluated action …
b) … through procedures founded on criteria and premises of explicit and reasoned value (or in any case, that can be made clear and reasoned) …
c) … to take decisions regarding the evaluated action, its authors, the persons to whom the action is destined, the beneficiaries of the evaluation.

The purposes of the evaluation of a public action (Rossi et al., 1998):

- *compliance* to have the rules respected
- *management control* to keep the organisation under control
- *accountability* to account for the results obtained
- *learning* to understand if and how the interventions work
- *policy and program design* to direct the choices among policy alternatives

There are three fundamental objectives of any evaluation system (stimulate improvement, inform customers, exercise responsible management); one can find these objectives respected in every system.

> An adequate dissemination among users of objective and comparative information on type and quality of services offered (information which is currently available only to a limited number of users, often the most privileged), could also have the positive effect of stimulating institutions to improve their services by drawing comparisons with one another.

The evaluation can be *formative* or *summative*.

> If the evaluation has a formative function, it is oriented towards the improvement of the actions, to better structure the processes, to change, during the work, what seems to be not working. Formative evaluation is essentially based on the qualitative judgement of experts, even if it depends on data or indicators, and it typically concludes with recommendations[3]. The evaluation is carried out while the action is being performed. The evaluator becomes, in some way, a participant or co-responsible in the management of the action. In the case of the evaluation of Study Programmes, it is not necessary to cover all of them nor are rigidly programmed cadences needed.
> If the evaluation has a summative function, it is interested in the accountability, in certification or, in extreme cases, in accreditation. A summative evaluation usually rests heavily on data and indicators, and concludes with affirmations or opinions. The evaluation can also be performed independently from the implementation of the actions. The evaluator is neutral and attentive to outcomes and effects. Scriven (Scriven, 1991) illustrates the difference between these two approaches saying that a formative evaluation is the operation of the chef who tastes the soup to see if it is good, while the summative evaluation is the operation of the restaurant customer who judges the soup after it has been brought to his table.

The evaluation must identify and respect certain essential premises:

1) the mandate of the evaluation:

- know who will use the evaluation,
- know what will be the principal use of the evaluation (summative or formative).

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[3] from (Kristoffersen et al., Phare – ETF, 1998; ch. 6.3), *a good report has the following characteristics*:

- it is based on a thorough analysis of the self-evaluation report and the results from the site visit;
- it contains precise, operational and unambiguous recommendations;
- it constitutes a good starting point for follow-up activities.

2) the primary objectives of who is being evaluated:
know to what degree the evaluation must be oriented towards:

- internal efficacy: comparison of the results obtained from the programme or intervention with the initial objectives,
- external efficacy: comparison of the results obtained from the programme or intervention with the outside requirements (economic and social context).

3) the instruments of observation and judgement:

- know the value system of the organisation implementing the action,
- define the indicators that describe the primary objectives coherently with the value system,
- know how to concretely gather the information that will enable us to draw conclusions and express judgements (formative, summative or mixed) based on facts.

4) the organisation of the evaluation:

- identify the human resources, constraints and budget,
- define the management methods of the evaluation.

The evaluation criteria of a public action are of a very varied nature (Rossi et al., 1998):

- requirements, needs, wishes of the target-population,
- objectives and expected results,
- professional standards,
- customary practices or norms for other actions,
- legal requirements,
- ethical or moral values; social justice, fairness,
- opinions of experts,
- minimum levels to be reached, established before the intervention for the target population,
- expected conditions if the intervention is not undertaken (counterfactual),
- costs or relative costs.

2.2 Evaluation in Higher Education

University programmes can be considered particular examples of public actions and their evaluation requires specific *technical acts*.
These usually are:

- the formulation of *an evaluation model*
- the implementation of an *evaluation system*

- the adoption of a self-*evaluation process*
- documentation for the purposes of an *external evaluation process*

The so-called self-evaluation is, in fact, a process of reflection that obliges those who direct the actions to have an overall vision of the activity, it gives them a sense of ownership of the evaluation procedure; it motivates them to implement improvements, it has as its outcome the document which is subjected to external evaluation by independent third parties.

2.3 Quality

Quality in University formation concerns, obviously, the calibre of the results of the teaching and learning process.
This definition reveals its difficulties when we try to define the system of values and the relative indicators that "bite" into the problem of quality: the competence of the teachers, the suitability of the facilities, the existence of an organisation that is able to control and intervene in the formative process, the acquisition of knowledge by the student, their good results in exams, their pass rate and much more?

According to (Harvey and Green, 1993) as quoted in (Kristoffersen et al., 1998) conceptions of quality in higher education can be grouped into categories:

- *Excellence*: strive for the best, a traditional academic view, maybe set standards of excellence,
- *Zero errors*: needs detailed product specifications and standard measurements (not applicable),
- *Fitness for purpose*: no general (descriptive?) quality, but quality for a pre-defined purpose,
- *Transformation*: focus on students, empower students with knowledge, skills, attitudes,
- *Threshold*: a static notion, setting a definition of desired common minimum standards,
- *Enhancement*: the contrary of the "threshold" notion, focusing on continuous improvement.

The fundamental definition is "fitness for purpose", which is formalised in the following manner:

"Quality" = "The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs".
Quality, thus defined in a formal manner, obviously is based on descriptions using attributes and adjectives, but it has a more ambitious aim, measure the distance between objectives to be satisfied and their effective satisfaction.
There are evident problems.

First: the concept of purpose cannot lead to acceptance of any system that operates according to any identified and declared purpose: "fitness for purpose" must be complemented with "fitness of purpose", i.e., the relevance of the purpose must be challenged (Kristoffersen, Sursock, Westerheiden, 1998).
Second: if we emphasise too much the concept of "measure" in a technical sense, we may fall into the error of limiting ourselves exclusively to quantitative information (cardinal) directly expressible in a numerical manner, or forcing onto numerical scales information that is not of a metric type (such as ordinal data, qualitative information). It is true that theories on the analysis of data and on multi-dimensional graduation have been elaborated in relation to the study of qualitative data (often ordinal). But it is also true that an "atomistic" approach presents difficult problems of decomposition and recomposition of elements that do not live separately but indeed, interact in a non-linear manner because they are present together in a specific way and they reinforce or weaken each other. Take the case of contents and methods of a unit already quite small like a single teaching module: an expert will evaluate it gathering analytically some fundamental aspects, and recomposing them in a holistic judgement. It is clear that a non-linear model of any complexity can be devised, but is it worth it? Are not the dots of Seurat or the brush strokes of Renoir closer to reality?

2.4 Quality Assurance and Quality Systems

An all-embracing term including all those actions necessary to provide adequate confidence that a product or service will have "quality", i.e., it will satisfy given requirements.

In order to provide confidence in an institution's capabilities, such actions must not be haphazard, but, on the contrary, planned and systematic.
When we have a final product whose characteristics cannot be measured directly, it becomes more important to be able to check the processes that should lead to a given result. This is exactly the case of education.

2.5 Accreditation

According to (Hämäläinen et al., 2001), the term accreditation *is not a very precise one. In one sense, it expresses the abstract notion of a formal authorising power, acting through official decisions on the approval of institutions (or not) or study programmes.*

However, if the provider of the accreditation is a public organisation allotting funds, the meaning becomes quite precise: accreditation is a process aimed at introducing standards of quality, according to objective parameters, for those subjects who implement actions in the formation system in order to realise public policies for the development of human resources.

In the ETF vision (Kristoffersen et al., 1998), it can be considered as the award of a status, generally based on the application of pre-determined standards (either *minimum standards* or *standard of excellence*).
It can also be seen as a formal, published statement regarding the quality of an institution or a programme, following a cyclical evaluation base on agreed standards (CRE, 2001).
The ABET (Accreditation Board for Engineering and Technology, 1996) accreditation system for engineering in the United States, examines single educational Programmes: in the most recent version it requires that these:

- satisfy standard prerequisites on the contents of the study programme,
- show the capacity to produce completely qualified students, specifically through the definition of a series of cultural, technical and professional requirements that are projected over the entire work life,
- provide complete documentation on the means used to achieve the training objectives.

Moreover, the presence of a permanent evaluation system is required to ensure that the objectives are achieved. Finally explicit attention is dedicated to the measure and improvement of the learning outcomes and it evaluates the results of the training in terms of the competence expected in the student.

Accreditation is a binary judgement (pass/not pass) on the award of a status or on an approval.

It is a process, primarily an outcome of the evaluation. It can be considered an extreme case of summative judgement after an evaluation process.

The model of "legal validity" of academic qualifications and educational curricula existing in some countries, e.g. in Italy, may be compared to a form of accreditation/certification which attests to the existence of minimum requirements, and officially gives official recognition to formation programmes possessing these requirements.

In countries where this model is not accepted, or countries which are unable to guarantee the quality of formation programmes, the authority to grant accreditation or certification has largely been given to independent bodies possessing a specific professional capacity to analyse and evaluate quality.

These independent subjects may be:

- the formative institutions themselves, which adopt instruments for self-regulation and self-testing of the quality of training services which they provide;
- organisations delegated by government and industry to orient and monitor the formation system;

- organisations which serve as mediators between the demand and supply sides of formation by creating forms of collaboration;
- completely independent institutions whose purpose is to promote quality.

2.6 Responsibility

Responsibility for the quality of the formation is to be sought at the level where competences aggregate and are coordinated, that is, at the level of the Programme.

The Programme has the primary responsibility for establishing:

- the professional figure to be trained (integration between the university system and society or work market),
- the consequent learning objectives (expected level of knowledge and skill that the student must have acquired at the end of his studies, foreseen areas of competence and professional placement, possible national and international benchmarking),
- the timing, starting from which prerequisites and with which resources these objectives are to be reached.

2.7 Responsibility in Action

It is up to the Programme:

- to verify the correspondence between the professional figure actually produced and the general prospects of the work market,
- to implement instruments to verify the good progression of the teaching programme (student progression in quantity, quality, time),
- to coordinate the different formative experiences, entrusted (allotted or delegated) to the single teachers in the most varied forms (lessons, exercises, seminars, projects, field experience, etc.), check the coherence between these and against the objectives, ascertain the compatibility with the study timing and the available resources (human and material),
- to evaluate the development and the permanence of the knowledge during and at the end of the formation.

2.8 Transfer of Responsibility

Through these acts, documented in a reliable and verifiable manner, the Programme provides the reference Faculty and the University with the elements for judgement that will enable them to assume, with an adequate degree of confidence, the final responsibility:

- for the coherence of the study degree with the professional figure to be formed,
- for the level of the titles conferred in its name (the effective knowledge and ability of the graduating student),
- for the quality of the training that is provided to enable the students to reach that level.

2.9 Data, Judgements, Procedures

There are basically three types of instruments, quite different one from the other, on which an evaluation/accreditation model is based: quantitative indicators, qualitative judgements of experts, organisation system.

An effective evaluation model must resort to a combination of elements of these three "types". Moreover, it is general practice that it also includes a significant control element such as the gathering of the opinions of the students.

- Quantitative indicators

In the grammar of evaluation, these are like syllables or, at most, like words.
Some quantitative indicators "of performance" are essential. It is appropriate that these be produced at a central level in a uniform and certified way and supplied to the structures to be evaluated or accredited. As they are of a numeric type, they can provide (with due caution for the case) scales or comparisons of a type that are generally perceived as "objective".

> How many are needed? If there are too many (the fewer the better) they can confuse more than they clarify; the most useful intellectual exercise is to try to understand which are absolutely essential.

They must be collected, processed correlated and compared in a professional way: in developing a set of indicators the aim is to find a balance between measurability and relevance for drawing conclusions and making judgements.

> *Any indicator in itself measures a small aspect of quality, therefore how to combine and weigh indicators? If the indicators are few and simple, and are useful to set up minimum requirements for a binary judgement (approved /not approved) on technical facts (e.g. the presence of a certain percentage of teachers of a given qualification, or a minimum number of students), they can be used directly to make a decision. If, on the other hand, I want to gather more complex aspects of quality, it is better if they are interpreted as useful signals or warnings (indispensable) for the qualitative judgement of experts (Kristoffersen et al., 1998).*

- **Qualitative judgements of experts**

In the evaluation syntax these are the sentences that make up the discourse.
Many aspects important for quality of formative processes, like scientific research, cannot, partly or entirely, be reduced to calculations (e.g. appropriateness of the objectives or resources, the effectiveness of methods, the results of learning). It is therefore necessary to have the professional judgement of experts, usually well-known researchers, professors and professionals.
These experts benefit from maximum credit when they analyse situations that fall into the area of their direct competence. Their evaluation, in such cases is constructive and supports the quality management of the Programme.
On the other hand, this process is not so appropriate for setting up scales of comparison (where these are desirable), and it is also slow and costly, so that it can be replicated only in long periods (for example, every five years).
Here, too, it is important to reduce to the bone the aspects of quality that have to be examined.

- **The Organisation System**

We must ascertain then, that the system is kept under control in an appropriate way. The results are not directly evaluated, the implicit assumption is that correct management (with precise responsibilities, accurate documentation, competence, resources ...) will bring into play all of the control elements that lead to an analysis, bring to light the weak points and therefore press forward towards the improvement of the results.
As it is a standardised type of evaluation, it is easier to find experts able to conduct it, also in shorter time and at lower costs. But such experts can be more easily deceived on the real nature of what they are examining and, on the other hand, concentrating on purely procedural aspects, they run the risk of wasting time with factors that are not strictly pertinent to the qualities that are perceived as such by the students and academics.

2.10 The H3E Position Paper

As stated in the H3E position paper on Quality and Quality Assurance, ISO 9001[4] definition on Quality:
"The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs" in higher education can be interpreted as (Sparkes, 1999):
"specifying worthwhile learning goals and enabling students to achieve them".

[4] ISO 9001: 2000, Quality management systems Requirements: specifies requirements for a quality management system for any organization that needs to demonstrate its ability to consistently provide a product that meets customer and applicable regulatory requirements and aims to enhance customer satisfaction. It is now the only standard in the ISO 9000 family against which third-party certification can be carried

Where:

(i) specifying worthwhile goals' involves paying attention to academic standards, to the expectations of society, to students' aspirations, to the demands of industry and other employers, to the requirements of professional institutions, to the fundamental principles of the subject, etc.; the 'stated or implied needs' of these stakeholders are not all mutually compatible, so there can be many possible and valid interpretations of 'worthwhile';
(ii) enabling students to achieve' these goals involves making use of research into how students learn, adopting good course design procedures and building on successful teaching experience, all of which may require professional development for most lecturers;
(iii) it also involves establishing quality assurance procedures …

This is a "fitness for purpose" vision, with a special focus on the "transformation" of the student.

Similar statements in the ETF position (Kristoffersen et al., 1998) are:

- quality in higher education needs to be defined in light of specific purposes
- these purposes must be suited to a higher education system
- different categories of customers (or "stakeholders") hold legitimately different opinions; academic excellence is one of these opinions
- as the primary users of higher education, students are an important category of customer
- … …

However there is here something beyond simple "fitness for purpose". Enablement implies a philosophy centred on the student; a "comprehensive" system which, before excluding, seeks to understand the reasons behind the exclusion, and asks itself whether and to what extent it is the student who must adapt to the system or the system that must adapt to the student.

> This does not mean adopting a "cafeteria-style" formation system, in which the student is allowed freedom to create his own study program through a collection of disconnected courses, but rather offering one or more organized sequences of concurring modules with specific training objectives to be reached within certain time limits.

As a corollary necessary for planned and systematic actions, but with understandable caution regarding the possibility that quality management in the study course may be reduced to a game of papers, the procedures are defined by Sparkes as informally as possible and close to the needs of a training service, underlining that they are not a purpose in themselves[5], but rather ancillary and pervasive:

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[5] From (Sparkes, 1999): *It is important to appreciate that quality assurance procedures are only intended to help maintain (and sometimes improve) good quality teaching and learning, once they have been achieved. Achieving good*

… procedures are to be aimed at (a) ensuring that everyone does their best at their allotted tasks, (b) ensuring that students' learning is well supported and (c) obtaining information on how well the methods for achieving 'quality' are known and practised by staff. They can include:

• Ensuring that all those taking part (which includes Heads of Departments, secretaries, laboratory technicians, lecturers, counsellors, etc.):
– have clear job descriptions (set out in the Manual) and know their responsibilities;
– carry out their responsibilities competently and on time;
– are properly trained or retrained;
– keep appropriate records;
– participate in the procedures for ensuring the teaching tasks necessary for achieving good quality are being carried out.

• Ensuring that the following activities are properly organised:
– planning and control of admission and entry standards;
– regular and formalised reviews of current courses and teaching methods;
– planning procedures for future developments;
– consulting students about their needs and expectations;
– obtaining feedback from students as regards the general conduct of teaching activities and on the environments in which they take place; (Note: this is quite separate from the business of obtaining feedback on individual teachers' effectiveness)
– … …
– arrangements for student guidance and support (either face-to-face with a teacher or through access to personal computers);
– mechanisms for reporting and dealing with students' personal problems; procedures for the setting and checking of exam papers and for their distribution, for the invigilation of exams and for the marking and monitoring of students' responses, etc.

Universities and heads of departments should ensure that all these procedures are taking place in their own departments. The Quality Assurance Manual should state departmental policy on all them.

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quality in the first place is primarily a matter of 'knowing what to do', … It is not the case, as is sometimes assumed, that 'quality assurance' alone will bring about good quality outcomes.

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3. The Ideas in the European Evaluation Models

A limited selection of a few representative models will be now examined, bringing out the minimum structure that they have in common and with the widest evaluation horizon summarised in the previous chapter.

These documents are:

- CNAVES, Conselho Nacional de Avaliação do Ensino Superior (Portugal) – Processo De Avaliação, Ensino Universitário – Guião De Auto-Avaliação (2000)
- CNVSU-MIUR, Final Report of the Workgroup "Accreditamento dei Corsi di Studio", 2001, HTTP://WWW.CNVSU.IT_LIBRARY/DOWNLOADFILE.ASP?ID=10680
- Consejo de Universidades (Spain), II Plan de la Calidad de las Universidades – Guía de Evaluación de da Titulación (2002)
- CRUI, Il Modello di Valutazione CampusOne, http://www.capusone.it/link/?ID=95
- Estonia – "Quality Assessment Council", Standards for Accreditation of an Educational Program in Estonia (Programs), Abbreviated Checklist for Evaluation Experts (1998)
- ISO 9001:2000, Quality management systems Requirements
- Phare / ETF, Quality Assurance in Higher Education – Manual of Quality Assurance: Procedures and Practices, European Training Foundation, Nov. 1998
- SECAI (Sistema de Evaluación de la Calidad de las enseñanzas de Ingeniería), CRE-COLUMBUS, http://www.columbus-web.com
- QAA, Handbook for academic Review, Quality Assurance Agency for Higher Education, 2000, http://www.qaa.ord.uk
- VSNU. Quality Assessment Made to Measure, Protocol for the External Assessment of,Educational Programmes 2000-2005, July 1999
- ZEvA (Central Evaluation and Accreditation Agency Hanover), General Standards for the Accreditation of New Degree Courses, Bachelor's Degree, Master's Degree, Continuing Education
  http://www.zeva.uni-hannover.de/eiqa/Standard(GB).pdf
- ZEvA (Central Evaluation and Accreditation Agency Hanover), Cross Border Quality Assessment in Physics – Evaluation Report, Series "Lehre an Hochschulen" 24/2001, Hanover 2001, http://www.zeva-uni-hannover.de/eva/E_Ber/crobo.pdf

A first key to the comparative reading of these documents regards the mandate of the self-evaluation document that is to be drafted.

A second key regards the specific contents of the model of self-evaluation, contents that can be read more easily if forced into the frame of four fundamental "aspects" of formation quality:

1 – Requirements, Objectives
2 – Teaching, Learning, Assessment
3 – Learning Resources
4 – Monitoring, Analysis, Improvement

Aspects 2, 3, 4 closely correspond to sections 6, 7, 8 of ISO 9001: 2000 standards (doc. F):

6 – Resource management
7 – Product realization
8 – Measurement, analysis and improvement

while Aspect 1 expands subsection 5.2 – customer focus".

With regard to the first key to the reading, the VSNU (doc. J – 1.2) remains on a rather general level: "*The whole system of quality assessment, internal and external, has three purposes : quality assessment, quality improvement and establishing accountability*", a statement that gives no indications on the preferred model contents.

CRUI-CampusOne (doc. D) declares that its model of self-evaluation "makes use of a methodology based, with due adaptations, on well known models used for evaluating the quality of businesses that produce services (ISO 9000) and drawn up in collaboration with professional associations in the quality control sector".

Substantially, the declared primary purposes are:

- Compare the objectives against the results ("fitness for purpose")
- Evaluate quality to increase quality
- Evaluate to inform the actors involved and the outside world ("to provide public information")

QAA (doc. I – Annex C, 1) first declares great attention to the learning environment and the outcomes of the learning:

A self-evaluation document is a statement that demonstrates that a subject provider has evaluated the following, in a constructively self-critical manner:

- *appropriateness of the academic standards it has set for its programmes;*
- *effectiveness of the curriculum in delivering the intended outcomes of the programmes;*
- *effectiveness of assessment in measuring attainment of the intended outcomes;*
- *extent to which the intended standards and outcomes are achieved by students; and*
- *quality of the learning opportunities provided for students.*

ZEvA (doc. K – 1) also bites directly into the flesh of "quality" of higher education, by declaring:

The basic guidelines along which the degree programmes ought to be orientated if they are aiming at accreditation by ZEvA are:

- *The graduates must meet the expectations of them (from the higher education institution, the labour market, society); the higher education degree awarded must be a reliable indicator that the relevant demands have been fulfilled.*
- *The examinations must reach a level and standards necessary for the completion of the degree course and the awarding of the academic degree in accordance with the Diploma Supplement.*
- *The curriculum must be suitable for providing the necessary qualifications and imparting the appropriate knowledge for the examinations.*
- *The resources necessary for this must be available; the organisation of the course of studies, the teaching and the examinations must fulfil appropriate conditions.*
- *The concepts, on which the curriculum is based with regard to the qualifications to be obtained and to the educational goals determining the courses offered, must be appropriate.*

ZEvA at (doc. L – 2.3.2.3) states:

> *Quality plays a role on three levels: individual courses, the curriculum phases and the curriculum as a whole, with particular emphasis on the internal coherence. It includes two aspects: the quality of performance of the staff: lectures, materials, timetable, etc. and the quality of students: what they have learned in the respective parts of the curriculum.*

3.1 Requirements and Objectives

The formation requirements must be established on the basis of outside references, taking into account the professional roles the students are to be prepared for:

The learning objectives (contents and learning outcomes) are to be consistent with the recognised requirements.

QAA (doc. I – Annex E: 8, 10) evaluates the intended learning outcomes in relation to external reference points:

- *What are the intended learning outcomes for a programme?*
- *How do they relate to external reference points including relevant subject benchmark*[6] *statements, the qualifications framework and any professional body requirements?*
- *How do they relate to the overall aims of the provision as stated by the subject provider?*

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[6] Subject benchmark statements provide a means for the academic community to describe the nature and characteristics of programmes in a specific subject. They also represent general expectations about the standards for the award of qualifications at a given level and articulate the attributes and capabilities that those possessing such qualifications should be able to demonstrate.

- … …
- *How does the provider ensure that curriculum content enables students to achieve the intended learning outcomes?*
- *How does the provider ensure that the design and organisation of the curriculum is effective in promoting student learning and achievement of the intended learning outcomes?*

VSNU (doc. J – 2.1) states that:

The objectives result in a specific, well-defined profile or a spectrum of profiles of graduates that corresponds to the academic and professional requirements that can be set by both national and international standards. The labour market prospects that the institution has in view for its graduates are also set out.

… …

- *Academic objectives of the curriculum by international standards*
- *Professional objectives of the curriculum by international standards*
- *Envisaged profile of the graduate*
- … …
- *Operationalisation of the objectives in goals*

ZEvA (doc. L – 3.1) states that:

The starting point for the formulation of aims and objectives should be the qualifications one wants to equip graduates with. Since a considerable portion of the Diploma graduates continue studying for a Ph.D. or for a doctorate in engineering, preparation for independent research, as required for preparing a doctoral thesis, should be part of the objective, if only to prevent the doctoral phase from taking excessively long. However, only a small number, even of those students who obtain a doctorate, will stay in academic life.
Thus, to a large extent the desired qualifications should be determined by the requirements of occupations outside academic research.

… …

The inventory of desirable qualifications … obtained will certainly be too large and diverse to be covered by a coherent programme of reasonable length. Each faculty will thus have to make a selection, guided by the opportunities this will imply for graduates, as well as by the sort of programme that can be offered by staff or by guest lecturers.

They provide the academic community with a means to describe the nature and characteristics of the study programmes in a specific subject area. Subject benchmark statements also provide support to institutions in pursuit of internal quality assurance.
The primary purpose of Benchmarking declarations is to support: the university institutions in planning and validating their Programmes, the evaluators, both internal and external, in assessing and comparing standards, professional organisations if accreditation processes are undertaken, students and employers when they seek information about Programmes.
Up to now, the QAA has published benchmark statements of 47 subject areas, the outcome of two phases of a project designed to make explicit the general academic characteristics and standards of bachelors degree with honours in the UK. http://www.qaa.ac.uk/crntwork/benchmark/benchmarking.htm

CNVSU-MIUR (doc. B) articulates Aspect A: REQUIREMENTS as follows:

A1: Which students is the Programme addressing:

- *What are the entry qualifications?*
- *What are the student types? (e.g. age, sex, geographic origin ...)*
- *What is the predictable number of the students?*
- *What is their preparation? (is there an entry test: what does it ascertain; is it reliable?)*

A2: For what roles is the Programme preparing the student:

- *What are the outside references and expectations? (requirements of professional organisations, expectations of employers, standard profile references or accreditation, academic requirements, preparation to research)*

A3: What are the principal characteristics that you want to instil in the student?

- *What are the expected learning outcomes(formation)?*

In general terms of:
  - *information, knowledge, skills,*
  - *cognitive skills,*
  - *autonomous learning,*
  - *specific technical skills,*
  - *transferable skills*
  - *advancement towards work or further studies*
- *In which sectors and at which level? (threshold, intermediate, advanced)*
- *Are the expected learning outcomes consistent with the planned roles?*

CRUI (doc. D) articulates Dimension B – REQUIREMENTS AND OBJECTIVES as follows:

B1. requirements of the interested parties

The Programme must identify and define in a clear and well-documented manner, jointly with the social and economic context in which the Programme is operating and which presumably the graduate will enter, the formative requirements of a cultural, technical and or scientific character as well as current and foreseeable employability requirements.

B2. learning objectives

The Programme must define learning objectives that are: coherent with the formative objectives, specific, measurable, realistic, achievable in the period of time consistent with the duration of the Programme (with reference, particularly, to the profile of the average incoming student), planned in time … The learning objectives must be defined in terms of knowledge (understanding), capacities and skills (know how to do) and behaviour (know how to be) expected from the student at the end of the educational process.

ESTONIA (doc. E), asks:

REQUIREMENT III: STUDY PROGRAM (Criteria)

- *Program goals are clearly formulated and must reflect graduation requirements.*
- *Program is comparable with programs of similar institutions within Europe.*
- *Program is flexible to changing circumstances and requirements in Estonia.*
- *Curriculum is based on cumulative entirety of all subjects and enables students to obtain level of general, specialized, and professional education with sufficient competitiveness in labour market.*

The Consejo de Universidades (doc. C) lists the following justifications to be provided when a Programme is designed:

1.2. – Analysis of the demand and employment of graduates:

- *……….*
- *Existence of studies or prospective data on the demand and on the level of employment of the graduates*
- *To what extent the employment level of own graduates has been taken into account, as a criterion for planning and access limitation*
- *The near term evolution of the title conferred, the possible convenience of reformulating the objectives as a function of job demands*
- *Whether and how data on the follow-up of graduates are effectively taken into account by the authorities in charge of the Programme*
- *Other reasons (academic, historical, …) that may support the setting up of the Programme.*

CNAVES (doc. A) seems to dwell more on the institutional framework of the Programme, rather than on external references; the result looks somewhat self-referential:

Origin and evolution of the Programme

- *Objectives of the Programme*
- *Brief description of the context in which the Programme was conceived*
- *Institutional articulation of the Programme with the department and/or Schools within the University*
- *How the Programme is related to the pertinent scientific area, at national and international level; evolution of the Programme during the analysed period (note: the last 5 years) …*
- *Modifications introduced as a consequence of previous evaluations*

However, this is found in the section "III – Data relative to the Programme"; in section "V- Analysis and Comments" the view becomes ampler:

> *During the elaboration of this Guide five dimensions have been considered: relevance, adequacy, students, processes, resources. In) simple language, such dimensions regard,*

respectively, "why / the reason for a given programme", "what /which Programme", "for whom", "how" and finally "by which means" of a given Programme.
Concerning the "relevance", i.e., the justification for the existence of a course, we can identify two criteria: one regarding the justification of the Programme in the light of the requisites of the society in which it operates and of the strategies … of the University (criterion pertinence) and the other which concerns the internal and external influence of the Programme (criterion impact).

3.2 Teaching and Learning

QAA (doc. I – Annex E: 13 to 18) evaluates:

Curricula: the means by which the subject provider creates the conditions for achievement of the intended learning outcomes.

- *Do the design and content of the curricula encourage achievement of the intended learning outcomes in terms of knowledge and understanding, cognitive skills, subject specific skills (including practical/professional skills), transferable skills, progression to employment and/or further study, and personal development?)*
- *Is there evidence that curricular content and design is informed by recent developments in techniques of teaching and learning, by current research and scholarship, and by any changes in relevant occupational or professional requirements?*

Assessment: the assessment process and the standard it demonstrates.

- *Does the assessment process enable learners to demonstrate achievement of the intended outcomes?*
- *Are there criteria that enable internal and external examiners to distinguish between different categories of achievement?*
- *Can there be full confidence in the security and integrity of assessment procedures?*
- *Does the assessment strategy have an adequate formative function in developing student abilities?*
- *What evidence is there that the standards achieved by learners meet the minimum expectations for the award, as measured against relevant subject benchmarks and the qualifications framework?*

Teaching and learning: the teaching delivered by staff and how it leads to learning by students:

- *How effective is teaching in relation to curriculum content and programme aims?*
- *How effectively do staff draw upon their research, scholarship or professional activity to inform their teaching?*
- *How good are the materials provided to support learning?*
- *Is there effective engagement with and participation by students?*

- *Is the quality of teaching maintained and enhanced through effective staff development, peer review of teaching, integration of part-time and visiting staff, effective team teaching and induction and mentoring of new staff?*
- *How effectively is learning facilitated in terms of student workloads?*

VSNU (doc. J – 2.2, 2.3, 2.5) evaluates:

Structure and content of the programme

- *Level and contents of the propaedeutic year*
- *Orientation function of the propaedeutic year*
- *Selective function of the propaedeutic year*
- *Level and contents of the basic degree curriculum*
- *Level and contents of main subjects and specialisations*
- *Level, contents and scope of options*
- *Function and place of the graduation paper in the programme*
- *Academic standard of the programme and links with research*
- *Attention paid to academic and professional skills*
- *Attention paid to verbal, written and computer skills …*

Learning and teaching environment

- *Effective concept for the educational and teaching environment*
- *Suitability of the educational methods chosen in terms of curriculum content and targets*
- *Proportion of contact hours, independent study and other study activities*
- *Examination and assessment methods*
- *Quality of the supervision and assessment of graduation papers*

Curriculum organisation

> *The typically Dutch concept of 'studeerbaarheid' reflects the extent to which the programme allows students to complete the study programme without unnecessary obstacles or bottlenecks in time. This reference to 'allowing' in the previous sentence means good counselling and supervision, supported by a good system for monitoring students' progress.*

- *Counselling and supervision*
- *The propaedeutic year and the basic curriculum can be completed in the time allowed for them*
- *… …*
- *Balance between planned and actual study load*
- *Examination schedules*
- *Obstacles to specific groups of students*

ZEvA (doc. L – 3.2) in the chapter about teaching and learning methods makes a number of interesting statements, which are worthwhile recording:

> *The profile selected by the faculty will have consequences not only for the contents of the programme, but also for the blend of teaching methods chosen to implement it. In addition to attending ex-cathedra lectures, students need the opportunity to learn how to tackle problems using the methods employed in physics.*
> *The development of oral and written communication skills is vital not only in professional life but also in furthering the acceptance of physics by society at large.*
> *To develop problem-solving skills, it may be advisable to confront students with problems that increase in complexity, from simple applications of material treated in lectures to projects that require a combination of knowledge and skills taught in different parts of the curriculum, supplemented by independent study.*
> *A common feature is a shift of focus from what is taught by the faculty to what is learned by students.*
> *The explosive increase in our knowledge makes exhaustive coverage by ex-cathedra lectures illusory.*
> *Finally, lack of motivation on the part of many first-year students may be a factor in the large dropout rate, which is detrimental both to students and to the public image of the university. More active involvement of the students might lead to better motivation.*

Phare / ETF (doc. G – page. 47) has a section "Teaching and Learning practice" where the following checklist is proposed:

- *Teaching and learning methods applied (e.g., lectures, seminars, laboratories): description, justifications for the choices made and analysis*
- *Study skills course (e.g., learning note taking, learning how to learn, critical thinking)*
- *Encouragement of independent (individual work) and team learning (group work)*

and a section "Evaluation of students" where:

- *Assessment methods used … : description, justifications for the choices made and analysis*
- *Frequency of assessment (continuous assessment / end of term examinations only): description, justifications for the choices made and analysis*
- *Responsibility for setting the level and standards for the assessment …*

ESTONIA (doc. E), whose checklist is derived from Phare, asks:

REQUIREMENT III: STUDY PROGRAM

- …
- *Optimal proportion of lecture and individual learning are available with sufficient materials to develop good learning habits.*
- *Educational program involves problem-solving tasks and creativity at all levels.*
- *Graduating procedures clear, guarantee objective evaluation, and correspond to program goals.*
- *Content of continual education programmes corresponds to academic goals and offers the newest knowledge and skills.*
- …

REQUIREMENT IV: EDUCATIONAL (TEACHING) PROCESS

- *Modern teaching methods used and adaptable to deliver knowledge in a most rational manner.*
- *Computers and licensed software extensively used in teaching and learning.*
- *Congruous programs at different academic levels allow transfer students to join program easily.*
- *Program of study is based on a detailed academic calendar.*
- *Student assessment is objective and based on goals of program. Flexible examination procedures exist. Written exam results are used for analysis and monitoring.*

CNVSU-MIUR (doc. B) articulates Aspect B: PROGRAMME as follows:

B1: Structure

- *is it documented that the structure (general contents of the teaching, breadth, depth, connections) has been established in function of the intended learning outcomes?*
- *for each type of learning experience (lessons, exercises, laboratories, projects, etc.), have the corresponding learning objectives been specified?*
- *are teaching methods explicitly designed to promote the interconnection, the recomposition, the permanence of the knowledge?*
- *is the study load programmed, is it evaluated in a realistic manner?*
- *have load limits, set up at the department and university levels, been respected?*

B2: Contents

- *Are the specific contents developed by lessons coherent with the intended learning outcomes?*
- *are the contents up-to-date?*
- *are the contents compatible with the students' qualifications at the point when they are proposed?*
- *are the single teaching contents coherent with the programmed workload at the general structure level?*

B3: Materials and Methods

- *are the teaching materials and methods set up so that they take into account the different learning styles present in all student populations?*
- *are the methods specific in relation to the intended learning outcomes? (laboratories, seminars projects ...)*
- *are study materials effectively available (books, handouts, documents, software, etc.) and do they adequately support the intended learning outcomes?*
- *are the instruments employed to assess the achievement of the expected learning outcomes (during and final) appropriate, effective and reliable to measure to what degree the student has achieved the intended learning?*

The Consejo de Universidades (doc. C) on the subject of exams dwells on the following evaluation elements:

The variety of methods used for the assessment of the students' learning
The most common assessment practice in relation to the following aspects:

- *type and content of examinations, tests and other forms of assessment*
- *mechanisms for grading*
- *pertinence of the grading criteria*
- *value and weight of practical contents*
- *whether criteria are adopted to average or compensate grades among different subjects of a semester or of a course*
- *means and location to inform students of mid-course or final exams*

3.3 Learning Resources

QAA (doc. I – Annex E: 20, 21) evaluates:

Staff:

Is the collective expertise of the academic staff suitable and available for effective delivery of the curricula, for the overall teaching, learning and assessment strategy, and for the achievement of the intended learning outcomes?

- *Are appropriate staff development opportunities available?*
- *Is appropriate technical and administrative support available?*

Facilities:

Is there an overall strategy for the deployment of learning resources?

- *How effectively is learning facilitated in terms of the provision of resources?*
- *Is suitable teaching and learning accommodation available?*
- *Are the subject book and periodical stocks appropriate and accessible?*
- *Are suitable equipment and appropriate IT facilities available to learners?*

VSNU (doc. J – 2.9) evaluates according to the following checklist:

- *Effectiveness of the organisation and staff qualities*
- *Effectiveness of the organisation*
- *Communications and spread of responsibilities*
- *Academic standard of the staff*
- *Distribution of expertise*
- *Adequate size of the establishment for reasonable teaching load*

- *Educational and teaching standard of the staff*
- … …

Facilities

- *Size and quality of teaching rooms*
- *Practical and laboratory facilities*
- *Library*
- *Computers and ICT*
- *Financial constraints*

ZEvA (doc. L – 2.3.2.2) describes requirements set to resources as follows:

Academic Staff

a) *The quality and dedication of staff is of paramount importance for the success of an education in physics.*
b) *The staff must be large enough, in terms of experience and interest, to cover all of the curricular areas of physics. Qualified teachers for the non-physics subjects in the curriculum must be available.*
c) *Teachers or other staff must ensure that students receive proper curricular and career advice. In addition, to a certain extent it should be possible for students to obtain help with personal problems related to their studies.*

Supporting Staff

d) *Staff of sufficient number and quality must be available to carry out managerial, technical and administrative tasks related to the study programme, such as the administration of study progress, working out the yearly schedule and timetable of courses, gathering and dissemination of management information, assistance with information and communication technology and maintenance of laboratory equipment and computer facilities.*

Facilities

e) *A (subject) programme can only be properly implemented if adequate facilities, including offices, classroom space and laboratories, are provided.*
f) *The libraries must contain subject-related and non-subject-related literature, including books, journals, and other reference material sufficiently varied and up to date for collateral reading in connection with the instructional and research programmes and later professional work. This is also important for maintaining contact with alumni.*
g) *Computer facilities for students and staff must be adequate to allow and encourage their use during the study. Computer equipment must be appropriate for searching information resources and for all other applications in (subject), including modelling, simulation, data processing and laboratory work.*
h) *The laboratory facilities must reflect the requirements of the study programme; this includes appropriate up-dating and maintenance of the equipment.*

ESTONIA (doc. E), asks:

REQUIREMENT V: ORGANIZATION OF STUDIES AND RESOURCES

- *Organization of studies assures rational use of student's time and creates conditions for best achievement.*
- *Students receive good counselling and sufficient/timely information on organization and content of studies.*
- … …
- *Appropriate policy exists for promotion and renewal of staff and distribution study loads to improve the curriculum successfulness.*
- *Sufficient faculty exists with needed qualifications. Faculty must systematically improve their qualifications.*
- *Sufficient financial and material resources exist to fulfil the goals of the program.*

CNVSU-MIUR (doc. B) articulates Aspect C: FACILITIES AND SERVICES:

C1: material resources

- *Does the laboratory equipment satisfy the Programme requirements?*
- *Is the equipment intended prevalently for teaching activities generally adequate?*
- *Are the library resources adequate and accessible at suitable hours?*
- *Is the computer equipment available to students adequate and accessible at suitable hours?*
- *Are computer facilities available to students?*

C2: Human resources

- *Are the competence and the qualifications of the teaching staff, and their distribution in the various roles, adequate?*
- *What is their level of excellence, documented by scientific and professional production?*
- *Are sufficient teachers available in all the involved subject areas?*
- *Does the teaching staff remain stable enough to ensure continuity?*
- *Are there teacher-training activities for newly recruited teachers?*
- *Is the technical staff supporting the activities of the Programme adequate in terms of quantity and professional qualifications, for functions that support teaching?*

C3: activities of:

– orientation, selection, insertion,
– tutorials, assistance, remedial work.

- *Is the assigned staff specifically trained?*
- *Are the student support activities active and effective to facilitate the advancement and completion of the studies?*
- *How much do students know about them and use them?*

SECAI (doc. H) groups resource indicators under the factor "Quality of teaching process":

- *Human resources: teaching staff (9 indicators)*
- *Human resources: administration and general services staff (3 indicators)*
- *Material resources: buildings, equipment and other material (6 indicators)*

CNAVES (doc. A) takes into account the following resource indicators:
Human resources:

- *List of teaching staff involved in the Programme, indicating: name, category, ... age, academic position, …, years of teaching experience*
- *For each teacher, a form describing teaching and research activities)*
- *List of supporting staff*

Material resources (relative to the analysed period):

- *Equipment dedicated specifically to the Programme; teaching, audio-visual and IT equipment; equipment of laboratories, libraries, support services*
- *IT facilities specific to the Programme, access to students (access hours, ease of use)*
- *Multimedia resources available to the Programme, access to students (access hours, ease of use)*

3.4 Monitoring, Analysis and Improvement

A preliminary remark: the analysis is based both on qualitative observations and on numerical data and indicators.

These last (for example; enrolment, drop-out rates, average study time, staff numbers, international exchange, ...) provide necessary support for evaluation of the activities. However, they are considered warnings or clues, rather than actual evaluation parameters.

> As Phare indicates – ETF (doc. G – 6.1.3): *Indicators however should be interpreted with care as their meaning is often ambiguous. It can be misleading to believe that indicators necessarily reflect quality. Failure rates is an example of a relevant indicator for the analysis of an institution effectiveness that, in itself, does not reflect quality. A low failure rate can indicate a low academic level (low quality) or a highly effective student support (high quality). … Therefore it is necessary to interpret the quantitative data within the context of the institution and specifically its goals and objectives.*

On the other hand, it is necessary to plan and implement a strategic review activity, in order to verify the suitability of the Programme in relation to its aims and objectives.

On this topic, QAA (doc. I – Annex E: 17) at the section "Enhancement" states that the institution's approaches to reviewing and improving the standards achieved shall be evaluated.

Reviewers should ask:

- *How does the subject provider review and seek to enhance standards?*
- *They should then evaluate the adequacy of the processes used.*
- *Sources of information will include internal and external review documents, external examiners' reports, professional and/or statutory body accreditation reports, and examination board minutes.*
- *Review activities will include analyses of information, practices and procedures, discussions with teaching teams and discussions with external examiners.*
- *As a result of these activities reviewers should be able to assess the capacity of the subject provider to review and calibrate their standards, and to promote enhancement.*

It is a very elegant and concise style to establish goals and methods of the review activities, an effective way to establish a rule without making the language and contents too heavy.

VSNU (doc. J – 2.4, 2.6, 2.7) handles the fundamental data for the control of student intake/path/output with the following checklist:
Intake

- *Quantity of student intake (propaedeutic year, basic degree) in previous years*
- *Quality of student population (propaedeutic year, basic degree) in previous years*
- *Secondary recruitment (part-time, higher professional education) M/F ratio*
- *Attention to various groups within the population (for example ethnic minorities, foreign students)*
- *Satisfactory information and guidance*
- *Activities for transition from secondary education to university*

Success rates

- *Propaedeutic year success rates*
- *Post-propaedeutic year success rates*
- *Curriculum success rates*
- *Average length of study*
- *Policy*

Quality of the graduates

- *Academic qualities*
- *Professional qualifications*
- *Content and standard of the graduation papers/projects*

- *Content and standard of the traineeships*
- *Job market prospects achieved*
- *Rating of graduates by the job market*

ESTONIA (doc. E), asks:

REQUIREMENT V: ORGANIZATION OF STUDIES AND RESOURCES

- … …
- *Organization of studies is continuously improved by systematic analysis of student loads, grades, and failures.*
- … …

REQUIREMENT VI: FEEDBACK AND QUALITY ASSURANCE

- *Unit gathers enough information about working career of graduates regarding employer satisfaction of educational level, knowledge, and skills.*
- *Unit gathers data systematically and uses it to improve the quality of the program.*
- *University internal quality assurance system exists. Students actively participate in the quality assurance system. A corrective action procedure for deficiency elimination exists.*

CNVSU-MIUR (doc. B) articulates Aspect D: MONITORING, ANALYSIS, IMPROVEMENT as follows:

D1: indicators

- of: – result, – resource, – process, – context,
- students' opinions regarding the formative programme
- *data on the students' progression*

D2: Job insertion, – opinions of ex-students

- opinions of employers
- is it known where the students find work?
- is the position (after three years) congruent with the studies?
- are alumni opinions, regarding the Programme, collected and analysed?
- does the training received enable the alumni to overcome their early professional difficulties?
- *are data on the satisfaction of the employers collected and analysed?*

D3: analysis and improvement

- does a systematic analysis exist?
- are decisions made consequent to the evaluation results?
- are these decisions effective? Are their consequences verified?

CRUI (doc. D articulates Dimension E – RESULTS, ANALYSIS and IMPROVEMENT as follows:

E1. RESULTS

The Programme must identify the information and data, define and implement the methods of collection and processing and present the results related at least to:

- *the Programme's capacity of attraction of students and other interested parties;*
- *the internal efficacy of the formation (monitoring the students' careers, the students' opinions on the teaching, on other formative activities and on the Programme in general);*
- *efficacy of the support services;*
- *the external efficacy of the formation (monitoring the position of graduates on the work market; opinions of the graduates on the formation received, opinions of the employers on the preparation of the graduates);*
- *in order to be able to evaluate the correspondence of results with the set objectives.*

E2. ANALYSIS AND IMPROVEMENT

The Programme must promote adequate processes of analysis of the results, of continual improvement for the efficacy of the system of management for the processes related to all the dimensions of the evaluation (needs and objectives, organisation system, resources, formative process, result of analyses and improvement) through systematic research, the identification and the implementation of all the opportunities for improvement.
The Program must also deal with difficulties that arise in the supply of teaching and services, seeking the causes in an effort to prevent problems from recurring.

SECAI (doc. H) treats monitoring of internal and external efficacy in two factors, with the related indicators:

Quality of immediate results

- *The degree of achievement of educational objectives*
- *The relation between students that graduated and started a programme*
- *The average duration of studies*
- *Graduates' performance in post-graduate courses*

Quality of graduates' professional integration

- *Insertion in a first job*
- *Professional integration*
- *Effective placement of graduates*
- *Ability to learn during work life*
- *Recognition of the quality of graduates' training by employers*

3.5 Organisation

ZEvA (doc. L – 2.3.2) very concisely states:

Within the organisation of the faculty it must be absolutely clear which person or committee is responsible for the policy, the quality and the execution of all educational matters relating to a given study programme. Should these responsibilities be divided among more than one person or committee, the structure must allow for and guarantee the necessary coordination.
The person or committee concerned must have sufficient competence and authority to carry out what is deemed necessary, they must have the necessary resources, and must be well incorporated within the faculty government structure and the research environment.
As regards the management of the education programme, four distinct but interrelated aspects need to be considered. They are Policy, Resources, Quality as well as Information and Communication.

- *Educational policy: curriculum structure in the context of the political, economic and cultural situation and in the international context, providing international contacts for students, relations with secondary education and employers; educational concepts.*
- *Resources: teaching staff and facilities, management and administrative staff.*
- *Quality of the education: quality of individual courses, coherence within the phases of the curriculum and the curriculum as a whole, a proper system of evaluation.*
- *Information and Communication: gathering and dissemination of information concerning educational developments in general, study progress of students, developments in secondary education, job market, etc.*

VSNU (doc. J – 2.11) focuses on the internal quality assessment used by the unit which is being evaluated.

The committee looks at the structure and organisation of the quality assessment system and at the way it works in practice, among other things in the 'curriculum committee'.
(By Dutch law, each study programme has a 'curriculum committee' comprised of staff and students, that gives advise to the institute's staff management on all study related matters).
The review committee also considers the involvement in internal quality assessment of the students following the curriculum.
In describing the system of internal quality assessment, there is also an explicit examination of the way the institution dealt with the results of the previous assessment.

The following checklist is used for evaluation purposes:

- *Structure and organisation of the internal quality assessment system*
- *Operation of the internal quality assessment system (including curriculum committee)*
- *Student involvement in the internal quality assessment system*
- *Improvements and actions in response to the previous assessment*
- *Quality of the self-evaluation report (descriptive and analytical)*
- *Rating of strengths/weaknesses analysis and critical content*

ESTONIA (doc. E), asks, very concisely and effectively:

REQUIREMENT I: STRUCTURE AND MANAGEMENT OF EDUCATIONAL POLICY

- *Unit develops instruction, plans, policy, and procedures. Responsibilities for each area are formulated clearly.*
- *Formulated goals are known to relevant academic units. Units collaborate in program implementation.*
- *An unit should exist, performing systematic analysis of academic quality of program. Program is modified where and when needed.*
- *A supervisory system exists to monitor the performance of faculty and students.*

Dimension A – ORGANISATION SYSTEM of CRUI (doc. D, is an extreme example of a structure formalised in high detail, (at the opposite end compared to the "Review" activities of QAA,doc. E – Annex E: 17), and reflects a strong ISO 9001: 2000 commitment:

A1. MANAGEMENT SYSTEM

Il Programme must develop, keep up-dated and constantly improve its own system of management of the processes related to all the dimensions of the evaluation (organisation system, requirements and objectives, resources, formative process, results, analyses and improvement), with a clear identification and description of the processes to be managed.

The Programme must also define what documentation is useful for the management and provide adequate means of communication:

- *Processes identified for Programme management,*
- *Sequence and interactions of the identified processes,*
- *Specific norms or models adopted by the Programme as reference for the development of its own management system,*
- *Documents used for Programme management,*
- *Methods of document identification and retrieval,*
- *Means of Communication (with interested parties),*
- *Checking methods of the effectiveness of the communication.*

A2. RESPONSIBILITY

The Programme must determine its own organisation structure, define the responsibilities for the management of all the identified processes and ensure that these responsibilities are assumed.

- *Assignment and acceptance of the responsibilities and definition of the lines of communication among the various positions.*
- *Presence of the personnel with responsibility for teaching management.*

A3. REVIEW

The Programme must provide for a periodic review of the management system in order to ensure its continual suitability, adequateness and efficacy.

- *Review methods and validity period.*
- *Information and data taken into consideration for the review.*
- *Outcome of the review.*
- *Actions undertaken consequent to the review and their efficacy.*

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4. Statements Regarding Evaluation: a Proposal for the Debate

Universities can be very different, not only from one country to the next, but also among different scientific sectors within the same country.

Also the needs of the three levels of higher education are different. The three levels of higher education call for evaluation models based on different approaches.

Level I (bachelor or equivalent), which is the entry level for a large number of students, requires a strong emphasis on the legibility of the curriculum (in terms of basic, characterising culture, knowledge and skills target levels, areas of competence and professional roles envisaged, national and international benchmarking, if applicable) and on organisational aspects.

The evaluation of Level II (Master or equivalent) must take into account the fact that learning contents are geared to the highly specific (professional or research) goals of the reference Departments. A sizeable majority of international student exchange activities should be concentrated at this level.

The evaluation of Level III (Doctorate) should be based on the ability to provide a markedly research-oriented learning environment. It is closely interconnected with the evaluation of the research activities of the Departments.

This means: evaluation objectives and criteria which are well diversified but share a common requirement: formulating a final judgement on each Course of Study based on a very narrow final set of key quality aspects.

The latter should be selected so that, in a clear and readily recognisable manner, they go to the very "heart" of the quality of educational activities, which is not limited to the quality of individual teachers, but rather is the overall quality of a an organised collective effort encompassing several fronts.

After our review of the general principles (Chapter 1) and the examination of the main contents of various models (Chapter 2), we should now try to pinpoint a "minimum set" of desirable characteristics that should be present in the evaluation models of level I and level II Programmes.

Identifying the "minimum set" of evaluation requirements suitable for Programmes of the first and second level, common to all countries and to all scientific sectors, appears to be a reasonable and achievable objective. Such "minimum set" could stimulate discussion about what constitutes good quality within higher education and support the development of a common methodological framework and common quality criteria for comparative international evaluations within higher education programmes.

For the sake of clarity and to stimulate a lively debate, we shall make statements strictly geared to the needs of the learning process, i.e., not inclusive of all the many and various requirements mentioned in the literature on quality and evaluation of higher education.

4.1 Basic Policy of a Programme

A Programme should be evaluated on the basis of its ability to put into effect a policy focusing – clearly and distinctly – on the external and internal "efficacy" of the learning process:

- specify worthwhile learning goals,
- enable most students to achieve the established objectives.

According to a policy of this sort, quality must be interpreted in terms of:

- relevance of the purpose (fitness of purpose)
- fitness for purpose

with a special accent on "transformation" (see Ch. 1, 1.2 – Quality)
The "efficiency" criterion or, in other words, the cost awareness, should be seen as a constraint affecting the implementation of the policy, not as a policy in itself.

4.2 The Mandate of the Evaluation

The first and foremost purpose of the evaluation is to reflect the design and management of a Programme: the evaluation checklist should express the set of minimum aspects, and the main factors thereof, that the Programme should use in a stable manner before it is submitted to an external evaluation. The latter shall be conducted on the basis of the same checklist.

The self-evaluation document, as reviewed and commented on by external evaluators, shall be used by:

- the management of the Programme, with an educational function relating to the all the individual actions that put the policy into effect,
- the university that has entrusted the Programme with the task of bestowing on its behalf qualifications corresponding to the academic degree,
- government bodies or third parties for the correspondence between the qualification and the academic degree,

- partner universities, in our particular case those included in the European circuit, for purposes of mutual recognition; in particular within the countries signatories of the Bologna declaration.

Vision is needed: policies for evaluation and accreditation should not remain scaled down to local perspectives and to threshold requirements. In a recent contribution (Jeliazkova and Westerheijden, 2001) it is pointed out that:

… it becomes ever more interesting for higher education establishments to acquire recognition or "accreditation" for their programmes from agencies that are known and respected not just within their own (small) country – Europe is replete with small countries – but across Europe. …

4.3 The Focus of the Judgement

The instruments of the external evaluation are:

indicators: with summative functions: in particular: indicators of intake, progression, success of the student and of the graduate

experts' judgements: with both summative and formative functions, on the aspects and factors required by the model.

The organisational system, which is highly variable from one case to another and is always developed over several levels (Programme, Faculty, University), should be left in a free format and should be evaluated ex-post, in terms of its suitability to support those actions having a bearing on the internal and external efficacy of the Programme.

Thus, it is sufficient to ensure that the following indications are provided for each aspect/factor envisaged by the model:

- it must be absolutely clear which person or committee is responsible for the policy, the quality and the execution of all educational matters relating to a given study programme,
- that those responsible discharge their duties competently and on time[7],
- that each action is documented in a pertinent and accessible manner.

In other words, that the effectiveness of an organisational system is evidenced by the description of the actions and their documented effects, factor by factor.

[7] In addition to strategic actions, this includes simpler actions, such as, for instance, drawing up a schedule of examinations, the maintenance of facilities …

4.4 Changing the Philosophy of the Self-evaluation Report

Our proposal is to discard the logic and practice of periodic “evaluation reports” and adopt a logic of on-going monitoring: it is desirable that each Programme be required to maintain an “information model” that collects and updates the quantitative parameters and the qualitative descriptions enabling the external examiners (with special regard to: academic authorities, third parties, external evaluators ...) to formulate an informed judgement.

This “information model”, which preferably should be made known to the public, can be flanked by a “self-evaluation supplement” discussing the strengths and weaknesses; in many documents it is claimed that this analysis is a necessary preliminary condition for external evaluation.

4.5 The Structure of the Information Model

A comparative examination of the evaluation checklists has shown that the different items to be considered can be grouped into four key “aspects” or “dimensions” of the evaluation:

- Requirements and objectives
- Teaching and learning
- Learning resources
- Monitoring, analysis, review

An appropriate quality assurance mechanism will be present if these four aspects are kept under control in an effective manner by the Programme. Each “aspect” is clarified through a certain number of “factors” to be treated separately (even though it would be very helpful to consider their interconnections). The “factors” listed in Table I together with their “key aspects” represent the “minimum set” needed for the evaluation model.

4.6 The Contents of the Information Model

Let us examine the most critical factors.

Requirements

The first aspect of the model is “Requirements and objectives” instead of “Aims and objectives” to underscore the fact that in order to determine the occupational roles for which students are being trained it is also necessary to investigate the needs of the external parties concerned.

In some instances, it is possible to stipulate a veritable alliance with the world outside the university as a valuable aid to overcome deep-seated habits and to increase public awareness of the logic underlying the Programme.

In order to determine the requirements, expressed in *market language*, it is therefore necessary to identify clearly the parties concerned. Needless to say, it would be a mistake to push this attempt beyond reasonable limits for the sake of formal compliance. A traditional Programme that refers to well consolidated professional roles needs not be motivated by specific market surveys; the opposite is true for a Programme relating to new, evolving professions.

Educational Objectives

The translation of the "requirements" factor into "educational objectives" is performed by the university; it uses the know-how and the *language of training specialists*; it consists essentially of harmonising the knowledge building processes and learning outcomes that meet the requirements.

This is the point at which it is necessary to reflect critically on the strategies, make choices, clearly express justifications for the chosen priorities.

The best guide currently available for the formulation of learning outcomes is provided in the "Benchmarking Statements" by the QAA. This document could be adopted as the starting point for the definition of educational objectives, in terms of contents and levels.

Teaching, Assessment Methods

Once the educational objectives of the Programme have been identified and deployed as specific objectives of the individual courses of study, the teacher is provided with great freedom of action as to the methods to be employed in order to achieve them and to ascertain whether they have been achieved.

Nor could it be otherwise, considering that the teacher is by definition the professional possessing the competencies that qualify him/her for this function.

Table I – "Minimum set" of evaluation requirements

Aspects	Factors
external efficacy: specify worthwhile learning goals	
1 – Requirements, Objectives	– parties concerned, with whom to determine the reference professional roles – requirements of the parties concerned – main employment opportunities for the graduates – ensuing general educational objectives, benchmarking
Internal efficacy: enable most students to attain the objectives	
2 – Teaching, Learning, Assessment	– characteristics of students at intake – structure and content of the Programme – teaching materials and methods – examination and assessment methods
3 – Learning Resources	– academic standard of the staff – educational and teaching standard of the staff – technical and administrative staff – facilities (equipment, laboratories, accommodation, libraries, …) – academic support to students, guidance and welfare services
Technical efficacy: organisation and control of the educational process	
4 – Monitoring, Analysis, Improvement	– data on student intake – data on student progression – students/graduates opinions – rating and results of graduates on the job market – analysis and comment of data – review activities and follow up

The teacher and his/her course of study represent a complex system, whose management requires competencies of a technical-scientific nature as well as pedagogic and social competencies.

Effective system operation hinges on a diffused propensity to reflect, i.e., the ability of each teacher to observe the effects of his/her actions and to make appropriate corrections, as necessary.

The actual behaviour of a teacher can hardly be controlled effectively from the outside other than at the stage of apprenticeship, when the young teacher receives hands-on training in the field flanking, in a subordinate position, more expert teachers.

> People are the fundamental element in the quality of services, especially those like formation involving a high content of expertise and behaviours. But assessing people using objective criteria is by definition very difficult, and this is especially true for professionals in higher education.

It is advisable, however, to prevent teachers from proceeding by trial and error. This can be done through specialist training programmes for newly-hired teachers, to enhance the pedagogic and teaching skills they need to manage the classroom and apply the assessment techniques in a competent manner.

An effective way to assess the behaviour of a teacher ex-post is to examine the contents of the examinations in order to determine the knowledge/skills they are designed to assess, and the evaluation criteria adopted. In other words, to determine whether the tests ascertain the presence of the knowledge/skills required (and made known beforehand), avoiding both false negative and false positive results.

The collection of student opinions by means of questionnaires or other equally effective means is a complementary method that can supply useful indications.

4.7 Breaking Down the "Factors" into their Constituent "Elements"

A working description of the factors is provided by breaking them down into their "elements"; an overview of the evaluation modes, such as those mentioned in chapter 2 supplies many interesting indications.

An example: the "examination and assessment methods" factors can be broken down into elements such as (QAA, doc. E, Annex E):

- *Does the assessment process enable learners to demonstrate achievement of the intended outcomes?*

- *Are there criteria that enable internal and external examiners to distinguish between different categories of achievement?*
- *Can there be full confidence in the security and integrity of assessment procedures?*
- *Does the assessment strategy have an adequate formative function in developing student abilities?*

A list of common elements helps to make the evaluation reports more comparable; however, it is advisable to leave freedom of choice in the selection of the elements making up a factor. The first two “aspects/factors” levels, in fact, reflect an analytical approach, with a list to be obligatorily exhausted.

The “elements” should have an underlying structure that can be composed in a variable manner from one Programme to another; moreover, at this level, a holistic approach stressing the interdependence between the elements and their complementarity should be encouraged.

A vision, that is, which is diametrically opposed to the “molecular” approach: the elements must be addressed and then evaluated in a context of mutual relationships. Accordingly, while, as a rule, it will not be possible to accept compensations between the factors of an aspect, it is reasonable to consider the possibility of compensations between the elements that, taken together, add up to a factor.

Thus, the information model will reveal that the Programme is much more than a static configuration of components or a mere list of actions. Indeed, it is a self-organised structure, susceptible of evolution and development, to be assessed on the basis of efficiency criteria.

4.8 External Judgement

The external examiners shall formulate their judgement based on the contents of the “information model” and, if made available, also on those of the “self-evaluation supplement”. Their judgement shall take into account the indicators and the documents mentioned in the information model and, finally, shall use meetings and discussions.

Final judgement will be expressed by factors, and shall be expressed, in a “summative” manner, by selecting an ordinal category from a set. It is a good idea to add comments or statements with a “formative” function.

Of great interest for its conciseness is the approach adopted in doc. E (Estonia, 1998), wherein the individual requirements are articulated in statements expressing a desirable treatment of each factor or element. Example: “ Responsibilities for each area are formulated clearly”. The external evaluators, on the basis of the provided description and evidence, choose one of three categories:

Not Met – Concerns – Met

Alternatively, in the approach of QAA (doc. I), the examiners identify/comment strengths and weaknesses by aspects, and place them into one of three categories:

failing – approved – commendable

QAA recommends:

Within the 'commendable' category, reviewers will identify any specific features of the aspect of provision that are exemplary. To be deemed 'exemplary', a feature must:

- represent sector-leading best practice; and
- be worthy of dissemination to, and emulation by, other providers of comparable programmes; and
- make a significant contribution to the success of the provision being assessed. Incidental or marginal features do not qualify for designation.

A combination of the two approaches is probably the best choice. The evaluation of each factor will be made on a scale of four categories, supplemented by a brief explanatory statement or comment, as follows:

☆☆☆ best practice (state why, max 5 lines)
☆☆ approved (optional comments, max 5 lines)
☆ concerns (describe concerns, max 20 lines)
– not approved (state why, max 5 lines).

This establishes a reasonable scale for the treatment of factors, distinguishing between those in need of being re-examined because of some reservations (concerns) and those to be approved or not approved on the basis of explicitly or implicitly shared standards. At the same time, space is allowed for above standard (excellent/exemplary) treatments.

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PART 3

New Trends on Evaluation and Recognition

Rapporteur Alfredo Soeiro

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1. Summary

Accreditation of engineering activities have been analysed considering the classical degrees like bachelor, master or doctorate. The question of continuing professional development activities has been recently addressed due to the increasing importance of the lifelong learning in engineering. These activities become more difficult to recognize when taking the format of distance learning or of e-learning. This document tries to present current issues related with informal learning and proposes recommendations for use in the future.

2. Accreditation of Informal and Prior Learning (AIPL) in Engineering

This is a relatively new area where experiential learning can be credited towards a qualification. AIPL seeks to give credit for all learning by placing it within a recognised accreditation framework. It involves the identification of learning wherever and whenever it takes place, selection of that learning which is relevant to a desired outcome or progression route, demonstration of the validity of and appropriateness of that learning, matching learning outcomes to those stated within a chosen accreditation or progression framework, assessment of evidence against predetermined criteria to ensure the validity of the claimed competence and accreditation within an appropriate accreditation framework (1).

The relevant methodologies proposed for accreditation of AIPL are based on performance evidence and knowledge evidence. These evidences are connected with credit units that can quantify the embedment in a framework system enabling a formal partial or total recognition within a qualification framework. This qualification can lead to a degree or to a level of professional recognition. The board in charge of the analysis of the historical evidence and of other proofs of learning should look into authenticity, directness, breadth and currency (2). The approaches based on the workload and on competency-based systems require qualifications to have clear learning outcomes, levels and progression built into them. The learning outcomes act as the basis for the assessment of AIPL and any subsequent award of credits. Different methods exist for this accreditation process including the use of accreditation boards, portfolio presentation or just taking examinations.

The current issue is being addressed by different educational systems either at the national level or at institutional level. The most known is the one envisaged by France that has incorporated the process into a legal framework. The law that establishes the procedures for universities was published in 2001 and is currently in practice. The issue was discussed in several countries and, for instance, in Portugal it was analysed by the universities in January 2002. The ideas common to this legal support are the validation and accreditation of the recognised progress done outside the traditional educational settings. This legal ground allows a flexible approach using at the same time rigor of procedures and quality of results. The complexity of these processes implies certain prudence in the approach, evaluation of the results and correction of the respective procedures in accordance with the appraisal. In Annex 1 it is included a case study (5) that reflects the case studies of a British and of a French universities.

3. Accreditation of Distance Learning

Taking into account that distance learning is a mode of delivery of lifelong learning where credits gained by distance learning should be linked to clear learning outcomes. Therefore distance learning has no special implications when used in the context of credit accumulation frameworks. The key point is to express the learning in outcomes and engineer workload. The ageing of qualifications is significant in the engineering context of credit accumulation systems where these are time-limited in the sense that outdated qualifications/credits are not necessarily recognised for professional practice or access/exemption purposes.

A credit accumulation system for engineering could be developed and applied to lifelong learning. The system to evaluate these credits could be similar to the ECTS (European Credit Transfer System – europa.eu.int/comm/education/index_en.html) where the paradigm shift from teaching to learning is materialized. The tools used in this system for undergraduate students in Europe can be used for distance learning with a strict quality assurance mechanism. The use of credit-based, modular open and distance learning (ODL) programmes would certainly facilitate the development of qualifications tailored to job functions. This helps in the assembly of courses from the best sources that would certainly contribute to personal development. In-company training should be recognised providing it is rigorous and appropriate to the professional recognition being sought. This type of credit system is compatible with the labour market and with the requirements for professional accreditation (3).

The issue becomes more significant if one considers the continuing professional development of engineers done using any form of elearning. The acquaintance of engineers with the new information and communication technologies is certainly easier and more profound than in other professional areas. That is the reason why the accreditation system based on the evaluation and recognition of the knowledge acquired becomes more important. There have been innovative approaches to this difficult issue taking into account the problems related with major issues like measuring workloads, learning progress, quality evaluation of materials and teaching methods, credit distribution, credit transfer and learning assessment. An example of the lack of response from the traditional educational structures is the initiative from the private sector or from associations. One of the most recent examples is the launching of the ICDE (International Council for Distance Education – www.icde.org) of an accreditation agency for distance learning and a summary is in Annex 2.

4. Transfer of Accredited Engineering LLL

The question of mobility for engineers and the professional recognition is an important issue. Several initiatives have tried to solve like the Washington accord, the Engineering Mobility Forum (EMF – www.ecsa.co.za/International/EMF/2000/EMFSecodRevisionMoU.htm) and the World Federation of Engineering Organizations (WFEO – www.wfeo-cee.org) meeting in 13 March 2001 in Paris. These have tried to deal with recognition within certain groups of the professional qualifications for the initial qualifications. These are bilateral or multilateral agreements based on a mixture of initial education and professional experience. The issue becomes more complicated when considering a large influence of LLL. The two main issues with mobility related with LLL are a common measuring method and a recording system of the learning and experience accumulated (4).

Concerning the reference system there is a proposal by IACEE (International Association of Continuing Engineering Education – www.iacee.org) that is based on a system prepared to work on a world-wide basis and it is independent of the educational and of the professional systems in engineering. It contains the description of credit unit measurements of formal/informal training activities, participation in engineering events, publications, articles, work based learning and participation in projects. The summary of the rules for attribution of the international credits of continuing engineering education forms is based presented in Annex 3. The guidelines expressed in this text can be extended and adapted to other new forms of learning since these are flexible and comprehensive.

Considering the records of the LLL achievements there are examples like the Diploma Supplement, the Eurorecord and the Europass. The Diploma Supplement is a device to provide information on the nature, level, content, context and status of individual qualifications in order facilitate their fair recognition. The EuroRecord is a development process, supported by a software tool, guidance material and facilitation, which helps individual engineers and other professionals in the engineering industry in recognising their learning through formal education, work-based learning and experience and maintaining an up-to-date CV focusing on their competences and professional strengths, and establishing their professional asset value (5). A description of the Eurorecord (control.ethz.ch/eurorecord) experience and details can be analysed in Annex 4. The Europass (europa.eu.int/comm/education/programmes/europass/index_en.html) is a system adopted in the European Union for recording work-based periods of professional development learning done in countries abroad. The main role of these recording forms is to be included in a credit-based system for recording lifelong learning achievements by creating transparency.

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Annex 1:The Accreditation of Prior Learning: from Minority Concern to Majority Interest

Introduction

Education and training is less and less the business of the trainers and the providers and more and more part of a wider set of relationships between individuals and the various stakeholders. It is in this context that the accreditation of prior experiential and work-based learning (AIPL/AWBL) has emerged in a number of countries. AIPL represents a different approach to the relationship between education and training on the one hand and the world of work on the other. Work has increasingly become ‘intelligent’, involving more complex understanding and a site where knowledge is not only applied but is also produced. We now understand that significant learning takes place at work and in a wide range of voluntary and social activity; that the ‘knowledge in action’, the way of constructing reality and the modes of behaviour that have been developed in such settings have real value. They therefore need to be formally recognised by the institutions of education and training.

Education has also become an invaluable tool for the management of the professional and social development of individuals. A ‘career’ is less and less the normal pattern of working life and more and more characterised by breaks – voluntary or compulsory – more or less frequent. What is crucial therefore for an individual is to be able to capitalise on these experiences either outside the company or inside it if it is geared towards the development and recognition of competence.

The Implications for Universities

There are several consequences of this analysis for universities; we explore 4 of these below.

The organisation of AIPL in universities involves a formal acknowledgement across the institution that valuable, significant and relevant learning can take place outside the formal lecture halls of the institution. It means a recognition that the workplace, the family, the voluntary organisation, the sports club can be the site of and the source of knowledge and understanding. This fundamentally challenges the traditional monopoly of the university and its teachers over the production and transmission of theoretical knowledge, since others can now do this effectively. However, it also suggests a new role for them as organisers of knowledge, as professionals who structure, into a coherent form, the diverse and relatively unorganised knowledge and understanding acquired outside the university; it therefore implies a radically new approach to teaching.
AIPL challenges universities to review the content and structure of the programmes of study they offer, particularly those designed for professionals.

The implementation of AIPL leads to the development of new pedagogic strategies. Because the personal and professional background of the participants is unique, because their work situations have generated knowledge and understanding to varying degrees, the university needs to individualise the programmes if it is to offer a programme, which genuinely takes account of that learning. This means that teachers need to mobilise and organise all the available resources to create the most appropriate training experience, and this usually requires them to be freed from the constraints of the courses usually offered to students. To respond effectively to the needs of the participants and to accommodate the restrictions on their participation, means offering a diversity of modes of delivery: courses on site, independent learning, supervision and tutorial support, access to learning resource centres, distance education and so on.

In order to accredit work-based learning a dialogue must be opened with companies and other organisations and with individuals. It requires the university to listen and to understand through appropriate analysis, learning which originates elsewhere. This assumes not only an attitude of openness but also sufficient knowledge about what happens in other organisations to make sense of the voluntary or professional activity. This requires recognition of others – individuals and/or organisations – as partners.

The Experience in Two Universities

Universities in Europe have recognised these changes in their environment and over recent years have developed interesting examples of policy and practice in the field of the ‘accreditation of prior experiential learning’ (AIPL), as it is known in the UK or ‘validation des acquis professionels’ (VAP), as it is known in France. The Université des Sciences et Technologies de Lille and City University in London represent two such examples. Clearly they do not represent the complete range of experience, but they are nevertheless interesting case studies of different approaches.

The Case of the Université des Sciences et Technologies de Lille

In the mid 1980s the Université des Sciences et Technologies de Lille (USTL) made a strategic decision to adapt its organisation and programmes of study to promote the return of working adults, at any point in their lives relevant to their personal, social and professional needs. This strategy located VAP in a global approach involving the reception, induction, advice, guidance and support of adults seeking to undertake education and training programmes at the university. At the heart of this approach is the individual’s ‘project’. The definition, mapping out and realisation of this project is developed in a dialogue between the candidate, an adviser and the relevant teaching staff. VAP is one element of this process but a very important one not only in the final project but also in the education and training programme itself.
The main phases of the procedures adopted for VAP are:

a) reception, induction and the initiation of the process;
b) development of the candidate's project and discussion of its feasibility;
c) choice of the most relevant programme of study;
d) preparation of the 'dossier' for VAP if appropriate.

In France, two decrees govern 'validation des acquis professionels': the 1985 decree that authorises the university to admit candidates to a programme of study on the basis of their experience; and the 1993 decree that authorises the university to award part of a diploma on the basis of experience. USTL prioritised the implementation of the 1985 decree that is more flexible and tends to produce more positive results for candidates. In 1999, 926 dossiers were considered under the 1985 decree and 57 under the 1993 decree.

How is this translated into practice?

Under the 1985 decree, candidates receive exemption for certain years or modules. A judgement is made based on the candidate's potential and on his/her capacity to succeed in the chosen course. In order to do this, the candidate's level of responsibility, ability to solve problems, and relevant knowledge and understanding are assessed to ascertain that they are compatible with what is normally expected from those who do hold the required entry qualifications.

Under the 1993 decree, candidates are awarded modules or credits within a diploma of the university. The object here is to identify proximity rather than equivalence. The goal is not for a candidate to have acquired identical knowledge to that which is required of students undertaking the full programme of study, rather it is to check that candidates have mastered the intellectual processes and problem solving capacities that the programme seeks to develop.

Four decisions are possible:

a) candidate's application for VAP is accepted for the programme of study s/he wishes to undertake – the most positive outcome;
b) candidate's request is not accepted for the programme applied for but s/he is advised to follow a different programme, in which case a more positive outcome would be likely;
c) candidate's request is accepted with certain conditions, for example, to undertake lower level courses, either in advance or in parallel, to update or acquire missing knowledge or understanding;
d) request is rejected and the candidate is directed towards other training courses or organisations which offer more appropriate opportunities.

USTL took the decision to create a central committee for VAP, with teaching staff from different departments/faculties to guarantee coherent decisions and to ensure an interdisciplinary approach and consistency of decisions across the university.

Alongside these arrangements for VAP, course directors have been charged with adapting and organising their programmes so that they are accessible to people who work. Courses are usually grouped into one day or a half-day to make negotiations with employers and financing institutions easier. Different types of participation are becoming available: attendance at courses, use of open learning or resource centre, supervision and distance learning. In addition, learning support is offered to those adults who encounter difficulties and/or who request it. The training adviser who helped them formalise their project stays in contact with them throughout their programme of study and beyond. The university is also currently working on developing individualised programmes that do not necessarily follow the curriculum normally offered for a diploma but instead is based on the VAP activity and process. The system is still experimental and at present only applies to volunteer candidates and in programmes where the directors agree to 'play by the rules' of individualisation. This kind of development will lead to a break with the normal rhythm of the university year and to the possibility of entry at different points in the calendar.

The Case of City University, London

At City University, ultimate authority to establish and amend the regulations of the University lies with the Senate and all courses must conform to those general regulations. However, each department designs its own courses and is responsible to a central committee which approves not only the content and delivery of the programme of study and the assessment of students but also the entry requirements and arrangements for the accreditation of prior experiential learning AIPL if it is to be used. Once the internal approval processes of the university have been completed, responsibility lies solely with the department to manage the detailed implementation of the approval.

Of relevance to AIPL arrangements, is a rule governing the proportion of students without the 'usual' entry qualifications, who may be admitted to a course. At Masters level this is 25%, although this may be varied via the approval procedures, in certain circumstances. In addition, each course has at least one external examiner, an academic from another university with experience in the relevant field of study, who makes an annual report on the conduct of the course, the standards achieved by the students and the efficacy of the recruitment arrangements (including AIPL procedures) in attracting students capable of succeeding. Within this general framework there is considerable scope for diversity and for constructing arrangements to suit specific target groups - particularly different professional groups and the requirements of their professional associations.

The MSc in Continuing Education and Training

This example is taken from a modular part-time masters programme – the MSc in Continuing Education and Training – designed for adults working in human resource department of companies, private sector training organisations, public sector educational institutions or as independent trainers or training consultants. The course consists of 4 taught modules: one compulsory and the other 3 chosen from (currently) 6 options for a Postgraduate Diploma; students then complete a dissertation for the MSc.

One of the optional modules is a work-based project which can be taken:

- as a project to be conducted during the course supervised by a member of University staff;
- or awarded by AIPL for a project previously conducted independently;
- or partly by AIPL and partly by supervised work-based learning.

AIPL arrangements

Since the target group for the MSc is defined as professionals with several years experience in their field, the approach adopted is designed to be a collaborative, peer group process as far as possible, in which the supervisor's role is to guide, support, facilitate and negotiate rather than to direct.

There are essentially 3 phases in the AIPL arrangements:

Phase 1. Application
Enquiry and supply of detailed information pack

Application including a CV, an organisational chart of the candidate's company and her/his location in it and an outline of the project.

Consideration of application by 2 members of staff from the course. At this point a preliminary judgement is made about the extent to which the candidate is likely to be able to claim the whole or only part of the module by AIPL and the work (if any) required to complete. A supervisor with relevant experience is allocated to the student who formally enrols as a student of the University (if not already done so). Interview with the supervisor to negotiate and agree with the candidate, the scale, scope, depth and breadth of the project and the amount of credit to be awarded, and to provide guidance and advice on any further work based activity needed and on the preparation of the portfolio

Phase 2. Portfolio preparation

Candidates are required to assemble a portfolio for assessment including:

- an organised concise account of their chosen project,
- extracts from relevant documents to illustrate and support the account,
- a letter of confirmation from employer or line manager confirming the student's role in the project.

Tutorial support: each candidate has an entitlement to a minimum of 2 hours and a maximum of 9 hours individual and group tutorial support. This varies according to the 'readiness' of the candidate, the amount (if any) of further supervised work based learning to be conducted, and the amount of credit to be awarded. Interim assessment: the supervisor and one other member of staff together use the portfolio to assess the independent learning which has taken place. The student will be required to pass this interim assessment before proceeding to the case study and viva.

Phase 3. Completion

Case study: students are given a case study of an organisational development strategy or HRD project of a similar kind to their own but in a different setting to give them an opportunity to demonstrate that they are able to effectively transfer their knowledge and understanding to a different context (a key skill at masters level). They are given 7 days to reflect on the strengths and weaknesses shown in the case study.

Viva: the viva is a formal meeting between the student, the supervisor, one other member of the course team, and a external professional from the relevant field of practice. The student: presents the portfolio, engages in a discussion about his/her learning, and responds to the case study. If the student performs satisfactorily, the supervisor recommends to the Course Director that the student is awarded the module.

Formal award: formally all awards of modules, courses, diplomas and degrees are subject to the approval of the external examiner for the course.

Similarities and Differences

A comparison between the systems in France and the UK makes it clear that over and above the differences in the organisation and functioning of universities there is considerable convergence in the way in which AIPL or VAP has been developed in terms of the actors and the procedures involved. Nevertheless there are differences that reflect the strength of the cultural traditions of each education system. But these differences are not so important that they constitute an obstacle to shared understandings and practice or to the development of a European perspective.

Similarities in procedures:

In both cases the focus is the accreditation of experience, in order to facilitate participation in education and training leading to a university diploma. Both take into account personal and work experience – the focus is on the totality of experience; voluntary and family activities are taken into account alongside professional activity. Two kinds of AIPL/VAP exist – one that facilitates access to programmes of study by exempting candidates from the qualifications normally required for entry – and one that facilitates the award of modules or parts of a diploma and thus shortens the course.

Procedures involve similar phases: reception, induction and advice on the development of a project; support for the development of a portfolio; decision-making and evaluation of the dossier. In both there is considerable emphasis placed on advice, guidance and mentoring alongside encouragement to the individual to take responsibility for his/her own project.
Similar organisational arrangements have been put in place, adapted to the particular situation of each university.

Similarities of actors:

In both cases continuing education services or departments have a driving role in the development and implementation of arrangements. AIPL/VAP developments have been led by individuals who have a clear vision of the university of the future. AIPL /VAP involves actors responsive to the needs and experience of different kinds of students. Those in favour of AIPL/VAP confront similar obstacles and difficulties in persuading their colleagues to take into account skills and experience gained outside formal education and training.

Nevertheless there are differences:

There are no legal statutes governing AIPL in the UK, the opposite is the case for VAP in France.
There is a greater emphasis in the UK on the attempt to extract knowledge and understanding equivalent to the academic learning outcomes. In France the emphasis is more on the candidate's problem-solving ability, ways of thinking and reasoning skills.
There are differences in the concepts which underpin the practice. AIPL arrangements in the UK tend to be more cautious and require more concrete proof than those for VAP in France. The dossier required in France tends to be much smaller than the portfolio required in the UK. In the UK there is usually a clear line drawn between the time, place and the people involved in the development of the portfolio and those involved in the evaluation of it. This is not the case in France.

There is no minimum length of experience required of candidates in the UK, but usually instead a minimum age. Also the part of diploma that can be awarded by AIPL does not normally exceed 50%. In France at the present time the minimum length of experience required is between 2 and 5 years depending on the decree and the whole diploma, except one module/unit, can be awarded by VAP.

The Future

Although institutionalised AIPL/VAP arrangements are still uncommon in most universities, developments are taking place in many countries. These are frequently local initiatives created by teaching staff, teams or departments for their own students. Often the university has little or no knowledge of the practice and the impact on potential candidates or on businesses is limited. However, today the challenges are such that they require global responses from institutions of higher education, both in their mission statement and in the way their programmes and diplomas are organised and delivered.

The challenges:

The university must institutionally acknowledge that valuable learning can take place in action, outside the formal learning situations they offer; that the world of work, the family and voluntary activity can also be places of learning. The university must learn to 'read' experience based knowledge that is not presented in disciplinary forms in order to understand how candidates organise and mobilise their knowledge. In the process of AIPL/VAP candidates become actors in their own evaluation and the dossier that forms the basis of the evaluation depends partly on the quality of the relationship between the individual and the institution.

AIPL/VAP requires the university to question the way it makes its body of knowledge and expertise available. Since knowledge is increasingly easy to access outside the university and many situations are learning situations, should the university not become a place to structure, organise and formalise knowledge acquired in a more unorganised way? Should the teaching methods be reviewed?

AIPL/VAP prompts the university to review the content of programmes of study and diplomas. Are they defined in terms of objectives and learning outcomes? Or do they consist largely of lists of contents linked to the availability of teaching staff? What is the place of interdisciplinary and transversal approaches? How do theories articulate with practice? How innovative and relevant is the content? In order to make AIPL/VAP possible, the university also needs to divide up programmes of study so that parts can be awarded since long course make validation/accreditation difficult. Courses also need to be described in ways thath make it possible to compare experience with the learning expected in the academic situation.

AIPL/VAP is a period of self-reflection and self-analysis that helps candidates to become aware of what they know and what they can do but also what they still need to learn. Teaching staff needs to provide programmes of study relevant to these individual needs, which may mean a fundamental change to traditional arrangements and pedagogy. Finally, AIPL/VAP necessitates interaction with businesses and a range of different institutions and individuals. The university needs to adopt a listening mode to understand different organisations and different work roles and functions so that it can draw out the best from candidates. This presupposes openness and a receptiveness that will inevitable impact on external relations more generally. But the university remains in charge of its operations: decisions to admit candidates or to award parts of a diploma by AIPL/VAP remain in the hands of the universities' own committees.

Annex 2: Launching the ICDE Standards Agency

Need for an international quality standard in Open distance and e-learning

The issue of quality and standards in distance and e-learning are at the centre of debate and development in the field of distance and virtual learning today. Internationally there has in recent years been an increasing need for the creation of a quality standard in open distance and e-learning.

For organisations engaged in ODL and particularly those where no national standards presently exist – it is of great importance that such an international and credible quality standard is offered. It is equally important for students, their sponsors and those who fund this sort of education. The award of such an international quality standard would be a demonstration of accepted and acceptable standards throughout the world.

For a good number of years, the ICDE has been encouraged by members and partners to become involved in quality assessment and quality audits. ICDE, being the world membership organisation of open, distance and e-learning providers, embraces in its global membership most leading providers of open distance and e-learning in the world.

Under the auspices of a group of some of the leading experts in Open distance and e-learning, an international standards system for assessing quality in open distance and e-learning has now been produced, and a full process for undertaking quality audits of open distance and e-learning institutions and systems established, namely the ICDE Standards Agency (ISA).

The ISA is now available for undertaking quality audits and providing advice on quality and development issues to institutions, organisations, governments and corporations world-wide. The ISA will operate on a commercial basis and will involve leading experts in open distance and e-learning from the ICDE member institutions and others around the world as quality auditors and consultants.

The ISA will be working in co-operation with ICDE as well as using experts from the ICDE membership. The quality audit group will involve experts from ICDE member institutions, based on qualifications and ODL experience.

The mission of the ISA

The mission of the ICDE Standards Agency, hereafter referred to as the Standards Agency, is to promote public confidence that the quality of provision and standards of awards in Open Distance and Virtual Education are being safeguarded and enhanced. To this end, the Standards Agency carries out quality audits of the performance of institutions. This process of international institutional quality audit has been developed by the Standards Agency after assessment of standards in Open Distance and Virtual Education throughout the world, and represents an international standard for quality.

The Quality Audit Process and Procedures

Institutional quality audit is not a process for assessing the academic content or academic level of programmes. (There are no internationally agreed or applicable standards for academic content and level). Rather it is a process that pays due attention to the quality of programmes and the standards of awards at the point of delivery, as well as to institutions' ultimate responsibility for what is done in their names and through the exercise of their formal powers. It is an evidence-based process carried out through peer review, and balances the need for publicly credible, independent and rigorous scrutiny of institutions with the recognition that the institutions themselves are best placed to provide stakeholders with valid, reliable and up-to-date information about the quality of their programmes and the standards of their awards. At the centre of the process is an emphasis on students – in terms of the quality of the information they receive about their programmes of study, the ways in which their learning is facilitated and supported, and the academic standards they are expected to achieve, and do achieve in practice. ICDEs institutional audit process assumes that institutions will be operating within the overall national and/or state legislation and guidelines, which are applicable to them. The ICDE Standards Agency is the sole owner of the intellectual property rights to the ICDE quality standard in open distance and e learning. The services of the ISA are now available world-wide. On an interim basis, all requests for assistance and co-operation with the ISA should be directed to:
Admin@ucde.standardsgagency.org

Annex 3: ICU – The Credit Unit of the IACEE (International Association for Continuing Engineering Education)

The definition of ICU by IACEE [www.iacce.org] corresponds to the need of engineering professionals to face the challenges created by the obsolescence of engineering knowledge. It is important to guarantee the required competency of an engineer to perform its job. The adoption of an international benchmarked unit helps the public service, the employers, the changes in career and the quality of engineering profession. The current rules for the ICU – IACEE Credit Unit for Continuing Engineering Education (CEE) can be summarised as follows:

a) CEE is any form of learning or training taken after the graduation as engineer.
b) The total number of credits expected per year of CEE for any engineer is six.
c) ICU is attributed to formal training, attending conferences, presenting papers, publishing papers, work based learning and elearning.
d) One ICU corresponds to six hours of face-to-face training with evaluation and to twelve hours without evaluation.
e) One ICU corresponds to twenty-four hours of conference or meetings accredited by an official engineering board.
f) Two ICU corresponds to a published paper in an engineering reviewed journal.
g) Half ICU corresponds to a paper in a conference or meeting accredited by an official engineering board.
h) Correspondence of ICU to work based learning and to elearning is evaluated as prescribed in guideline d) if that learning is accredited by an university.

Annex 4: Case Study: EuroRecord – Empowering Professionals to Recognise and Record their Learning

Case study:

Individual commitment to lifelong learning is increasingly recognised as a key for improved business performance for employers and career progression for individuals. Continuing education therefore needs to be based on an *individually driven* education system – or rather "learning system" – where individuals have *learning agreements* with a variety of parties, including their employer, their professional body, and different academic and other providers. This requires a common language and currency both to improve communication and coordination between the partners, and to enable individuals to achieve *coherence* in their overall learning plans and activities.

At the same time, the growing awareness and recognition of the need for lifelong learning create a demand for greater transparency of qualifications, competences and achievements across corporate and national boundaries. Competence is the characteristic of an individual: the knowledge, skills, personality traits and attitudes – integrated through (work) experience – needed for successful performance. Individuals thus need to take responsibility for their own learning, for identifying development needs and taking the necessary action.

The EuroRecord – European Record of Achievement for Professionals in the Engineering Industry – has been developed in response to the above needs. The EuroRecord brings together the different elements of competence analysis, focusing on generic rather than functional competence, and does so on a genuinely European basis. Thus it provides, in a single tool, a comprehensive record of professional learning, transparent across markets. As such EuroRecord seeks to become the *de facto* European standard for recording such learning in the engineering industry.

The EuroRecord

a) gives individuals a tool that empowers them to take *ownership* of their own professional development
b) is a *competence* tool, focusing on *what* the professional learns, not *how* it has been learned
c) provides a *generic framework* to describe professional competence in a transparent, transferable way, but it is *not prescriptive* of the competences an engineer should or should not have

Benefit for professionals and their employers

The EuroRecord is a development process, supported by a software tool, guidance material and facilitation, which helps individual engineers and other professionals in the engineering industry to:

a) recognise their learning whenever and however it has taken place – through formal education, work-based learning or experience
b) draw up their career and competence development plan
c) prepare for applying for a job or for being promoted
d) maintain an up-to-date CV focusing on their competences and professional strengths, establish their professional "asset value" for themselves, their employer or their profession
e) provide evidence of their professional development to meet the requirements of a professional body or of external regulations
f) satisfy their career and personal goals and improving the balance in their life

For companies and other employers the EuroRecord can support internal professional development. By stimulating and supporting the recording of employees' learning, the EuroRecord offers organisations a comprehensive, up-to-date and easily accessed record of the competences of professional personnel. The EuroRecord helps to:

a) target Human Resources development and training with greater precision
b) save time and money in internal promotion issues
c) benchmark competences across company's international divisions
d) allocate the right personnel on projects

Description

EuroRecord is a software-based tool for the individual recording of professional achievement. It has been designed for the engineering industry to enable professionals to record their learning, however achieved, and to plan their continuing professional development. It is applicable across Europe and constitutes the first portable professional record of its kind. The individual user enters details of his or her learning into the EuroRecord. This information may relate to formal structured learning such as university degrees or professional qualifications; it may relate to skills acquired through on-the-job training; it may relate to personal knowledge and competence developed through work and non-work experience.

The EuroRecord tool consists of three sections, each of which has a specific character and purpose. Learning activities are entered in the Activity Log. For example, formal qualifications and continuing professional education can be recorded, but also less structured, experiential learning activities, for example taking charge of an important work project, or committee membership of a professional association. The important thing for the user is to reflect upon the activities and to record those that contribute to his or her learning.

While the Activity Log captures the learning the user has achieved, the Competence Profile describes the outcomes of that learning – what the user knows and can do. This section is the core of the EuroRecord and is supported by a comprehensive Competence Framework. The framework provides a structure, a classification for the competences the user might want to include in his or her profile. It has been developed to be applicable across the engineering profession throughout Europe. By providing a framework for describing all areas of competence relevant to professionals in the engineering industry it also provides users with “the complete picture” of professional competence, making it easier to identify areas of expertise and, even more importantly, areas of competence that need to be developed.

The user who completes and maintains the Activity Log and Competence Profile has already gone through a powerful self-assessment process. This information can now be used to draw up a Learning and Development Plan. Supported by a record of learning activities and a detailed breakdown of competences, the user can identify targets for personal and professional development and career achievement. This part is particularly valuable if used in consultation with mentors or other advisors.

Together, the three sections of the EuroRecord constitute the user’s professional record of achievement. Part of the power of EuroRecord, however, is that it is more than just a personal self-assessment or self-development tool. It can also constitute a public record of the user’s learning, skills and personal competences, which can be made available to the wider world of the organisation and the professional sector. Thus the EuroRecord enables the user to create personal profiles focusing on specific aspects of their professional competence and the key areas of expertise and achievement which are of value to their colleagues, their employing organisation or to potential employers. These Unique Specialist Profiles present the distinctive “selling points” of the user as a professional.

How is the EuroRecord offered to clients?

A consortium of European universities, companies, professional and trade union organisations and continuing education networks has developed the EuroRecord. The development project has been partly financed by the European Union Leonardo da Vinci programme. The EuroRecord software tool and the supporting documents have been released into the public domain. Anyone can thus download them for free from the web (http://control.ethz.ch/eurorecord/).

However, the process of analysis and reflection on professional learning and competence supported by the EuroRecord is not easy. To get the best out of this powerful tool, appropriate introduction and familiarisation are essential. The EuroRecord is therefore introduced to clients through a Facilitation Workshop. Users, who wish to start using the tool – whether they are nominated and sponsored by their employer, attending a continuing education programme or in the process of looking for a job –, attend a workshop. During this event, the EuroRecord is introduced and its application in recording and planning professional development is explained. The workshops also give hands-on training in the use of the software tool.

The EuroRecord supports the process of analysis and reflection on professional learning and competence. To support this process and to help users get the best out of this powerful tool, appropriate introduction and familiarisation are essential. The EuroRecord is therefore introduced to clients through a Facilitation Workshop. Users, who wish to start using the tool – whether they are nominated and sponsored by their employer, attending a continuing education programme or in the process of looking for a job – attend a workshop. During this event, the EuroRecord is introduced and its application in recording and planning professional development is explained. The workshops also give hands-on training in the use of the software tool.

Employing organisations are also given advice on the optimal use of the EuroRecord among their professional staff. In particular, managers will want to consider issues such as the provision of mentoring for staff to support the personal development intrinsic in the EuroRecord. Lifelong learning is a partnership from which both individual and corporate partners can draw significant benefits. The EuroRecord can be a central tool in that partnership. The EuroRecord is primarily based on self-assessment, even if users are encouraged to use the tool in dialogue with their line manager, a mentor, career adviser or some other external support person. This is of particular importance in the early phases of using the tool, as it helps the user in the process of reflection and awareness, which is unfamiliar to many professionals who are conditioned by our educational systems to teacher-led learning activities. Also in drawing up the learning and development plan, dialogue is crucial, as an effective professional development plan needs to integrate both personal and organisational objectives, and its implementation is often dependent on resources that need to be provided by the employer or some other organisation.

Conclusion

The EuroRecord has been developed for the European engineering industry and in the course of the development work, pilot test have been carried out in some ten countries. These have shown an overwhelming acceptance of the basic concepts, both within the primary target group of engineers in industry, but also more widely. A wide range of applications are being considered, ranging from its use to support annual appraisals or applying new competence-based pay schemes in companies to redesigning undergraduate engineering programmes and helping undergraduate students take ownership of their own learning. As it stands, the EuroRecord tool is applicable for any branch of engineering. The design of the software and of the competence framework makes it generic and easily adaptable to other professional areas. Discussions have already been launched about applying the EuroRecord to the health care, human resources development and other professions.

Annex 5: The Semi-automatic Generation of Yearly Academic Reports

The information system of the Faculdade de Engenharia da Universidade do Porto (www.fe.up.pt) is an administrative IS, covering aspects ranging from the school infrastructures and the academic records, to the course plans, scientific productivity or the external assessment processes. The early decision and continued effort of building it as an integrated IS has been the key to attain the progressive modernization of many processes and services and to become able to provide more accurate decision support.

The Director of the Engineering Faculty of Porto University (FEUP) decided in 1996 to start a project to build and put in place an integrated information system (IS). The broad motivation has been to enable faster access and dissemination of administrative, scholar, scientific, technical and other information resources, stimulating a stronger collaboration among the members of the academic community. But the more specific concerns included the wish to reduce the number of times that the same information had to be asked again and again in order to complete the numerous forms, reports and proposals that should be prepared. The data collection and organization for each of these documents was always a fresh new process requiring a lot of effort and with a low degree of systematization. So, although the establishment of the new IS has not been explicitly deemed a quality process, it set up the basis to improve several aspects of the operation of the institution.

In what follows, a brief overview of the current situation of the IS will be done, complemented by a more detailed presentation of the several available reports, and ending with a perspective on the impact of the IS on the overall quality assurance system of the institution.

Current situation

The system has been developed in-house, under the responsibility of the Computer Centre. It is still growing, partly to fulfil the rather ambitious initial goals but also driven by the evolution of the organization itself. Some of its characteristics include:

(1) The system is quite diverse and the information is dynamic and presents different validation periods.
(2) It is flexible and modular. New components are easily incorporated, such as new types of info-resources, new information providers, or new facilities needed by the end-users.
(3) The diversity of information providers is large, implying a disciplined intervention.
(4) Sensible information, like student marks and financial data, must be secure.

The project team has tried to find a balance between the development of an articulated system, moving towards full integration, and the incentives to the information providers within FEUP to creatively produce and disseminate info-resources.

Resources

The modules presently available accommodate a wide variety of information types and integrate multiple sources and repositories. The following table lists the most relevant:

Table 1. Current modules

Resource	Description
Presentation	Institution presentation, history, organisation, external links
News	General and specific notices
Legislation	Laws, regulations, statutes, minutes
Programme	
Plans	Programme descriptions
Course record	Official information of courses
Course Web-site	Course support resources
Teaching service	Allocation of teaching service
Timetables	Timetables for professors, labs, and classes
Lab classes	Enrolment in classes
Class summaries	Records the summary of each class and the possible support documents (slides, exercices)
Assessment	Recording of assessment results directly introduced by teachers or taken from a spreadsheet
Annual report	Production of the graphics, tables and indicators of the programme annual report
Accreditation	Accreditation and external evaluation reports
Pedagogical assessment	Results of the pedagogical inquiries
Continuous education	Continuous education programmes
Students	
Official page	Personal data
Student record	Record of grades
Personal page	Personal Web page
Certificates	On-line certificate requests
Statistics	Statistics of academic results
Print quotas	Running account of the printing credit
Academic fees	ATM payment and status

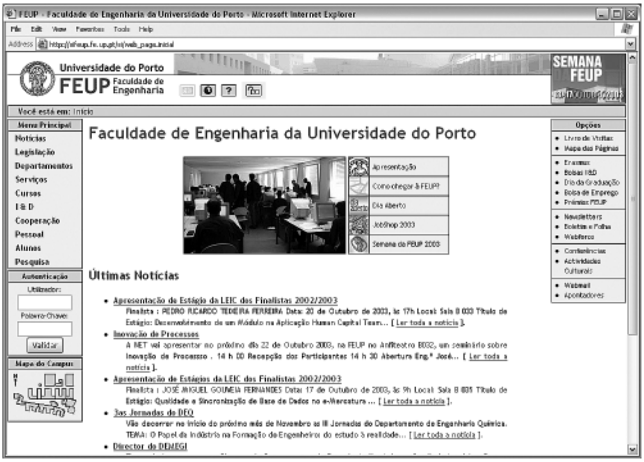
Alumni	Professional record, contact, personal page
Employment	Help on matching students and employers
Staff	
Official page	Personnal data
Personal page	Personal Web page
Staff records	Contracts, qualifications, positions
I&D	
Projects	Description, budget, participants, results
Scientific papers	Bibliography, abstracts
Facilities	
Building drawings	Layout of all the buildings and floors
Rooms	Descriptions of room characteristics
Assets	Official records
Computational resources	Hardware and software available, maintenance
Resource reservation	Booking of rooms, equipment
Other	
Budget	Project budget information
Trouble Tickets	Management of user support
Dynamic mail	Dynamic distribution lists
Foruns	Debate areas
Search	General search tool

The architecture of the information system has two vectors: the consolidation of the data in a relational database and the information access by Web browsers.
The system is reachable at the URL http://www.fe.up.pt. Descriptions of specific parts are also available in [1, 2, 3, 4, 5, 6].

For the sake of clarity, a few example modules are presented below in the form of a tour guide for the following situation: *On September 2000, the Faculty moved to a new location, in the city periphery. How could the SiFEUP help a professor in the move to the new premises?*

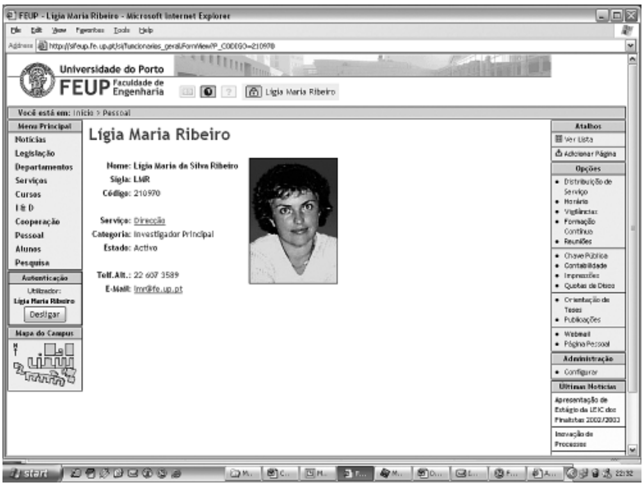
FIRST STEP

On the home page it is possible to see whether there is relevant news. The news module contains short notices posted by the different units of the faculty, which are automatically displayed and discarded according to a predefined schedule, and can be selectively viewed according to the user profile. The user will be prompted to a single sign-on to authenticate himself if the resource requires it.



SECOND STEP

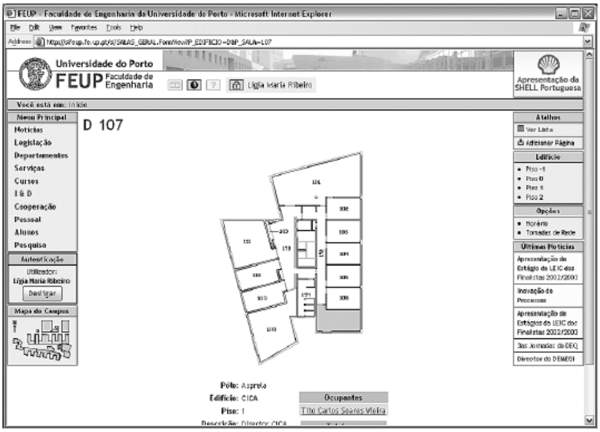
Selecting the option *Pessoal* (Staff) on the left menu find the official SiFEUP page. A query form allows the specification of several search criteria. Such a page exists for every member of the staff (as well as for every student) and contains all the relevant information concerning the activity in the institution: contacts, position, teaching service in the last years, timetable, publications, projects. If the user maintains a personal Web page, he may specify its URL in a configuration form attached to the official page, where the link becomes automatically included.



Following the link for the user's office a drawing of the floor and building will be displayed.

THIRD STEP

Locate the office in the map. See the room description, telephone, number of network access points and configuration information including IP address and computer name. This page contains an option for the room timetable that, in a classroom, shows its lecture hours. In an office it may be used for the student answering hours.

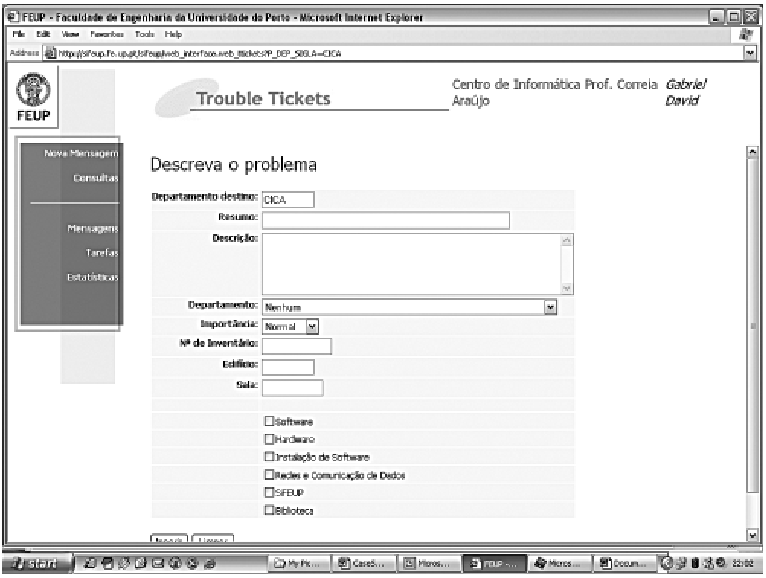


FOURTH STEP

Back in the official personal page one can see the timetable and follow the links to the lectures. Then find where are the different rooms, the classes, and the official course pages, containing the objectives, syllabus, assessment, bibliography, list of registered students, their photos, pedagogical inquiries, and course performance statistics. From the list of students one may select the e-mail option and warn the students about the beginning of the lectures.

FIFTH STEP

Find through the option *Serviços* (Services) the computer center and the trouble tickets (TT) module. Start a new TT asking for the creation of a set of database accounts for the students attending the next lectures.



Follow at any moment the evolution of the request using the TT module.

The reports setup module

Undergraduate engineering programmes are subject to periodic assessment, both by the Portuguese Council of Rectors and by professional associations. As the IS already contained a significant proportion of the information required by these reports, a module has been developed to automate as much as possible their preparation.

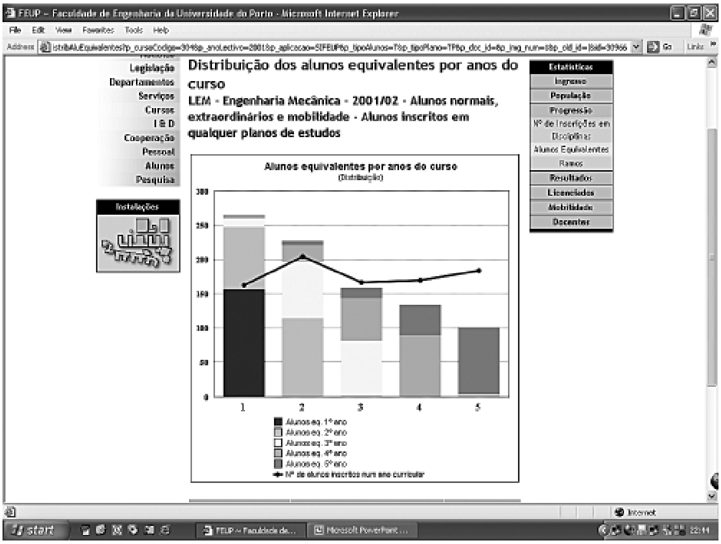
One of the characteristics of the assessment processes is the variability. The requirements of the evaluator change very often. And each programme has its particularities and each director his own views. So, in developing the module, instead of trying to build a model general and flexible enough for all the cases, the prototype approach has been followed.

For each category of assessment a prototype document is assembled, following the guide defined by the evaluator, for instance, a prototype for Council of Rectors external assessment and another one for the accreditation processes driven by the Engineering Professional Association. These prototypes include the database queries

and the graphics needed as well as the structure of sections and subsections of the document to be produced, according to the general specifications.
When a new process starts, a copy of the prototype is generated, with the programme and year of reference as parameters. The new document is self-contained and may, from this point on, be modified as required, both in its structure and in the specific database queries. The programme director is granted access to the document to write down, through a Web form, the due analysis and comments, but the starting point is already something half-complete. As everything is recorded in the IS, the director may decide to open access to the document to a selected group of staff, to help in its preparation or just to produce comments in order to improve the report.
This module has already been used in a dozen processes, with very good results. The traditional printed version of the documents is still sent to the external committees, along with a CD version. But the URL of the document and a password is also given. Afterwards, the report may become widely available, so everybody involved with the programme may read it timely and learn from its contents.

The whole process became so facilitated that an internal yearly report has been formatted for undergraduate programmes, starting in 2001/2002. The table of contents of this document looks like the next screenshot.

The Yearly Report contains several graphics and tables including this distribution of students per curricular year, displaying the proportion of subjects from preceding years the students are enrolled in.



The screenshot also shows the analysis added by the programme director.
It is currently under development a similar document to synthesize all the undergraduate reports for the Engineering Faculty.

Conclusion

The IS has had impact in the operation of the core business of the institution, the pedagogical relationship, by making it easier for students to get crucial information on their courses, summaries, presentations, etc., and by improving the communication between students and teachers. It also had been of value in the auxiliary processes like the operation of the academic services and the production of up-to-date management indicators.

Two guiding principles emerge has keys factors in the success of the system. The first one is integration, or one institution – one IS, maybe with subsystems but all connected in a global model. The second is the model of operation: the IS modules were meant to be part of the daily work of everyone at FEUP, thus becoming an essential tool for many of the tasks assigned to the teachers, the staff and, to a lesser degree, the students. The idea of confining the IS in a “Quality Department” or of making it a secondary record of activities primarily performed with other tools has been rejected since the beginning. Nevertheless, some compromises have been made in transition phases or during the initial massive data load, when special help has been provided to the users by the development team.

The system has not been primarily designed as a piece of a more general quality assurance system. It was only after the operational modules had been put in place that the reports module became feasible. The former are the foundations of the quality building of which the latter is the top. In fact, this module constitutes a valuable tool of the quality system currently in operation and it is being used by an observatory created in the scope of the FEUP Pedagogic Council.

The system helped a lot the modernization effort carried out by the FEUP direction board. The school management has now more accurate sensors of the actual academic and research activities, which support decision-making better suited to the school reality. Also, the task of convincing the professors to answer inquiries and produce information has been facilitated because the transparency of the IS exposes to everybody the misses and the possibility of on-line data entry simplifies the work.

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Activity 2 – Active Participants

Name	Institution/Country
Augusti, Giuliano	**Università "La Sapienza", Roma, Italy**
Baniotopoulos, Charalambos	Aristotelio Panepistimio Thessalonikis, Greece
Boev, Oleg V.[1]	Russian Association for Engineering Education, Russia
Bonev, Zdravko[1]	UACEG, Bulgaria
Bonne, Pim	BEST, France
Borri, Claudio	Università di Firenze, Italy
Cardon, Albert	Free University Brussels (V.U.B.), Belgium
Côme, Françoise	SEFI, Belgium
De Werra, Dominique	EPFL, Switzerland
Dodridge, Melvyn	University of Derby, United Kingdom
Dolecek, Valter[1]	University of Maribor, Slovenia
Dumciuviene, Daiva	Kaunas Technical University, Lithuania
Garcia Fernandez, Marinela	Universidad Politecnica de Madrid, Spain
Gernot, Beer	Technical University Graz, Austria
Gibson, Ivan[1]	National University of Ireland, Ireland
Godard, Michel	ADISIF, Belgium
Gola, Muzio	Politecnico di Torino, Italy
Hedberg, Torbjorn	Lulea University of Technology, Sweden

[1] Even if the Institutions of these colleagues are not partner of E4 TN we here acknowledge their contribution to this volume.

Heitmann, Günter	Technical University of Berlin, Germany
Hernaut, Kruno	E4 International Advisory Board, München, Germany
Jansson, Nella	Helsinki University of Technology, Finland
Kaiser, Hans	Technical University Wien, Austria
Kaps, Tiit	Tallinn Technical University, Estonia
Krogh, Flemming	Engineering College of Copenhagen, Denmark
Kurz, Gunther	University of Applied Sciences Esslingen, Germany
Levy, Jack	E4 International Advisory Board, United Kingdom
Macukow, Bohdan	Warsaw University of Technology, Poland
Manoliu, Iacint	Technical University of Civil Engineering, Bucharest, Rumania
Mulhall, Brian	University of Surrey, United Kingdom
Radosz, Andrzej	Wroclaw University of Technology, Poland
Rautanen, Tuomas	Helsinki University of Technology, Finland
Riccobono, Roberto	Università di Palermo, Italy
Sobkowiak, Andrzej	Politechnika Rzeszowska, Poland
Soeiro, Alfredo	**Universidade do Porto, Portugal**
Szentirmai, Laszlo	University of Miskolc, Poland
Toth, Agnes	Budapest Polytechnic, Hungary
Vinther, Ole	The Engineering College of Copenhagen, Denmark
Wastiel, Jan	Free University Brussels (V.U.B.), Belgium
Wauters, Philippe	FEANI, Belgium
Weck,Tor-Ulf	Helsinki University of Technology, Finland

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E4 Thematic Network: Enhancing Engineering Education in Europe

VOLUME E

Part I
Activity 3

Engineering Professional Development for Europe

PATRICIO MONTESINOS, ROBERTO ROMERO

Part II
Activity 4

Enhancing the European Dimension

JEAN-PIERRE CHARLOT, RADU CHISLEAG, BRIAN MULHALL

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Part I

Activity 3

Engineering Professional Development for Europe

Reflections and Recommendations to Manage Continuing Engineering Education as a Business. Ideas and Suggestions from 80 EU Experts

Patricio Montesinos, Roberto Romero

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0. Background

Mr. Patricio Montesinos[1]
E-mail: pmontesi@cfp.upv.es

Dr. Alfredo Soeiro[2]
E-mail: avsoeiro@reit.up.pt

Mr. Roberto Romero[1]
E-mail: rorollo@cfp.upv.es

This report resumes the experience developed by the SEFI Working Group of Continuing Engineering Education acting under the umbrella of the E4 (Enhancing Engineering Education in Europe) Thematic Network, specifically the label used was the activity 3 one, the activity that deals with Continuing Professional Development or, to be more accurate with the actual terminology in Europe, the activity that committed with the observation and the development of Continuing Engineering Education in Europe. How can 3 years of experience be resumed in less than 5 pages? Just with difficulties and with more difficulties when this is the professional opinion of more than 80 experts that is resumed.

In this report the authors are going to expose the long experience and the main conclusions achieved during the development of four different *benchmarking* exercises on three different occasions: 2001 (Espoo, Finland), 2002 (Vienna, Austria) and 2003 (Valencia, Spain) in the Annual meeting of the Working Group on Continuing Engineering Education (CEE) of the SEFI (European Society for Engineering Education) society. This activity has been partially supported by the European Thematic Network E4 (Enhancing Engineering Education in Europe), specifically its activity 3 (Continuing Professional Development). When the authors started this work in year 2000 they had on mind just to enhance engineering education in Europe and, in this case, the Continuing Engineering Education (CEE). The goal was to achieve a Continuing Professional Development guidance and support for the European Engineers when they end their undergraduated studios. The first step given was to put stress in having good CEE providers that could offer good courses to those engineers. That decision meant improving the management skills and abilities of these providers. During these three years the working group main "obsession" (among others) has been to discover critical success factors and decisive success processes related to CEE management. But,

[1] Continuing Education Centre, Valencia University of Technology, Spain.
[2] Prorector, University of Porto, Portugal.

how to do that? Management of CEE has some particularities. The most important one is that there is not a solution suitable to all the cases in the stormy world of the educational systems. It is difficult to find out what the others are doing and there is a need to react quickly in order to follow the market evolution. The market (and the CEE market is not an exception) seems to have something in common. It tries to run faster than the suppliers. Those suppliers that have enough "good health" not only to understand needs but also to respond quickly, can follow market requirements in order to not to be left behind. The basic strength that the working group members used as a fundamental tool to develop this difficult task was the cooperation with the SEFI Working Group on CEE (WG CEE). This group is a forum for individuals and organizations committed to providing the continuing professional development and lifelong learning opportunities to European engineers. Nowadays, more than ever, engineers need to stay fully competent to practice throughout their careers and to keep Europe in the forefront of the world's technological competition. The members of the working group and other individuals interested in CEE got together once a year during these three years in an intensive seminar that has taken place every year since 1985. It is a period where you can reach (fundamentally European) CEE providers to collect information and also to spread the results of your personal and institutional activities. In this article the vital experience of these more than eighty CEE experts all over the world are resumed in two main aspects. In the first part it is exposed a panoplia of CEE suppliers in Europe composed by an inventory of CEE suppliers offered and conceptualised. Managing "non classical" operations from University suppliers implies new structures that will help the classical system to interoperate with the environment needs. These structures, known generically as "binding units", helps in that interaction among the market and the classical university system. CEE is a business that operates in this "middle arena" and it suffers all kind of pressures by the external actors and the internal ones. External due to the fact that they would like to have responses in real time, and internals due to several people in the system that hates the changes created by an effective response to the society. This first part of the report must be understood with the idea of having a reflection on how Universities in Europe are organising their binding units related with CEE.

The second part is a guidelines and recommendations proposal for CEE activities exposed under the benchmarking scheme used during these three years and based on the value chain concept applied to CEE. More than eighty different experts on CEE Management delivery had used their time in the SEFI WG on CEE to compare and benchmark their methods of operation. It's not easy to share non-formal knowledge among experts and the traditional way of managing know-how (reading articles in a conference) are not bad but are not efficient enough to obtain results in a very short period of interaction time. So, the methodology used (benchmarking of critical success factors and critical success processes) has allowed to identify during twelve hours of very intensive work, all the issues that must be considered to understand customer needs (demand analysis), to understand how to design an effective CEE course (product design), to understand the marketing process of the CEE products, and finally, to identify critical success factors and process related to sharing Open and Distance

Learning (ODL) materials among CEE suppliers. In fact, at least four of the six steps of the Continuing Engineering Education courses value chain have been described using the model produced by the Cambridge Programme for Industry (CPI) in 1996. CPI introduced a wonderful group dynamics, the *benchmarking group dynamics*, in the 96 SEFI WG on CEE, coordinated by the actual Director, Polly Courtice. This model allows sharing implicit and explicit know-how in a very effective and simple way. This is not the objective of this report to describe that in detail but the detailed results of these four benchmarking can be reached in the Webs described at the end of the report. Also a short "list of recommendations" is presented in this report just to help those CEE actors that wants to begin the operations in the world of the "new wine in old bags".

Binding Units for different Institutional Attitudes

The public Universities governance and the relations with the society that finance the activity of our institutions are becoming relevant issues in the past two decades. The original role of the Universities has radically changed once the society that finances these institutions decided to have not only "ivory-towers" disconnected from real settings. Special efforts are being asked more and more to our institutions in order to give agile and fast responses to the inquiries received from the industry, the administration and the technical environments. In the next lines we will try to describe different models used by diverse Higher Education Institutions (HEI) in order to organise and structure in a stable way the relations among the University and the local, regional and international actors present in the Higher Education context.

Due to the socialisation of the knowledge began during the last century sixties, Higher Education Institutions won and are winning more external objectives assigned by the different "environments" and settings where these entities operates. CEE is, among other, one of this new hot issues. HEI are not allowed more time to be entities those lives in "own-generated" settings. The original roles assigned to our institutions have been modified and enhanced due to those who finance the public Universities (civil society, industry and administration) consider they can ask for more objectives and services. The social setting asks not only for the traditional "selection process" role but also for having an objective instrument that can help with "non-interested opinions". The industrial environment not only wants the universities degrees of future well-qualified professionals but also requires postgraduates being capable to understand the innovation and the key factors of the business success. The technical environment (capital goods industry & technical consultants) needs not only personnel able to learn permanently but also people with enough technical and personal skills that could conduct successful teams in their respective business.

Among others, these new roles and outputs are asked to HEI in a pressing manner, generating inside our organisations at least some kind of "*institutional stress*". And, as always, these changing processes can be ignored or can be conducted. Several HEI in the world are trying to conduct this situation using one of the key concepts of this study: the professionalisation of the process for building bridges to our respective contexts with a local/regional, national, European and international vision. These bridges help the institutions and the individuals to establish permanent links with the different settings the Universities nowadays must serve. These bridges are named generically linking or binding Units of the scientific setting and have been characterised under the theory of the *Regional Systems of Innovation.*

The new roles the HEI are asked to assume can be a traumatic experience for institutions with some "*institutional attitudes*". We define Universities can have an institutional attitude based in the majority attitudes of its members. We identified at least, six mayor basic attitudes inside HEI. When most part of the academia considers that the HEI must develop just educational activities, the general attitude for the institution is labelled as an "*academical HEI*".

If inside this attitude is included not also the educational work but also the basic research activity, this institutional attitude is identified as the "*classical*" orientation. When these two attitudes are present with a feeling inside the institution that considers that the problems of the social setting must have a solution elaborated within the University, then the HEI is labelled as a "*social institution*". When inside the HEI exists a feeling near to consider all the problems can be solved with a good project, and then we consider the basic attitude is a "*project oriented*" institution. This situation is very usual in the technical settings. If the institution participates in their setting problems collaborating not only with projects proposals but also financing structures that can participate actively giving answers on a local, national or international levels, then we identified an "*entrepreneur*" institution. Finally, if the institution participates actively in the economical development of their region via specific permanent units, the *binding units,* with the main orientation of facilitate the innovation and the competitiveness of their regional, national or transnational settings, and then we are describing the basic attitude of an "*innovative HEI*".

Each typology doesn't describes totally the vast complexity of the Higher Education Institutions but at least, allows to characterise the kind of models that are being used from the scientific setting in order to establish permanent links with the environments that interacts with the entities. The kind of units, centres or institutes used to develop these works must be different based on the basic institutional attitude more present in the organisation.

It is well-known how different HEI had organised its external links via different *binding units* but its is also well know that the same solution its a success or a bad experience based on the institution where this organisational approach is used. We consider the institutional attitude configured a special set of "internal handicaps" for the use of these units that can help the university to completely develop the new requirements and challenges faced nowadays.

Binding Units Organisational Models

The institutional attitude allows to consider the kind of "*linking units*" needed to develop permanent relations with the different settings. We have enumerated at least four different setting that characterises a *National System of Innovation*. This approach to describe how innovation takes place and how the Universities can have a role inside the innovation processes is name as the "interactive approach", Lundwall (1992). Other authors, Fernandez (1994) and Pavon (1997), describe not only the importance of relations (quantitative and qualitative) among the settings but also the definitive role of the units that allows the interactions among environments inside this model.

We can formulate a first approach for identifying units that allows the HEI to develop permanent and generic links and bridges with the different environments and settings the Universities are incorporated. The first approach identifies centralised units versus decentralised units, Mitchell (2000). Centralised units (unique unit) allow using the "*scale economies*" that can exist in the different "*value chains*" assigned to the unit, Porter (1998). A decentralised system allows to have more "accurate responses" to the settings requirements but disappears the possibility of the scale economy use. And always its possible to lose the "*hygienical elements*", Herzberg (1980), if the units begin a "competition process for the internal and external resources. A second approach modelled the units as internal versus external ones, Soeiro (1997). External units (independent from the "fiscal" point of view) has always the tendency to cover "own objectives" once the relation with the mother organisation becomes a "resources negotiation". The monthly payroll payments become more important than to cover the original institutional objectives initially approved. The Internal units are more linked to the institutional objectives and allow a better involvement with the inner institutional processes, Montesinos (2000).

This four variable methodology allows identifying easily the way the HEI organise its value chains for the external services offered via "linking units". Also the economical management, incomes and expenses (centralised or decentralised) allow to model easily the evolution degree of the institution. This methodology has been used to study, characterise and represent seventeen "binding units" all over Europe and forty one universities in Spain.

Initial suggestions for Binding Units in CEE implementation

The institutional attitude model allows characterising easily the kind of units used by the HEI studied. This methodology also allows identifying how the units organise its location (internal or external) and its number (centralised or decentralised) by the nature of its value chains.

To organise institutional units to be channels that helps/invigorates individuals and departments that respond to the external requirements it is no more a "strange fashion". It is a need and a tool that exists and must be used by the HEI. The access of the teacher to the industry/end users/public administration must be invigorated and supported by these "professional units", specifically all those who develop CEE. These initiatives must be a President/Rector strategical assumption. The CEE units must earn credibility and acceptance organising good internal services and excellent relations with the individuals that are part of the HEI. Teachers have the most important role and they need a very special professional that allows them to be the protagonist on the jobs to be develop but considering that invigorating the teachers permanently is also a job that must be seriously and professionally considered. As "new wine in old bags" needs a multidisciplinary team that can act over the different value chains pending to be defined. Continuing Education, Technology Transfer, "Spin-offs" and Entrepreneur programmes for the students, Employment services for students and former students and Innovation Services for the industry and the administration are, among others, services that requires special implications from the teachers point of view but also from the institutional point of view. New roles, relations and value chains are needed and must be defined and used in the next years. The challenge, again, is an enormous job that only HEI can conduct and develop successfully.

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1. Introduction

Patricio Montesinos
Activity 3 Co-ordinator & CEE Manager
Universidad Politecnica de Valencia, Spain

1.1 Some History

When we started Activity 3 in 2000 we had one aim in mind: to enhance engineering in Europe, in our case, the Continuous Engineering Education (CEE), in order to achieve a Continuous Professional Development of the European Engineers when they end their undergraduate studies.

To do so, we considered that the first step was to ensure we had good CEE providers that could offer good courses to engineers, this meant improving the management skill and abilities of these providers. During these 3 years our main goal has been to discover critical success factors and processes related to CEE management. But how?

Management has some particularities, the most important one is that there is not a solution suitable to all the cases. It is difficult to find out what the others are doing and there is a need to react quickly in order to follow the market. The market (and the CEE market is not an exception) seems to have something in common: tries to run faster than the supplier. Those suppliers that have enough “good health” not only to understand needs but also to react quickly, can follow market requirements in order not to be left behind.

Our strength, which we use as fundamental tool to develop this difficult task, was the SEFI Working Group on Continuous Engineering Education (WG CEE). This group is a forum for individuals and organizations committed to providing the continuing professional development and lifelong learning opportunities to European engineers. Nowadays more than never, engineers need to stay fully competent to practice throughout their careers and to keep Europe in the forefront of the world’s technological competition.

The members of the group and other individuals interested in CEE met once a year for the past 3 years during the intensive SEFI WH CEE seminar that has taken place annually since 1985. It is an occasion where you can reach CEE providers to collect information and also to spread the results of your personal and institutional activities. During these meetings we dealt with all the themes related to Activity 3. You can find a summary of the meetings in www.cfp.upv.es/e4

Now, in 2003, we are reaching the end of the E4 project, and we are happy to say that we have achieved most of the objectives of our Activity. What you are going to read from this point is a report of some of the outputs from Activity 3, "**Typology of CEE supplying in Europe. An Inventory of CEE suppliers**", and "**Recommendations for CEE activities**" (Demand Analysis, Course Design, Marketing and Sharing Open and distance learning materials).

We hope that these reports are useful for the readers, as the elaboration in a cooperative way has been for us.

1.2 Who should read these reports?

This report should be helpful for the Continuing Engineering Education Managers and Policy makers. You will find recommendations (best practices) in some aspects of the development of a CEE activity and some examples of different ways and process for CEE organising.

If you are an engineer looking for guides of exactly what aspects you should be looking for in courses, or if you are a Professor eager for new teaching methods or pedagogical aspects, you will find answers in the other Activities of E4, not this one.

1.3 About the authors

This information has been collected from all the participants of the three Seminars of Continuing Engineering Education, approximately 150 authors in all. From these, we would like to especially highlight Prof. Alfredo Soeiro, Mr. Anders Hangstrom and Ms Prof. Oddvin Arne, as quite active members of the group.

It has been a task of the co-ordinating institution, the Valencia Technical University (Universidad Politécnica de Valencia) via Mr. Patricio Montesinos and Mr. Roberto Romero, to gather this information.

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2. Core Report 1: Typology of CEE supplying in Europe. An Inventory of CEE suppliers

2.1 The environment of the Centre

Continuing Engineering Education (CEE) Centres often belong to a larger organisation, whether it be a University or a Company. Part of the taxonomy will deal with the description of these larger organisations, following the models put forward by Francisco Solé, Catalonia Technical University (UPC).

- *Model 1*: in this model, the university is fundamentally based on Degrees offered by schools or departments, which means that the schools and faculties (or departments) are the most important and powerful institutional "element". These models tend to comprise binding units that fulfil certain functions which, managed by each school or faculty individually, may be duplicated in the various schools or faculties. There are centralised services such as the "*porter's offices*", beadles, maintenance, security services, etc. In the institutional environment it is very difficult to obtain "scale economies" among the institutional "elements" (schools, faculties or departments) due to the fact there are only few people with a large degree of authority. This setting is common in old universities with traditional management channels. Management is usually confused with administration (see Fig. 1).

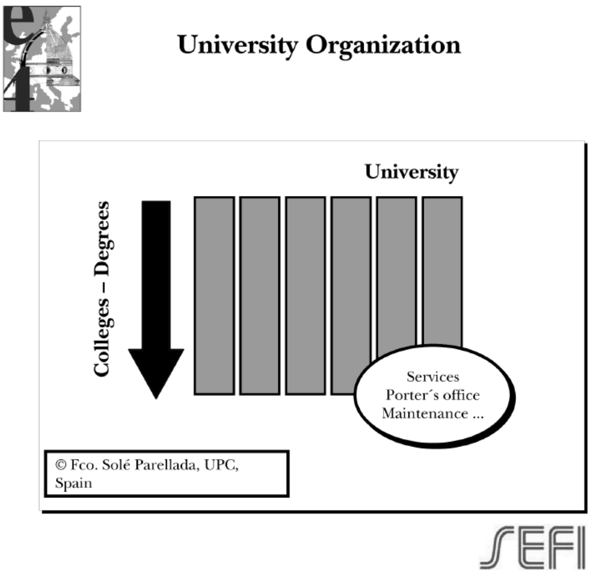


Fig. 1. University based on Faculties

- *Model 2*: in this model, departments have significant importance, which means that they become the main "powerful" units, even more so than schools and faculties. The evolutions from previous models are conducted creating centralised departments that give "teaching" services to the faculties. Students are "school property" but teachers are "owned" by departments. Research activities take place in the departments facilities. These models tend to comprise units that fulfil certain functions, which are similar across the departments. Scale economies are used in those services which require huge investments or rectoral/presidency dependent. The new scale economy services generate dependency with the campus facilities. There are also traditional centralised services as in the case of Model 1.

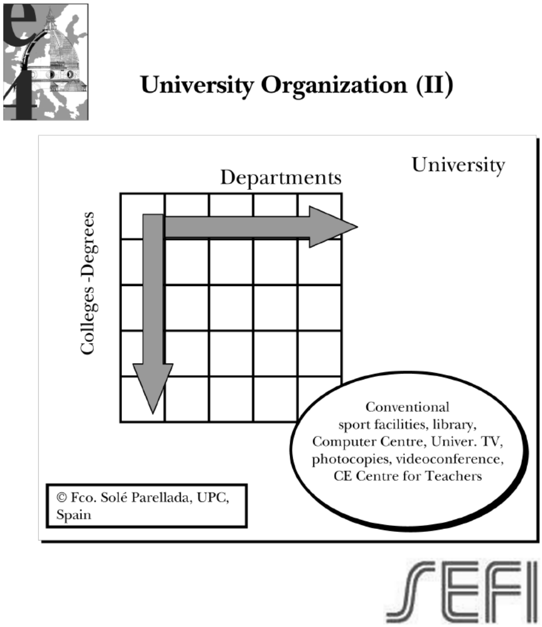


Fig. 2. University based on Faculties + Departments

- *Model 3*: in this model, the previously mentioned Figures are also present. However, the University represents an important Figure of general power with strategic policies that have to be observed by departments as well as schools and faculties. Moreover, this model promotes the setting up of new Support Units along these strategic lines (strategic services, services usually defined in the rectoral programme) and according to the detected needs (ad hoc units, probably strategic units in the past assumed by the university as accepted centralised services), as well as the creation of internal units, which are normally promoted by active members (individuals, groups, centres or institutes) of the University Community (individual and group initiatives are backed up, provided that they follow the strategic lines established by the university). A Unit or Service is intended to be general at University level, unless its necessity in a certain Department or Centre can be justified (see Fig. 3).

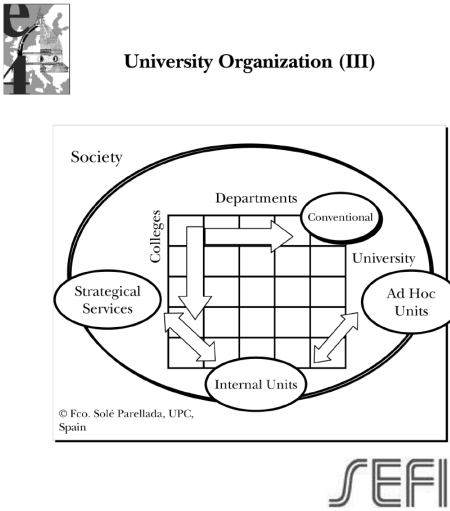


Fig. 3. University with a Technopol structure [Sole, F. 2000)

Moreover, it will no doubt be interesting to find out whether this CEE Centre is functioning externally to that of the larger organisation (whether its fiscal or tax status is different from that of the University or the Company).
Another aspect of the description consists of finding out whether the unit is the only one that can offer Continuing Education courses in the organisation (all Continuing Education courses always pass through the unit), or whether this training can also be offered in the organisational environment by other means. If we cross this aspect and the internal/external factor from the previous paragraph, the result is the Fig. 4.

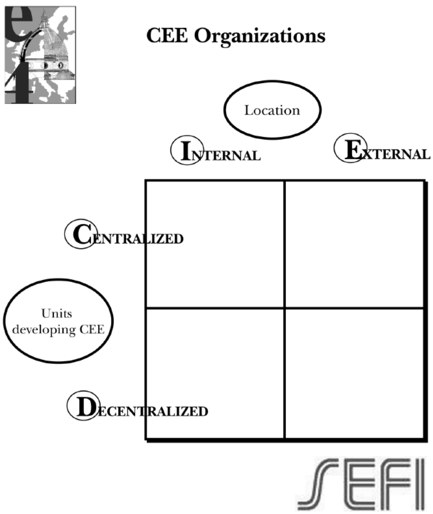


Fig. 4. Continuing Education Organisations alternatives

There is no better or worse option for these issues. Moreover, it depends on the institutional orientation. The difficulties to coordinate external and decentralised units are an evident issue and usually a headache for University managers. An internal and centralised service allows multiple advantages due to the use of scale economies and "external image economies". Same institutional impulse is transmitted and appreciates by potential users. Nevertheless depending the specific history and conditions of each organisation this model is a desideratum non possible to create. Is not the objective of this report to identify the "reactive" powers that avoid centralised and internal units, but a matter of fact that objective difficulties exist for the Rectors and Presidents to centralise services that in the past had been decentralised.

Decentralised systems promote internal competition for the same resources (customers and/or budget) and generate at least some confusion in the potential users. There is more" political" space but generally appears "wars for peanuts". External but centralised services are a good option for traditional institutions with a reluctance to allow "power concentration". The flexibility of these structures is a positive advantage for the immobilised old institutions but there is a severe risk that must be assumed. The budget for personnel must be assumed from the University budget. If not, these kind of binding units use to look for resources to cover the payrolls costs and can easily assume works to be developed with personnel not contacted through the university, due to possible lower costs. In that case a repulse reaction can be generated from the university to those institutions and the main reason to be created (to be used by the university community) is diluted in the glass of the binding unit needs. Some cases had occurred in Europe in the last ten years that illustrated that "India-rubber" effect.

2.2 Income and expenditure management

An important matter to deal with is how money is handled. Income can be managed as follows:

- *Centralised*, if the unit is paid by courses into one single bank account, whether it be a bank account belonging to the unit or to the larger organisation it belongs to.
- *Decentralised*, if courses can be paid into several accounts, whether it be separate bank accounts per course, per course group, etc.

With regard to expenditure:

- *Centralised*, if all decisions concerning payments to teachers, costs for materials and so forth are made in a centralised manner.
- *Decentralised*, if the costs for each course or course group are managed independently.

(See Fig. 5)

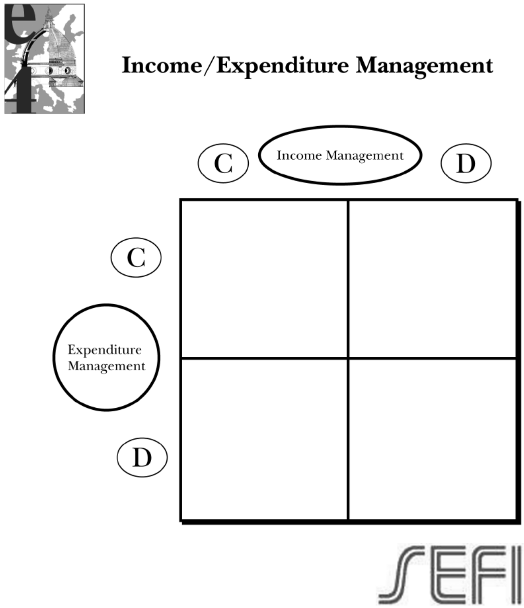


Fig. 5. How do we manage the money?

By way of example, we can affirm that the UPV's Continuing Engineering Education Centre has, on the one hand, a centralised system for income management (all payments are made into the University's bank account) and, on the other hand, a decentralised system for expenditure management (once the amount has been received, it is deposited in a "sub account" of the course and it is the person in charge of the course who has to decide how much each teacher is to be paid, what should be bought, etc.). This allows the University to control the amounts of money that move through the various University accounts and, at the same time, it allows for more flexibility when it comes to using these resources, as the cost issue is delegated to the people in charge of the course.

2.3 Value Chain

In what follows, a description of the value chains (what is to be done in order to give value to our product, i.e. a Course) for the different types of educational products that are offered is proposed, that is to say, what actions should be carried out to offer our product:

- *Presential (face-to-face)* courses offer: this type of product covers functions such as Demand Analysis, Design, Marketing, the management of enrollment/registration, fees, and costs (administration and secretary's office), teaching, Quality Control and After-Sales Services (see Fig. 6).

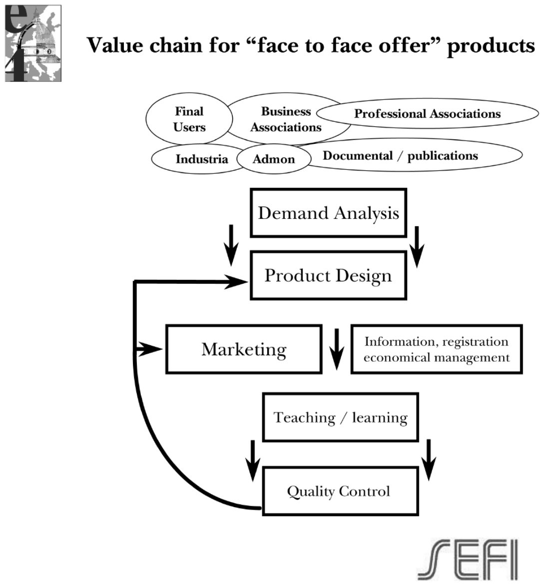


Fig. 6. Face to face offered courses

- *Face-to-face* courses on demand, which do not normally involve Marketing activities (the customer contacts us to ask for a specific course). However, there are additional actions such as negotiation that need to be carried out and there may even be actions such as cost justification and evaluation needed (see Fig. 7).

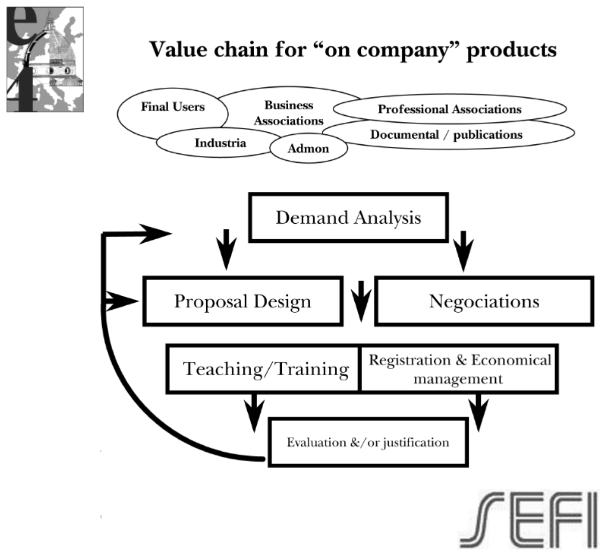


Fig. 7. In company courses

- *Distance learning* courses: in these types of products the production of materials and the teaching method are substantially different, as well as the relationship with the customer (see Fig. 8).

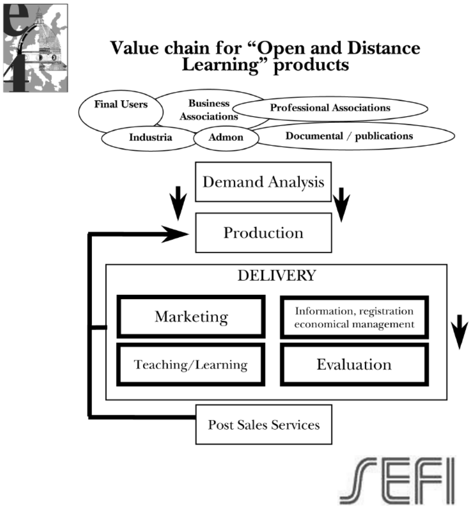


Fig. 8. ODL courses

2.4 Ways of carrying out these actions

Once having described the actions that are to be carried out, they can be classified in the following way:

- *Centralised or Distributed Action*: when someone wants to attend one of our courses, which series of actions should this person have to carry out with us (or is there at least a majority who want us to carry out this action)?
- *Internal or External Action*: this is to say, will this action be undertaken by ourselves in our Centre? Or, if we are asked to carry out a certain action, will we subcontract it or ask another organisation to carry it out?

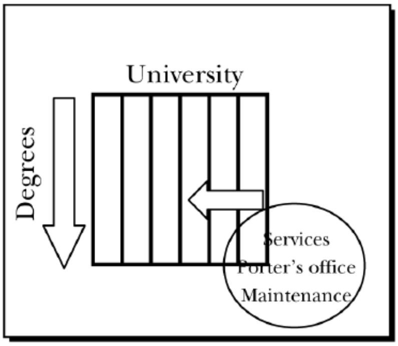
By way of example, we can point out that the Postgraduate Training Centre uses a centralized marketing strategy (we manage most of the publicity for the courses that take place at our University) but the execution of this strategic action is external. This system allows us to exploit economies of scale and to maintain the University's corporative image.

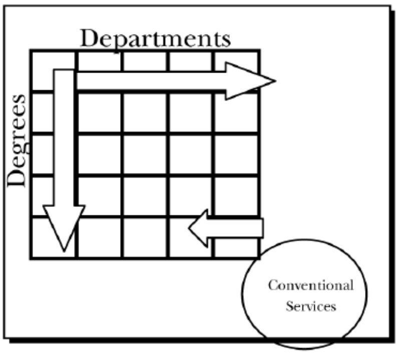
2.5 An inventory

We asked representatives from CEE providers to identify themselves in the graphics. (see the images). Then we could see that:

- There is a wide variety of possibilities. Looking at the results, we have not found an optimum model. Each model is good depending on the environment. What it is important is to know the different ways of managing Continuing Education, in order to choose the best one for your case.
- Nobody considers that they are in Universities with the power mostly in the Schools (Model 1). The average is between Model 2 and 3. This makes us think that we have explained the models in the wrong way, showing that Model 3 was the model of the future and the best option.
- Most of them are internal to the University. That shows that the Universities think that they can develop CEE inside the University, without help from one foundation or external unit. But the last few years we have seen a increment of external units to bring more flexibility to CEE.
- Most of them have a centralised income and expenditure system, although there is also a big group with expenditure distributed and centralised income.

University Organization





Blekinge Institute of Technology
Dept. of Mechanical Engineering
Sjödahl Stefan
SWEDEN

Helsinki University of Technology
Department of Architecture
Weck Tor-Ulf
FINLAND

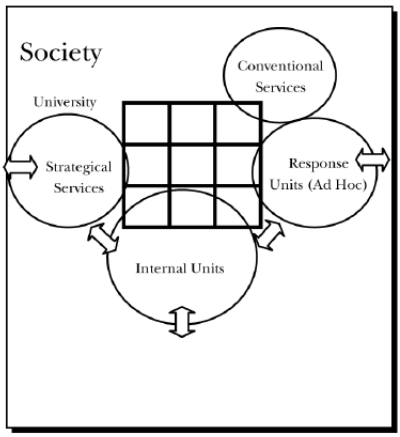
Wroclaw University of Technology
Malvszynski Wojciech
POLAND

Vestfold College
Department of Science a. Engineering
Gråthen Knut
NORWAY

Techn. University of Civil Engineering Bucharest
Manoliu Iacint/ Radosz Andrzej
ROMANIA

Vienna University of Technology Univ. Extension Centre
Steiner Andreas
AUSTRIA

Imperial College of Science Technology and Medicin
Centre of Continuing Education
Jones Mervyn
UNITED KINGDOM



Budapest University of Technology and Economics
Institute of Continuing Engineering Education
Sárközinè Zágoni Zsuzsanna/Ginsztler Janos
HUNGARY

Queen Mary, University of London
Mick Brennan
UK

Ecole Nationale Supérieure de Télécommuncations
Riesen Alain
FRANCE

Swiss Federal Institute of Technology Zurich
Hagström Anders
SWITZERLAND

Uppsala University
Lundkvist Leif
SWEDEN

Tallinn Technical University
Centre of Continuing Education
Olander Marika / Kiili Jaanus / Papstel Jyri
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Technical Foundation of Catalonia
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FINLAND

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FINLAND

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FINLAND

Mitthögskolan
Olofsson Stefan
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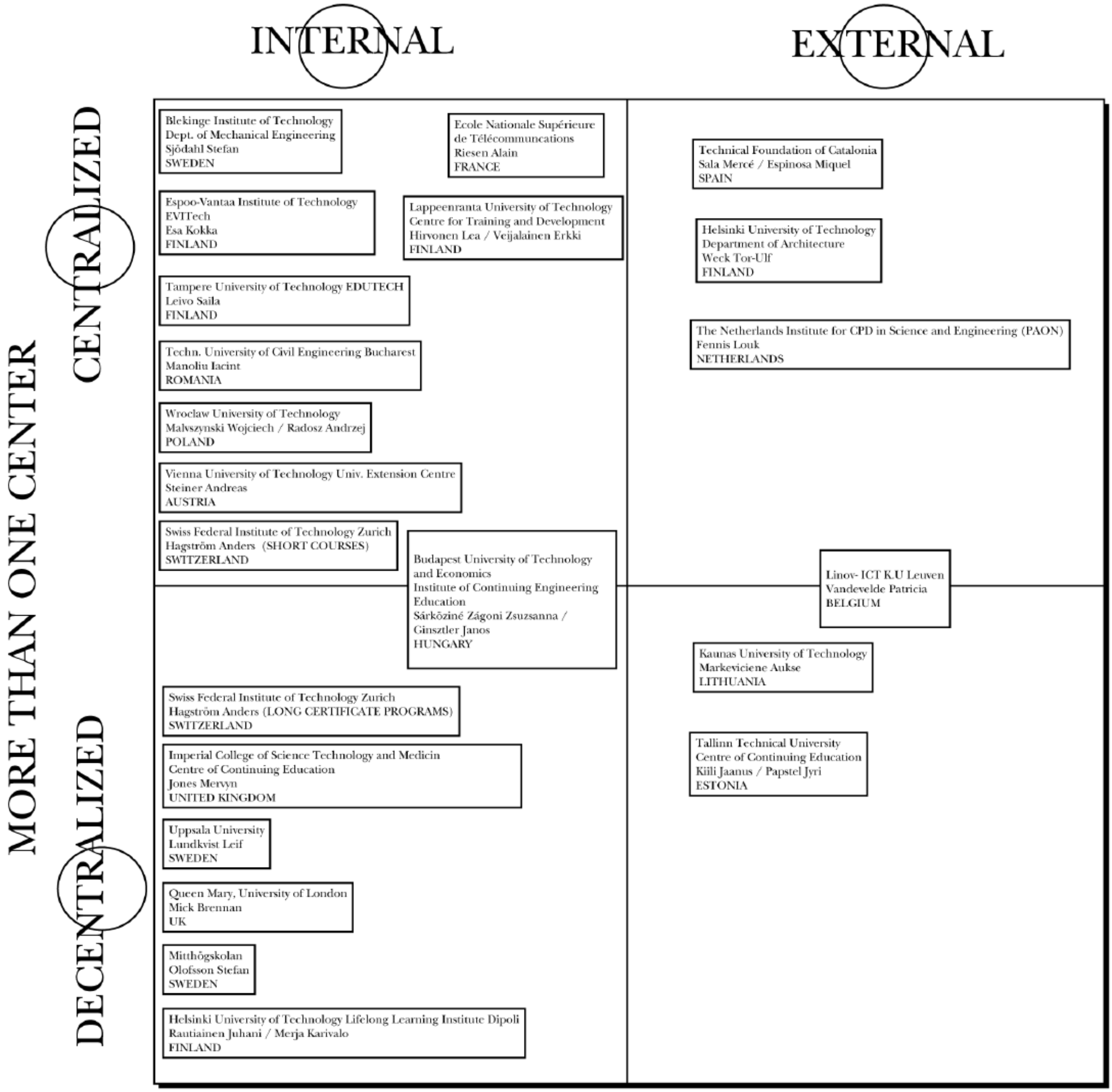
C E Organizations

LOCATION



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Income/expenditure Management

INCOME MANAGEMENT

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C	Blekinge Institute of Technology Dept. of Mechanical Engineering Sjödahl Stefan SWEDEN The Netherlands Institute for CPD in Science and Engineering (PAON) Fennis Louk NETHERLANDS Ecole Nationale Supérieure de Télécommuncations Riesen Alain FRANCE Tallinn Technical University Centre of Continuing Education Kiili Jaanus / Papstel Jyri ESTONIA Helsinki University of Technology Lifelong Learning Institute Dipoli Rautiainen Juhani / Merja Karivalo FINLAND Lappeenranta University of Technology Centre for Training and Development Hirvonen Lea / Veijalainen Erkki FINLAND Mitthögskolan Olofsson Stefan SWEDEN Wroclaw University of Technology Malvszynski Wojciech / Radosz Andrzej POLAND Technical Foundation of Catalonia Sala Mercé / Espinosa Miquel SPAIN (90%) Techn. University of Civil Engineering Bucharest Manoliu Iacint ROMANIA Helsinki University of Technology Department of Architecture Weck Tor-Ulf FINLAND Tampere University of Technology EDUTECH Leivo Saila FINLAND Uppsala University Lundkvist Leif SWEDEN Tallinn Technical University Centre of Continuing Education Kiili Jaanus ESTONIA Budapest University of Technology and Economics Institute of Continuing Engineering Education Sárkôziné Zágoni Zsuzsanna/Ginsztler Janos HUNGARY Swiss Federal Institute of Technology Zurich Hagström Anders SWITZERLAND	
D	Budapest University of Technology and Economics Institute of Continuing Engineering Education Sárkôziné Zágoni Zsuzsanna/Ginsztler Janos HUNGARY Swiss Federal Institute of Technology Zurich Hagström Anders SWITZERLAND Tampere University of Technology EDUTECH Leivo Saila FINLAND Uppsala University Lundkvist Leif SWEDEN Tallinn Technical University Centre of Continuing Education Kiili Jaanus / Papstel Jyri (30%) ESTONIA Helsinki University of Technology Department of Architecture Weck Tor-Ulf FINLAND Imperial College of Science Technology and Medicin Centre of Continuing Education Jones Mervyn UNITED KINGDOM Vienna University of Technology Univ. Extension Centre Steiner Andreas AUSTRIA Espoo-Vantaa Institute of Technology EVITech Esa Kokka FINLAND	Technical Foundation of Catalonia Sala Mercé / Espinosa Miquel SPAIN (10%) Queen Mary, University of London Mick Brennan UK Tallinn Technical University Centre of Continuing Education Papstel Jyri (70%) ESTONIA Vestfold College Department of Science a. Engineering Gråthen Knut NORWAY Kaunas University of Technology Markeviciene Aukse LITHUANIA

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3. Core Report 2: Recommendations on Continuing Engineering Education Management

3.1 Methodology: Benchmarking

How can you collect best practices and recommendations from a group of 50 participants in three hours?

The technique of *benchmarking* allows the development of innovative ideas through a series of successive comparisons and permits one to take advantage of the synergy generated through teamwork. In fact, this technique is a tool for expert learning. Non formal learning takes place in several ways, but expert interaction is a fundamental road to "make experts learn". This methodology, developed by the ***Cambridge Programme for Industry*** in 1996 (www.cpi.cam.ac.uk), has helped A3 to fit our objectives.

Benchmarking group dynamics has two implicit phases:

- Comparative Phase: problems which people have in common are proposed and each participant explains how they would resolve the problem. This phase functions to place the participant in a specific context and,
- Creative Phase: at this point, a participant is capable of generating new ideas on the basis of the results of the previous phase.

Benchmarking is, therefore, a management tool of great utility which makes possible the incorporation of innovations in products as well as in processes, facilitating the putting into practice of innovations by following the recommendations of those who know specific techniques, understanding this to be "best practice". This means, therefore, a learning process from the best in the studied area. Nevertheless, one should not undervalue the contributions of others, who although they are not so expert in the matters in question, because the "oriented brainstorming" can contribute nuances and details which may turn out to be enriching and complementary. Sometimes desiderata of "what I should do" can help others to better understand "what they are doing".

3.2 Themes discussed

For choosing Benchmarking themes, we decided to cover parts of the CEE value chains (the main peripherical aspects to do to get a good course): two for the "face to face" offered product (Demand Analysis, Product design) and one general for all the cases (Marketing). We also produced a benchmark dealing with an activity demanded by the group: Sharing ODL Materials.

If you want more information about the process or the exact and complete results, you can obtain them in www.cfp.upv.es/e4

3.3 Recommendations on "Demand Analysis"

In the group it was decided that the things to do to obtain information about what courses we should give are:

3.3.1 Understanding business processes and strategy of your customers

Most of the members of the group deliver courses to companies. Therefore understanding what they do and what they want to achieve is a good beginning for a demand analysis. Going deeply, it would be a good idea if we:

- *Talk to your customers continuously*. We should build a permanent relationship with our good clients, by including them in advisory boards or inviting them to events, for example.
- *Collect information about the company*, by reading company literature, visiting its web sites, etc.
- *Know the whole value chain of your customer*, what the company knows which it is important for its business.
- *Network: use alumni's professional associations.* These associations have relationships with the university, so it is easier to contact them, and are potential customers of our products.
- *Employ people with business experience*. It is a way to reduce the gap between the University and the company market.

3.3.2 Get to know your customers

This point deals with the individuals that attend to courses. The results are similar to the previous point:

- *Personal contact (Face to face)*. In this case through interviews to representative individuals, or former students.
- *Organise events (conferences …)*. This is a good way to know if the people are interested in some themes.
- *Contact with professional Associations*. They usually represent groups of individuals and know them quite well.
- *Smart customer databases*. Designing them and collecting data can help us in the demand analysis.

3.3.3 Knowledge of technical trends

In the engineering fields, knowing the latest technological trends is essential. Therefore, if we could see what trends are going to be important for engineering, probably we would find a gap in the market, wherein we could develop our courses. To do so, we recommend:

- *Contact professional bodies*, again.
- *Prediction of the trends by scientists.* This is a source that can be found inside the University. Reading scientific journals or other sources can also help.
- *Create an expert group.* This means join different experts in one area to foresee trends. You can use Delphos methods; for instance, ask them for reports, mining, etc.
- *Localising the leading markets.* When the MIT bet for the Information Systems, it became a milestone for this market.

3.3.4 What the competitors do not deliver

This is the last part of "See what all the others see, think what little think and do what nobody does". Finding a market gap is good, as long as there is a market (customers in this gap). Always try to find out why the others do not deliver it. Some good ideas:

- *Analyse the information: advertising, course programs, webs, etc.*
- *Ask the customer.* This part can be done in the first and second point of these recommendations (customers).
- *Look at the international market.* Sometimes there are successful products in other countries that nobody in ours has implemented. But always remember the differences between the markets in different countries.
- *Use your imagination. Look at the future.* If you are looking for something new, sometimes you have to take the risk and invent it.
- *Talk to researchers or experts of the field,* as commented above.

3.3.5 Competences to be developed

That means that, a way to do a demand analysis is using competences. To do so:

- *Curriculum negotiations,* with the target groups.
- *Identify the goals of the company and derive the competence goals.* The employees must be prepared enough to help the company to reach their aims. A good idea would be to interview your clients' customers.
- *Recruit or mobilise experts.* Again,
- *Use a defined methodology to define competences.* There are experts who have development maps for competences. Do not re-invent the wheel, just use it.
- *Identify prerequisite knowledge (background).* To achieve some competences sometimes you need previous competences.

3.4 Recommendations on "Product Design"

It was decided in the group of experts, that to do a good design of a group, you should do the following:

3.4.1 Precisely identify the competence needs of the client

This means, in short, to do a good demand analysis (benchmarking done before). The ideas in this point were quite similar to the benchmarking in demand analysis: *understand your client's business* (for example, by finding the right people in the companies for interviews), interviews with *professional bodies*, and *test your clients' knowledge.*

3.4.2 Choose an adequate price

For doing this, you should:

- *Calculate costs (expenses),* including the publicity, the materials, and one important thing: find out how much do the professors want to earn as a minimum.
- *See competitors' price,* because our clients will use the price as a factor (among others) for choosing one course or another. Price and hours are usually the most objective points of comparison for clients.
- *Study the quality the customers expect,* as quality and price must go together. Nobody is going to pay a lot for a course that does not provide high quality teaching.
- *Explain what they will get for this price.* We should be able to explain clearly why our customer is to pay the price of the course, in order to convince them of how right the price is.
- *Study possible discounts.* Customers are quite keen on discounts.
- *Decide if we are doing it as a business or a service.* Universities have other priorities apart from having benefits. Sometimes it is better to lose money but to do something that benefits the society.

3.4.3 Define right content

In this case:

- *Know the level and expectations of the client.* Always take into mind the public at whom you are aiming in this course.
- *Capitalise on previous experiences.* Try not to re-invent something you have already done.
- *Structure in the content (how to present).* It is important that all the contents of the course have a logical appearance and they are coherent.
- *Pilot projects.* If you have the opportunity, try your product with a small group before going to bigger groups.
- *Define needs and goals.* Take in account the pre-requisites of the course and define what the student will achieve after the course.

- *To know the state of the art in the field (including comparison with other competitors).* Probably there are similar products with success, look at them.
- *To know your own competencies in the subject.* If you are from a technical university, probably there is no point in designing courses to teach law. Do not deceive your customers with false expectations from the beginning.

3.4.4 Staff competence

It is important that in your centre the people who are designing the course should be competent enough. To do so:

- *Social competence/communication skills.* Your staff should be prepared in "soft skills".
- *Didactics/pedagogical competence.* The people who are designing the course should have this competence, at least some of them.
- *ICT competence.* Your staff must be aware of the new technologies that can be used.
- To obtain these competences, you can *develop a competence network*, a *system to measure the competences*, and prepare *training* (or prepare interchanges with other centres to see how do the work). But these tasks are part of the Human Resources people.

3.5 Recommendations on "Marketing"

In this case, what the group decided was most important was:

3.5.1 Know the market

It is important to know the customers with whom you want to create a relationship. It is not the same to prepare marketing for CEOs as it is to prepare it for individuals that have just left the University and want to find their first job. To do that:

- Use techniques of *Business Intelligence* (using your professional experience).
- *Define what information you want to get – is it already done?* Sometimes you can find information already prepared to know the market.
- *Find market niches.* This was commented in the Recommendations on "Demand Analysis".
- *Control the success of programs*, not only yours, but from competitors to see how good you are or if you need more improvement.
- *Making interviews (interview team)*, as it was commented in the Demand Analysis.

3.5.2 Obtain a good quality in the content of the course

and if it is so, try to get it certified somehow:

- *Use certification to prove the good quality of the contents.* Use examples as the project Abet of quality insurance. If the certification can be European, then that is better than regional. Try it to make it external to your institution.

- *Improve the quality of the providers:* managers or professors. You can use circles of continuing improvement and motivate the individuals with rewards (salary increments, for example). Try to put together managers, teachers and students to improve quality.
- *Take care about the infrastructure of the delivery.* Do not forget any part of the value chain of the product.

3.5.3 Increase society-university interaction

The relationship between university (provider) and society (consumers) is part of the marketing. To do that you can:

- *Organise open door days.* You can prepare events for specific target groups in collaboration with an association representing the target group.
- *Student projects can serve the society.* This can be done if this projects are done in collaboration from companies, and helping them to get a prototype from an idea the students have.
- *Advertise the University.* You can make the services of your University better known. The brand of the university must be one strength for our marketing strategies.
- *Make the university an access point of international networks,* that will benefit the region.
- *Organise university-companies partnerships,* so as to solve some specific problems in the society, and let the society know it.

3.5.4 Networking and co-operating with other providers

Creating and studying *alliances and projects* with institutions, be them national o international. In these networks you can *share knowledge*, examples of different ways of working, *formative tools* and you can also *compare* yourself with other institutions.

3.6 Recommendations on "Sharing ODL Materials"

ODL has high costs of production, but after that, the distance is less important. But can you spread these materials all over the world? From our experience, there are some points (language, the need to do some "face to face" activities, culture) that recommend you to work with a local institution sharing materials. Here you can obtain some aspects to take into account:

3.6.1 Adaptation of the materials

in the following aspects:

- *Linguistic aspect.* If you have in mind to share, you better use a carrying language, such as English. The idea is to produce in your language and also in English, so that the other institution can use the English version or try to translate it. If they want to translate it, there is a need not only to know the language by the translators, but also for the subjects to be in their domain.

- *Cultural aspect.* There can be a difference in the technologies between the countries, so you should identify which parts are common and which should be reviewed. For example, management training needs always an adaptation. Anyway this cross-cultural course is also enrichment for the student.

3.6.2 Clear protocol/contract

All the things not stated from the beginning can become a problem that can spoil the relationship and confidence between institutions. If the responsibilities are clear from the beginning, the institution can decide to participate or not easily. To do so:

- *Define and use some models* of collaborations, with standard contracts.
- *Talk about all the aspects and the responsibilities in the contract.* Who is going to receive the money from clients, how much is each institution to earn (fixed amount, depending on quantity of students, ...), which institution provides tutors, ...
- *Mutual trust between institutions.* This will facilitate all the tasks.

3.6.3 Modular design & top-down design

If you are going to share materials, prepare them to be chopped into different parts. If you have not yet produced the materials (if so, they will need adaptations), agree with the other institutions in:

- *Didactics, learning styles.* This can be done through meetings between the institutions. This information must arrive to the tutors of the course.
- *Use pilot project in small groups.* After the project get feedback from students and tutors.
- *Keep modules simple,* defining pre-requisites and aims of each module.
- *Be flexible.* To arrive to an agreement, both institutions must be flexible enough.

3.6.3 Other important aspects

must be taken into account:

- *Create a map of institutions you can collaborate with,* and contact them.
- *In all the ODL courses, the human interaction is quite important,* do not forget it.
- *Give clear instructions to students about how to follow the course.* These instructions should come from an agreement between institutions.
- *Remember the technologies,* as video (live recorded) examples, simulations and remote access to some (expensive) equipment.

3.7 Recommendations resume

Value Chain step. For …	Recommendations
Demand Analysis	✓ Understanding business processes and strategy of your customers ✓ Get to know your customers ✓ Knowledge of technical trends ✓ What the competitors do not deliver ✓ Identify competences to be developed
Product Design	✓ Precisely identify the competence needs of the client ✓ Choose an adequate price ✓ Define right content for courses ✓ Staff competences in the CEE Centre
Marketing	✓ Know the market ✓ Obtain a good quality in the content of the course ✓ Increase society-university interaction ✓ Networking and co-operating with other providers
Sharing ODL Materials	✓ Adaptation of the materials (linguistic and cultural aspects) ✓ Define a clear protocol / contract ✓ Modular design & top-down design ✓ Create a map of institutions you can collaborate with, and contact them ✓ Give clear instructions to students about how to follow the course ✓ In all the ODL course, the human interaction is quite important

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You can find more information about the themes of this document in:

Conference Papers

Montesinos P., López M., Romero R., (2002) "Life-Long Learning Management Models". Procs. SEFI Annual conference, Firenze 2002, "The Renaissance Engineer of Tomorrow", SEFIrenze 2002, ISBN 88-8304-481-9.

Monforte C., Vierlinger U. (2002) "The Role of the Facilitator in eLearning ". Procs. SEFI Annual conference, Firenze 2002, "The Renaissance Engineer of Tomorrow", SEFIrenze 2002, ISBN 88-8304-481-9.

Webs

www.cfè.upv.es/e4 *There you can find deep information about the three Seminars mentioned. There are other partial webs for each Seminar, but here you can find all the information together.*

www.ing.unifi.it/tne4, *where you can find general information about the e4 project in general.*

Articles

Montesinos P., Hagström A. (2002) "The annual Working Group Seminar: a kind of group therapy" SEFI News, ISSN 1024-445X.

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E4 – A3 Activity Report 2000/2001.

E4 – A3 Activity Report 2002/2003.

Annex I

Activity 3 Active Participants

Name	Institution/country
Arder, Raimo	Bauhaus University Weimar, Germany
Bricola, Valeria	SEFI, Belgium
Côme, Françoise	SEFI, Belgium
Girinin, Olivier	BNEI, France
Grathen, Knut	Vestfold University College, Norway
Hagström, Anders	Swiss Federal Institute of Technology, Zurich, Switzerland
Kaiser, Hans	Vienna University of Technology, Austria
Kaps, Tiit	Tallin Technical University, Estonia
Karhu, Markku	Espoo Vantaa Institute of Technology, Finland
Koskinen, Tapio	Helsinki University of Technology, Dipoli
Lallement, Regis	BNEI, France
Lauritsalo, Laura	Helsinki University of Technology, Finland
Manoliou, Iacint	Technical University of Civil Engineering Bucharest
Markkula Markku	Helsinki University of Technology, Finland
Monforte Carmen	Universidad Politecnica de Valencia, Spain
Montesinos, Patricio	**Universidad Politecnica de Valencia, Spain**
Moreau, Claude	University of Technology of Compiègne, France
Nevares, Ignacio	Universidad de Vailladolid
Pursula, Matti	Helsinki University of Technology, Finland
Radosz, Andrzej	Wroclaw University of Technology, Poland
Rautiainen, Juhani	Helsinki University of Technology – Lifelong Learning Institute Dipoli, Finland
Reichl, Franz	Vienna University of Technology, Austria
Romero, Roberto	**Universidad Politecnica de Valencia, Spain**
Soeiro, Alfredo	Faculdade de Engenharia da Universidade do Porto
Toth, Agnes	Budapest Polytechnic, Hungary
Valiulis, Algirdas	Vilnius Gediminas Technical University, Lithuania
Van Ham, Ronald R.	BEST, France
Weck Tor-Ulf	Helsinki University of Technology – Dpt of Architecture, Finland

Part II

Activity 4
Enhancing the European Dimension

Jean-Pierre Charlot, Radu Chisleag, Brian Mulhall

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4. Introduction

4.1 Background

Internationalisation was proposed as a specific action area for E4, to encompass a number of aspects through which higher engineering education changes from being a process embedded in, and oriented to, national cultures to one which is intrinsically wider. This widening would be initially at the European level although, with the rapidly growing globalisation of industry, it is clear that this is already too narrow a view. For many years education has been nationally oriented, even in those countries which have traditionally accepted a large number of students from abroad (often from countries with historically strong cultural and economic links to the host, as is the case in the UK). Yet one aim of the European Union is to create a single economic area in which goods, services, capital and labour can all move freely, so maximising the potential for economic prosperity.

As far as the Thematic Network E4 is concerned the questions of interest relate to how the education of Professional Engineers can be modified to further the aims of the European Union. As an aside it should be noted that Professional Engineers – those engineers who are the product of a process of higher education at a University, Technical University or equivalent institution – are not the only members of the labour force who could be considered. Nevertheless, it is only these who are specifically in mind for the purposes of the present study, even though many of the remarks and conclusions are of wider relevance.

There are clearly some constraints on the mobility of labour which are legal and institutionalised within the national political structures, and others which are cultural. At the legal and political level are regulations, which vary widely between countries (and can even vary within countries – for example, registration in one province in Canada does not automatically give the right to practice in other provinces). This aspect is considered under Action 2 of the current Thematic Network, following on the work of its predecessor, H3E.

The cultural constraints can be found acting on both the employers and the employee. This led to the idea that enquiries should be made into both these areas. On the one side, the question should be asked, what really dissuades or inhibits employers from taking on engineers from abroad? On the other side, there are the questions about what discourages graduates from seeking employment abroad, and what components of their education should be developed or modified to make them more outward looking. A more restricted view of this matter is that graduates should have the cultural awareness and tolerance to be able to work with their colleagues in other countries, even when they are based, and normally active, only in their own country; this aspect is not considered separately, for it subsumed in the wider view taken in the current work.

4.2 Methodology

A number of the partners in E4 expressed interest in Action 4, and several lively and stimulating discussions were held. On several occasions it was proposed that surveys should be carried out; on further consideration it was concluded that the recipients of any questionnaire are already subject to so many surveys that a representative set of replies would not have been received, and E4 just did not have the resources to carry out a more reliable study. Nevertheless, the active membership all have considerable experience of the topics discussed, so the summaries reported here are believed to have validity.

In addition, the views of students were sought directly in two ways. In the first a questionnaire was sent to both current students and graduates of ISTIA, an Engineering Institute of the Université d'Angers, France. It invited students to summarise, in not more than 1 page, why they thought a period of work or study abroad was necessary; the course at ISTIA requires students to spend a period abroad, and virtually all the respondents had done this already. Some of the replies were from graduates of several years standing, who were well into their careers. In most cases the period abroad had been for industrial experience, or to undertake a project (in some cases this had been a JEEP team project within the earlier Thematic Network, H3E, as discussed below). From the form of question and the group surveyed positive views were, perhaps, to be expected, but the uniformity of the points made, albeit expressed in very different ways, is both noteworthy and gives the survey value. In addition, a few negative points were made, again strengthening the overall value of the survey.

The second survey was a residential symposium, organised by BEST at the Technical University of Crete, in Chania. This involved 22 students from 9 European countries. They differed from the Angers group in that most were either on exchange programmes for study, or had participated in such programmes. The aim of the meeting was to identify student expectations of exchanges, to discover how far they were realised and, if not, to consider the difficulties encountered. In a first, brain-storming, session a list of expectations was generated. This was discussed in a subsequent session, and then ranked by means of a secret ballot. After ranking the expectations the discussion moved on to how far they were realised. By means of a similar process to the above the problems were also identified, and then ranked in order of perceived importance. The results are discussed below, but it was interesting to note how little difference there was in the dominant aims and expectations between between those going abroad to study and those going for work experience.

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5. The Real Needs of Industry

5.1 Employers

It had been intended to study the barriers to mobility within the labour market but, as indicated above, further discussion led to the conclusion that to conduct an effective survey, to which a representative response could have been ensured, was beyond our resources. It also seemed to us that the rapid changes already taking place had probably already overtaken the planned study. The following brief summary of the situation is based on the views of several E4 participants who have experience of dealing with industry, mainly in order to find places for students on work experience.

Certainly barriers to mobility do exist on the side of employers, some of whom are unwilling to recruit from outside their own state and educational system, and others of whom may be restricted in recruiting because of legal constraints (this is particularly the case in the construction industry). Even here practice varies widely – some countries, such as Norway, have a strong tradition of young people going abroad (especially, but not exclusively, to the UK or the USA) for their education, while other countries, such as the UK, are fairly open to engineers educated abroad. However, being outward-looking and thinking on a trans-national scale is, nowadays, essential for the prosperity of all but the smallest and most domestically oriented industries, and these attitudes engender a receptiveness to employing engineers from other countries, or those who have been educated abroad. One problem is that of understanding precisely what competencies and capabilities are implied by a particular qualification. In this respect the work of A2 aims to simplify the task for the employer – ideally to the point where there is no more uncertainty over the foreign qualifications than there is between different universities in the home country. It should be remarked that the growing use of the Bachelor and Master title is, initially at least, increasing the uncertainty, for the new names are often used to label stages in educational structures in which little has fundamentally changed. Nevertheless, it appears that employers are good at selecting suitable staff and are quick to learn the significance of a particular qualification. A stronger reason for rejecting an applicant of foreign nationality (especially if educated abroad, but also if educated in the host country, and in contrast to a home student educated in the home country, or even a home student educated abroad) is often the feeling that (s)he will not be prepared to stay long enough to justify the costs of relocation and training. It also seems that companies large enough to have a dedicated Personnel Department are more likely to cast their recruiting net wide than are small companies, which are often much more local in their attitudes and in their catchment area.

5.2 Employees

A second set of barriers can arise on the part of employees, who may be unwilling to work for any extended period outside their home country. However, there appears be an increasing number of young engineers doing precisely this. We have not studied the interplay between the curriculum (of which exchange programmes form a component) and subsequent attitudes to mobility – suffice it to observe that the main reasons given by students for participating in academic exchange programmes (under SOCRATES/ERASMUS) were, firstly, to become fluent in another language, secondly, to experience and become part of a "European" culture and, thirdly, to prove oneself in the ability to live and work abroad. Thus, it seems that the current generation of young people is already accepting the concept of looking at Europe as a single area in which to seek employment. Our conclusion is that for the engineering profession a single European labour market is already and clearly developing. In our view it is of paramount importance to develop and promote exchange programmes – which can, of course, take many forms – even though these are inevitably expensive, for it is through these that students acquire precisely the skills and attitudes they will need in a European-wide labour market.

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6. Internationalisation in Universities

6.1 Introduction

Nowadays "Internationalisation" often Figures quite prominently in the policy statements of Universities, and goes on to form an element of their promotional and marketing literature. It is an aspect which is seen as important by students. Internationalisation can impact upon staff and students in many ways. The categories of subject of internationalisation might be:

(1) Home students, at their home universities.
(2) Students (whether on exchange, or whether taking the full course abroad) at the host university.
(3) Host universities, at an official level, with respect to the guest students.
(4) Academic staff at host universities, and their attitudes to (2) and (3).
(5) Perhaps it would also be of interest to include attitudes of academic staff to (1) – here there are marked national differences, both in the overall attitude to students and in attitude to student-oriented international activity!

Within E4 the only formal studies have been of the attitudes of students to internationalisation, although from these it has been possible to make some useful remarks on aspects such as the motivation of staff and the policies of universities. The studies have been the two described above, under Methodology. In both cases the students themselves identified their own motivations for seeking experience abroad, and the relative importance of these.

6.2 Work Experience (Angers)

Of the 32 students who responded to the Angers survey most mentioned (1) becoming fluent in another language (or languages) as their main motivation, followed closely by (2) gaining familiarity with and understanding of another culture and (3) learning to adapt to and to become tolerant of another culture. Each was mentioned by over 90% of respondents. Other reasons, appearing in half or fewer responses, were (4) the development of personal qualities, such as self-reliance, independence and adaptability, (5) improved prospects of employability, through having a more interesting CV and (6) gaining technical skills, knowledge of industrial processes and an understanding of industrial life. Indeed, the last two points were made in only about 25% of replies. As mentioned above, the great majority of these students had been engaged in technical work abroad, either gaining experience in industry, or undertaking a project in a more academic environment.

6.3 Study Exchanges (BEST – Chania)

The Chania group of students represented a somewhat wider cross-section, in being from more countries and from several different universities. Their experience abroad was mainly for study, to complement or to enhance the courses at their home universities. As a result of the ranking process the dominant motivation for going abroad was found to be (1) to become more open-minded, or to enlarge ones perspective, followed by (2) becoming part of a "European" thinking culture and then (3) learning a new language. The apparent differences in importance between the various aspects were not so marked as in the Angers study – perhaps as a result of the different methodology – but other points made were (4) to experience a different approach to the topics studied, or to come into contact with a "new" way of teaching, (5) to gain access to other courses, not existing at home, and (6) to prove oneself, and ones capacity to adapt to new environments. Other points were made, but were ranked as of less importance.

In comparing the two sets of responses it appears that the cultural benefits of being abroad are seen as the most important. The students who went into industry saw this as the local culture, whereas those in a university environment were more conscious of an international, or European culture. Language is also seen as important, the more so by those who would have had more exposure to everyday language. The academic or technical experience to be gained is seen as less important; in part this must depend on the which the home and host countries are, for in many cases the academic or technical opportunities will vary little from one country in Europe to another. What was also agreed by all was that being abroad physically was important, for even those most oriented to and familiar with the internet could not see virtual experience being a satisfactory way of gaining cultural and linguistic experience to the depth desired.

6.4 Elements of Good Practice

If going abroad is accepted as being the most important component of internationalisation in the university curriculum, then "good practice" can be measured by the extent to which it is facilitated. From the students' perspective the dominant problem was (not surprisingly) (1) financial, followed by (2) encountering excessive bureaucracy, (3) studying in a foreign language, (4) feeling too restricted in choice of opportunities and (5) having inadequate preparation for the change in cultural environment.

Most students (or their parents or family!) take responsibility for financing their own studies, with any subsidy for studies abroad being provided by the home state or university. Even ERASMUS funding is administered through the national office of the home country and the home university. Good practice for the home university centres on making the procedures for obtaining funding clear and straightforward; sadly, increasing the funds to meet student wishes is rarely an option, although schemes to obtain additional support from industry or local organisations can only be welcomed. The host university should make available accurate and up-to-date information on all costs the visitor has to anticipate (some of which may be quite unexpected, in view of the variety of levels of social provision in different countries. Ideally the host should make available accommodation and, indeed, most of those participating formally in exchange programmes seem to reserve a number of rooms at a controlled rent for visiting students.

Bureaucracy affects exchanges in many ways. If considered together with the question of preparation for the different study-culture abroad there are two broad aspects. One is the fact that the procedures[3], customs and ways of doing things are just different in different countries, and learning to adapt is part of the experience and the benefit. Nevertheless, there needs to be a mechanism, whether provided by academic staff, administrative staff or other students, to prepare the student before exchange and to help as needed. Such help is needed at both the home and the host universities. In the symposium students regarded widening the choice of opportunities as desirable, although from the university viewpoint support is more easily managed as the number of exchange partners becomes less.

Within cultural preparation must be mentioned language. There can be few universities at which language courses – even if only self-study for the less widely spoken languages – are not available. Students are clearly aware of the need for preparation before studying in a foreign language; what is less clear is how effective the preparation actually is. At the very least it has to be recognised that there may be a problem, for which an allowance has to be made, by granting an extended study time, by accepting a lower examination performance, or by some other means.

A solution to the language problem is to offer courses given in a more widely-spoken language. This language is often English, but courses given in French or German are also available, as described below. Where such courses are available to the home students the internationalising influences affect all the students, both those from the home countries and the visitors. The experience of those universities – and they are few in number, the University Politehnica Bucarest being one example – where this happens appears to be good, although the topic arose too late for any further study to have been made within E4.

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[3] Examples include:
(1) the format of examinations – are they written or oral?
(2) the timing of examinations – is there only one session of examinations, or is there more than one occasion on which a particular examination can be taken?
(3) duration of examinations – is the time allowed so short that it puts students under pressure?
(4) is reference material allowed in the examination room?
(5) does failure to register well in advance of the examination date, or failure to present oneself for the examination after having registered, constitute failure?
(6) the level of support available from the academic staff – for example, provision of written notes, formal tutorial classes, etc.

A second question relates to the bureaucracy of transferring credits. In principle this should be made straightforward by means of the European Credit Transfer System (ECTS). In practice matters are not so simple. The host university should have little difficulty, for all that is required is that full information on the guest student's performance be supplied and, at the minimum level, this is just the information provided to home students (subject taken, course hours and content, mark or grade obtained etc.). Good practice requires that the information be converted to ECTS format. Where problems arise is in the home university, because ECTS is generally not, of itself, sufficient to allow automatic transfer of credit. This is discussed later in this report. Suffice it to say that, for the student about to embark on an exchange programme, good practice demands that the home university makes clear, in advance, what studies (course modules) will be accepted for credit and how the credit will be awarded. Since the decisions on such matters are often made by one member of academic staff (even in cases where a committee is formally responsible, its decision is usually based on the recommendation of one or two individuals) the smooth-running comes down to academic staff who will invest the extra effort needed to understand what their colleagues abroad are doing. Annex II is a description of ECTS, prepared by members of E4 in the course of the present work.

6.5 Concluding Summary

In summary, the most important and significant component of internationalisation in the curriculum offered by a university is the opportunities it affords for students to gain experience abroad, whether these opportunities are for study or for working in industry. For such programmes to function effectively and smoothly requires committed staff, both administrative and academic. Many universities provide the former, by setting up an International Office, even though these are often not lavishly staffed and funded. The weakness is often with the academic staff, for whom the international activity is seen as of low priority compared with carrying out research and obtaining funding for research; even when compared with normal teaching duties the effort of fostering exchange programmes is disproportionately high in relation to the formal recognition given.

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7. Project Teams

7.1 Background

The idea of forming international project teams of students was a major topic, the so-called JEEP teams, in the earlier Thematic Network, H3E, and has continued to be thought of as the most important part of the programme of Action 4 of E4. Undoubtedly project work is seen as important by all involved in Engineering Education. At the highest level of Degree, the doctorate, the award is usually based on original work (a research project) carried out largely, if not exclusively, by the candidate. At lower levels of Degree an important part of the overall assessment is a Final Project, with a minimum level of performance being demanded in it. Industry often places more weight on the major project as evidence of a candidate's interests and abilities as a practising engineer than they do on examination performance.

More recent developments are the recognition of the importance of teamwork – of which acceptance by universities, to the extent that team projects are now included in the curriculum in some courses, has lagged many years behind industry – and the realisation that industry and employers generally are becoming increasingly conscious of the need for internationally aware engineers. It should be remarked that this need for international awareness does not necessarily manifest itself as a willingness to employ foreign or foreign-educated staff. The JEEP Teams work combined these two aspects in a study and pilot projects to learn how to set up and manage a team of students from several countries working on a joint project.

Rather disappointingly, no project team was ever established under E4, but the experience of this, combined with the experience under H3E, and the fact that some universities responded to enquiries and claimed to be running this type of project work, allows the following guidelines to be drawn up.

7.2 Guidelines

7.2.1 Size and Composition of Teams

It was agreed that, whilst the absolute minimum for an international team project had to be two students from different countries, a far more desirable constitution would be four or five members, from at least three countries. Too large a team, with too great a number of institutions participating, becomes too difficult to manage.

7.2.2 Institutional Links

It is clear, from the work of H3E, from the difficulties experienced under E4 and from observing the rather small number of schemes which appear to be functioning successfully, that the participating institutions have to have strong links, which go beyond the immediate needs of the team projects. Institutions, in this context, can include participating industry, for this may well be an invaluable source of supplementary funding, or of motivation for the students. What clearly does not work well is an open call for students to join a project – this was tried under JEEP and H3E and, although teams were established, the administrative effort required was disproportionately large, and needed to be repeated for each new project. However much use could theoretically be made of the internet, it seems far better to restrict the formation of teams to students from closely collaborating groups of institutions, rather than to devise alternative administrative procedures aimed at recruitment from a wider field.

7.2.3 Level of Project

The general view is that international team projects should be run at the MSc level. This probably reflects the effort needed to organise this type of project, so it is better justified here rather than at lower academic levels. Other, more radical, ideas, such as the formation of teams combining students from several levels, were mentioned in discussion, but were not considered further.

7.2.4 Travel by Students

Nowadays a considerable amount of the project planning and design will be done using software tools. That the team members would be located in different places and different countries, communicating by email and other forms of telecommunication, merely reflects how many of them will be working after graduation. Nevertheless, it is important to generate the level of rapport that comes only from personal contact, so some funding for travel by students is essential. This was one problems encountered in the JEEP work, and which would be more manageable within a group of regularly collaborating universities.

7.2.5 Institutional Commitment

Organising any project demands time and effort from the academics involved. Yet more time and effort is needed where teams of students have to be set up and tutored. The need is even greater when external organisations and other countries are involved. Unless such projects are to be run infrequently, by exceptionally interested and committed staff, it is necessary to give staff proper recognition for their efforts; this will only be done if this type of project plays an important role in the policy and curriculum of the university. Other matters in which the commitment of the institution is important relate to the assessment and recognition of credits, and the alignment of academic timetables; without official support an inordinate amount of time and effort can be expended in smoothing out the problems which inevitably arise.

7.3 Conclusion

In the guidelines above there are two points which are also in the nature of problems. One is the question of student finance, the other is the question of staff and institutional commitment. It does now appear that, at least for projects at the level of MSc or higher, funding of student travel may be possible within the Framework 6 research programmes, at least insofar as the projects form part of the research programme. Moreover, under these circumstances both staff and university can justify the extra effort demanded by international student projects because they also contribute to what is currently seen as the most important role of universities, namely engaging in research.

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8. Register of Courses given in Foreign Languages

All the evidence and experience of the participants in Action 4 point to the value of spending a period of work or study abroad. This is primarily to gain cultural awareness and to develop personal independence, rather than merely to learn another language. Universities also have reasons for wanting to attract foreign students. In some cases the fees which can be charged are important to the finance of the university. More subtly, the foreign students increase the pool of talent from which selection takes place, or they may simply compensate for the decline in interest in engineering among young people found in some countries (for example, in Germany or the UK). In some cases there may be a wider national policy, of which the universities are one agent of implementation, to promote the country abroad. Whatever the background, those countries with less widely-known languages are clearly at a disadvantage, for most students will not want to invest the additional time and effort in becoming fluent in a language they see as of limited use.

The response of a number of universities to the foregoing has been to offer engineering courses taught in one of the more widely used languages – inevitably English is the most usual, but French and German are also offered. The courses can be as little as a few lectures, or may lead to a Degree. It is not the place here to discuss the effectiveness of such courses. There is work (Jochems, 1991) which has attempted to measure the effects of teaching and of learning in a second language, and there may well be a worthwhile topic here for future work. Nevertheless, even if it can be shown that working in a second (or other foreign) language impairs teaching or learning in a technical subject, there may still be significant benefit to the overall cultural experience.

The benefits of courses given in a foreign language will vary from one group of participating students to another. For the foreign students, who will be working either in their native language or in a second language which they are comfortable with, there is still a strong cultural experience. The culture experienced may be more international than local but, as has been shown, this is often what the students find acceptable; it may well be the best preparation for a career in the European or the global economy. It should also be mentioned that the way technical subjects are taught varies greatly from country to country, and this variation is unlikely to be affected much by the language of instruction. For example, to take a fairly extreme example, a French academic lecturing in English will still use a mathematical approach quite different from that of his British or American counterparts.

For the home students being taught in a foreign language there is the benefit of exposure to the same international culture as the visitors. There is also the increased likelihood that they will be able to participate in other exchange schemes. Finally, in many cases these courses will be supported by companies which operate internationally[4], so providing possibilities for cooperation on project work and access to international business practices.

[4] The companies may be foreign companies which have established subsidiaries in the host country, as in many Central or Eastern European countries, or they may be global companies operating from a relatively small home country and market.

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9. Conclusion

The picture that has emerged from the work of Action 4 is believed to be essentially the same as that which much more extensive studies would have produced.

On the one side, it seems that engineering students in most countries are already aware of the need to think internationally and wish to prepare themselves for a European or a globally based career. What they most want is the opportunity to acquire another language at a good level of fluency, coupled with familiarity with another culture. Moreover, this other culture is as likely to be a European, or even a global, culture as it is another national culture. Given that this is desirable – and it is, after all, both what the students themselves want and is what the development of a single European economic unit requires – then the role of universities should be to foster this through the international aspects of their courses.

On the other side, there are strong pressures on universities which, in turn, lead to pressures on academic staff to give active involvement in internationalisation a low priority. The prime function of universities is seen to be the acquisition and the development of knowledge, which leads to the most important demand on staff that they should be successful researchers. As has been seen, providing the international dimension to education requires more staff time and commitment than does giving traditional, nationally or locally oriented courses. The key to better internationalisation is for universities explicitly to support those staff engaged in international activities. Moreover, if it can be accepted that participation in exchange programmes will increase access to the most stimulating and creative students and colleagues, then internationalisation will also be seen to support the research role of the university.

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Annex I – ECTS

Behind any credit transfer scheme is the idea that study carried out in one (or even several) institution should be able to satisfy in part the requirements for an award at another institution. The development of the European Credit Transfer System is directed to satisfying a very clear need, as ever more students are spending part of their studies at other universities (and, in the vast majority of cases, in another country). A secondary use of a credit transfer system is as a means of comparing courses and, moreover, of comparing the quality of courses. Of course, the way that courses are built up, and marks awarded and combined to determine the final Diploma or Degree, are based in almost all institutions on a credit accumulation system, or on a system which is, in essence, a credit system, even though the word credit may not be used. It is only when transferability of credit is desired that all the implicit assumptions and compromises inherent in any academic system become apparent.

The basis of ECTS is that each course of study should be divided into a number of modules. The modules are at different levels, depending on where in the course they are normally taken. The most common pattern is for each level to correspond to a year of study, and for it to be necessary to have obtained credit in (that is, passed) a sufficient number of modules at a lower level before any modules at a higher level may be studied. Unfortunately, even at this point problems arise, caused by the fact that there exist quite different understandings and perceptions of what a module is. These range from a module being understood to consist of just a single normal lecture course or seminar to a module being a comprehensive learning arrangement embracing various teaching/learning and working activities, with their different course contents and targeted to a defined multi-dimensional learning outcome. A step forward, consistent with the thrust of much of the work in E4, would be for the description of modules to be in terms of learning outcomes, rather than in terms of syllabus content. It may well happen that virtual university approaches and the development of world wide accessible learning software will contribute positively to an acceptable module and credit system.

The credit value of a module is a measure of the amount of study demanded. A crude measure is the number of hours of lectures or instruction given, perhaps expressed as the time spent in the classroom or the number of hours of contact with the teaching staff. A better measure, to be used within ECTS, is to focus on student learning and the overall workload for students, contact (teaching) hours then being only one factor in the estimate of workload. For lectures, for example, a 1 hour lecture might demand a further 4 hours of private study. A full year's study corresponds to 60 European Credits. Unfortunately, even with this measure of Credit (but there are yet other factors, to be discussed below), there are constraints to developing a generally accepted and satisfactory scheme of credit transfer and accumulation; such constraints are not engineering specific, but are of a more general nature.

1. The workload associated with 1 credit differs significantly throughout Europe: Some countries using ECTS tend to calculate 30 hours per credit, so 60 credits (a year's worth of study) corresponds to a total workload of 1800 hours, all examinations included. At the other extreme, in the UK, the total workload is only 1200 hours, calculated on the basis of 120 credits per year, but only 10 hours of workload per credit. So, although 2 UK credits should be equivalent to 1 ECTS credit, this is clearly often not the case on a workload basis. Other countries like the Netherlands use to attribute 40 hours per credit equal to a one weeks workload. There is some consistency, in that the UK calculations also assume 40 hours work per week; however, in the UK the undergraduate academic is only 30 weeks long (the remaining 22 weeks are vacation, the greater part being in the summer). Moreover, in the UK the examinations are included within the 30 teaching weeks, whereas in some other countries the examinations are held outside the 30 teaching weeks.

Needless to add, the number of hours to be spent by the typical student in earning each credit is not scientifically determined, but is based on the estimate (guess?) of the lecturer giving the course.

2. The ECTS pilot project has tended to encourage a simple, mechanistic conversion between contact hours and credits by just using a specific factor – e.g. a factor 1.5 if 20 contact hours per week in a semester is to be worth 30 credits. Yet it is the experience of every academic that the demands made of a student vary widely between courses and between styles of teaching. The use of standard factors discourages serious reflection on these matters.

3. The award of Credits implies that the student has successfully finished a course or module, but that alone is rarely sufficient, even for the internal purposes of the institution, and certainly not for international transfer of credit. Further measures of the credit are needed, specifically (i) a measure of the quality of the pass, (ii) a measure of the place in the course, or the level, and (iii) a description of the course content.

Since there is already so much divergence on the matter of credit value, despite the fact that it is the measure which it would be expected would be most amenable to objective analysis and harmonisation, it might appear futile to discuss the other measures. Nevertheless, if a satisfactory transfer and accumulation scheme is to be devised, these other matters must also be resolved.

Even the level of study is not easy to define. Clearly any university will know at which stage (year) a particular module is usually given, but even this is rarely a sufficient specification, given the variations between countries, and even between institutions within a country, in the education preceding this stage. It is also sometimes the case that a module is taken by students at quite different levels – the outcomes may then be different, but in a certain sense all will be successful.

The measure of the success with which a student has completed a module is a further important factor in specifying the credit. We might refer to this as the “points value” or “mark” attributed to the credit, as opposed to its “amount” or “credit value”. In a Grade Point Averaging scheme (the GPA used in the USA) the mark is obtained by multiplying the credit value by the points value, and aggregating the total; the average is then found by dividing the final total by the aggregate credit value. In ECTS the points value is defined by a letter (A is high, down to E, and F for failure to attend the examination) with the boundaries being expressed in terms of a supposed normal (Gaussian) distribution of marks. This appears to be objective, but transferability will only be practicable if the performance statistics of the class in the sending university are similar to those in the receiving university. Among the many problems are:

(i) In practice marks distributions are rarely normal, even in large classes,

(ii) Even in universities where there is tight control of the examination process, so that the mean marks for the different modules are consistent among themselves, the standard deviations tend to be much less well controlled,

(iii) The mechanism for calibrating one university against another hardly exists. Theoretically the system of external examiners in the UK, where each course in a university has in its panel of examiners teachers from other universities, ensures consistency, but there are few who believe that the worth of a Degree is independent of the University awarding it.

Despite the foregoing, it is relatively easy to perform the statistical calculations needed to generate ECTS points values. This is done in the Department of one of the authors (BM), where it can be shown that at least point (ii) above is satisfied.

The final element in specifying a module is the content. As has already been suggested, this will be most usefully done by specifying learning outcomes. Indeed, a good description of a module will include a specification of the intended outcomes, a brief statement of the nature and content of each component of the module (e.g. lectures, examples classes, laboratory classes etc.), a statement of the duration and format of examinations and an estimate of student workload.

In view of the foregoing discussion it will be clear that the proposal that Bachelors' programmes in Engineering of 3 years duration should consist of 180 ECTS credits is of very limited value for the harmonisation and comparability of programmes, and the indication of profiles and quality levels. Thus, ECTS has so far failed in its original aim of becoming a recognised and accepted “currency” Europe wide for learning activities and learning outcomes. Each university or college must still decide for itself whether credit from another higher education institution can be accepted and recognised or not, because judgements have to made on all factors discussed above. A University will normally only accept credits awarded by other Universities which are well known to it, and whose attitudes and standards are similar to its own. The problem is not confined to international movement of students, for in countries where the universities have strong control over the admission of students (the UK is a good example) exactly similar questions arise when a student wishes to transfer from one university to another, and the process is far from automatic. Thus, the ideal of free movement of students, collecting credit at each step on the way, is far into the future.

However, because transfer both is wanted and already takes place, and because it must, therefore, be assumed that a form of ECTS will continue to be implemented more and more widely, some crucial questions should be studied and answered. First, should the requirements for first- and second-cycle degrees be expressed in terms of years of study or in credits? It may be that resolution of the problems of credit value will also provide the answer here, or it may be that there are other, more subtle factors to be considered. However, it should be noted that in some countries the discussion has already started on how to count intensified studies, with nearly no holidays, and whether to allow the accelerated collection of credits by individual students (as is quite normal in the USA, for instance). Second, should a first-cycle degree in engineering be specified as 180 ECTS credits, or should it really be more, Bologna notwithstanding? And, then, is a Masters' degree achieved by an overall sum of 300 ECTS credits or can it be less? Another question is whether and how to recognise within ECTS credits gained by the accreditation of prior, informal and experimental learning, by open and distant learning, by continuing education or just credits by providers other than higher education institutions, even schools of the upper secondary level.

Up to now in engineering education not much open mindedness and trust can be observed. Change in this behaviour and in the administrative processes of student transfer will depend very much on whether the credit system can include not just a quantitative workload but also the additional qualitative dimensions.

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Annex II – Enquiry Form, Courses given in a Foreign Language

(This type face shows a sample entry)

(1) Name of University, Location, Country
University ñPolitehnicaî Bucarest, Bucarest, Romania

(2) Courses offered in the following languages:
English
French
German

(3) Courses offered in the following subjects, at the levels specified:
Electrical Engineering & Computer Sciences (E, F, G, to Diploma, MSc and PhD)
Mechanical Engineering (E, F, G, to Diploma, MSc and PhD)
Chemical Engineering (E, F, to Diploma, MSc and PhD)
Industrial Economic Engineering (G, to Diploma, MSc and PhD)
Materials Science (E, F, to Diploma, MSc and PhD)

(4) Degrees offered
1. Diploma, equivalent to MEng, Dip Ing or Diplome (5 years, integrating BSc and MEng)
2. MSc
3. PhD

(6) For further information contact:
(Here there should be postal addresses, web addresses (with links), and links to a local cache or page with as much extra information as is supplied or as we feel able to include).

Contacts: **Faculty of Engineering Taught in Foreign Languages, University Politehnicaó;**313, Splaiul Independentei, Building J, Room JE105, Sectorul 6, RO- 060042, Bucharest, Romania; Phone and Fax: +40214029889;
E-mail: decanat@ing.pub.ro webpages: ://ing.pub.ro, ://www.pub.ro/English/Ects/Dsi/htm

Dean: Prof. **Adrian Pascu;** apascu@meca.omtr.pub.ro, apascu@ing.pub.ro
Vice-dean: S. Lect. **Adrian Volceanov**, avolceanov@ing.pub.ro
ECTS Director and Responsible for the **French** Stream: Prof. **Cezar Fluierasu**, cfluerasu@ing.pub.ro
Responsible for the **English** Stream: Prof. **Paul Cristea** pcristea@ing.pub.ro
Responsible for the **German** Stream: Prof. **Sergiu Iliescu** siliescu@ing.pub.ro

This should include admission requirements.

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Annex III: Activity 4 – Active Participants

NAME	INSTITUTION /ORGANISATION
Jorgensen Anker-Staher	The Engineering College of Horsens
Jean Michel Alaverdov	Ecole des Mines d'Albi
Petros Anagnostopoulos	Aristotle University of Thessaloniki
Jean-Pierre Charlot	University of Angers
Dominique Dubois	University of Angers
Radu Chisleag	Politehnica University, Bucharest
Richard Comley	School of Computing Science, Middlesex University,
Anneroos Dijkhuis	TU Eindhoven
Knut Guthen	Hogeskolen i Vestfold
Juan Manuel Ortiz	BEST
Antonio Pouzada	Universidade do Minho
Jossé F. G. Mendes	Universidade do Minho
Alfredo Soeiro	Universidade do Porto
Brian Mulhall	**University of Surrey**
Dominique Depeyre	Ecole Centrale Paris
Bruno Di Maio	Università di Palermo
Laszlo Szentirmai	University of Miskolc
Gay Tischbirek	EPF – Ecole Polytechnique Femminine
Frank Dochy	Groep T
Giuliano Augusti	Università “La Sapienza” Roma
Guenther Kurz	University of Applied Sciences Esslingen
Isabel Arribas	BEST
Knut Grathen	Hogskolen i Vestfold
Oddvin Arne	Hogskolen i Vestfold
Ole Vinther	The Engineering College of Copenhagen
Werner Weber	RWTH Aachen

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VOLUME F

Activity 5

Innovative Learning and Teaching Methods

Inkeri Laaksonen, Matti Pursula

Klaus Bednarz, Anders Hagström, Raimo Harder,
Joost Groot Kormelink, Miia Lampinen, Ulla Lehtonen,
Frank March

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Finland	Espoo-Vantaa Institute of Technology	73
Finland	Helsinki University of Technology	77
Germany	Universität Karslruhe, Zentrum für Multimedia	81
Greece	Aristotle University of Thessaloniki	83
Greece	Technical University of Crete	87
Italy	Politecnico di Milano, Centre METID	91
Netherlands	Delft University of Technology	95
Portugal	University of Porto, Faculty of Engineering	99
Spain	Universidad Politécnica de Madrid	103
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Preface

The innovative methods have been widely discussed in higher education in recent years. Problem Based Learning and Project Learning are becoming more important by offering students the possibility of combining theory and practice. One of the noteworthy questions in society in recent years has been how little higher education institutions and working life co-operate. The new approach to teaching and learning makes it easier for students to transfer from study to work. The question of e-learning also is still a burning question asked by teachers and students alike. Information and Communication Technology (ICT) is predominantly seen as facilitating traditionally based teaching and learning giving students some added value, for example, by making it easier to look up the course timetables, course material and register for an examination via the Internet or Intranet. The innovative use of ICT in teaching and learning is still in its infancy. The development of technology, however, makes the infrastructure widely available in Europe, but the level of technology and its learning tools vary from country to country. The significant role of pedagogy when using information and communication technology in teaching and learning seems to become more widely important along with, and abreast of, technical tools and infrastructure.

Activity 5, "Innovative Learning and Teaching Methods" (http://virtal.hut.fi/E4_Action5) of the SOCRATES Thematic Network Enhancing Engineering Education in Europe (E4) (http://www.ing.unifi.it/tne4) provides a significant basis for further discussion of engineering education and its challenges in the e-future by offering examples, for example, of a virtual campus, good practices, transnational and online courses. This final report of Activity 5 includes a great amount of hyperlinks, which can be accessed by using the CD-ROM version of the report.

Finally, we would like to extend our warmest thanks to all the participants, especially the active partners Mr. Anders Hagström and Ms. Miia Lampinen, Swiss Federal Institute of Technology Zurich (ETH), Switzerland; Mr. Raimo Harder, Bauhaus-University of Weimar, Germany; Mr. Frank March, TU Ilmenau, Germany; Mr. Klaus Bednarz, TU Berlin, Germany; Mr. Stefan Gnüchtel, TU Dresden, Germany; Mr. Joost Groot Kormelink, TU Delft: Ms. Director Anneli Lappalainen and the academic co-ordinators Ms. Johanna Hartikainen, Ms. Riitta Saarinen and Ms. Ulla Lehtonen from Helsinki University of Technology, Finland. The student's organisation BEST (Board of European Students of Technology, http;//www.BEST.eu.org) and SEFI (European Society for Engineering Education, http://ntb.ch/SEFI) also earn our thanks for the lively discussion of the themes and their active role in organising the events where academics and students had a chance to discuss ICT in teaching and learning, problem-based learning and project learning.

Many thanks as well to all the experts who commented on the text and, thus, contributed to this publication, especially Ms. Tytti Tenhula, University of Oulu, Finland, who is responsible for the Finnish National teacher training programme "TieVie" and Ms. Anna-Kaarina Kairamo, Ms. Riikka Lauhia and Ms. Anna-Maija Ahonen, Helsinki University of Technology, Finland, who kindly gave information and the numbers of engineering teachers or planners who have passed the teacher training programs in Helsinki University of Technology.

In the end, many thanks for the teachers, who gave their expertise for finalising the part "Experiences of net-based and transnational courses" in this report: Mr. Jan Baetens, Instituut voor Culturele Studies, Katholieke Universiteit Leuven, Belgium; Mr. Ari Ekroos, Helsinki University of Technology, Finland; and Mr. Ben Nothnagel, Nothnagel & Associates, Finland.

Helsinki University of Technology
Otaniemi, Finland
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1. Introduction

1.1 Enhancing Engineering Education in Europe (E4)

The Socrates Thematic Network (TN) "Enhancing Engineering Education in Europe" (E4) (http://www.inf.unifi.it/tne4), focused on enhancing the many aspects of the Engineering profession in Europe and, hence, by improving compatibility facilitating greater mobility and integration of skilled personnel. Three associations, BEST, SEFI and Cesaer strongly supported the TN. The participation of the above mentioned organisations was important in one particular reason: one of the significant aims was to get students' views concerning the new methods and ICT in learning and teaching.

The participation of the E4 was structured in five Activities which all had their own objectives but a common goal: to make the higher engineering education more innovative, high-quality, flexible and competitive throughout Europe and share the knowledge and innovations during, and as a result of, this project.

1.2 Aims and Themes of Activity 5

Activity 5, "Innovative Learning and Teaching Methods" (http://virtual.hut.fi/E4_Action5), focused on supporting the required innovative learning and teaching methods at the institutional level, clarifying the role of ICT in learning and teaching, utilising distance learning in higher education and supporting the modern networked university by paying attention to the teaching and learning attitudes.

Activity 5 was divided into four themes (http://virtual.hut.fi/E4_Action5/themes.htm). The first theme "Virtual Campus and Virtual University Activities in Europe" focused on clarifying the existing approaches and problems of virtual university initiatives. The Swiss Federal Institute of Technology Zurich (ETH Zurich) carried out a survey on this subject. The second theme "Good Practices in the Use and Support of New Teaching and Learning Methods" focused on finding out good practices in Europe. TU Ilmenau, Germany, played an active role concerning this theme. Helsinki University of Technology, Finland, was responsible for the third theme "Training Engineering Teachers on Facilitation of ODL[1] (open and distance learning)". The theme focused on facilitat-

[1] The terms "open learning" and "distance education" have been widely discussed. According to Dewal (1986, 8), distance education "refers mainly to mode of delivery, open education refers to structural changes". Distance education institution can be open or "closed" with respect to time, space or mode, etc. Lewis and Spencer (1986, 17) for their part argue that the distance education is a sub-category of open learning. Foks (1987, 74, 76), however, contradicts both views and argues that "open learning is not synonymous with distance education and continues "open learning is a state of mind, an approach taken to the planning, design etc.". In the current discussion, the difference between the terms is blurred (Holmberg 1995).

ing ODL, as well as ICT in teaching and learning. The fourth theme "Transnational pilot courses on both "common core" and specialised engineering discipline subjects" focused on to collect experiences of net-based and transnational courses through the active institutions of Helsinki University of Technology, Finland, TU Ilmenau, Germany and Bauhaus-University of Weimar, Germany. Two of the reported courses "Environmental Law and Economic Law" and "Literature and Cinema" were implemented by the EUNITE-network.

1.3 Working Methods of Activity 5

The Activity 5 working methods were web conferencing, questionnaires, reports and meetings. The home page and the working area were in use from the beginning and some discussions took place on the discussion forum. Early on, the participants noticed that the group was more familiar with exchanging ideas and comments using e-mail than web conferencing. The results of the questionnaire for the participants (the web-conferencing user questionnaire) showed that there were many problems with using web conferencing as a working area. The biggest problem was the lack of time and unaccustomed users. The web conferencing culture was still new for most of the participants and that's why this method was not very efficient. The question arose that further training should be offered before using the new interactive technical environments as a working method.

The work group meetings and e-mails, as well as explicit knowledge like reports and information on home page, became the main working methods during the project. The questionnaires also played a central role when collecting information from European universities.

The Thematic Network as a discussion forum offers at best an active forum for knowledge creation and sharing experience and disseminating good practices between higher education institutions. On the other hand, the lack of time and discontinuous financial support effectively diminishes the interest in networking and working on such a project.

In this case, however, open and distance learning (ODL) has a special meaning: information and communication technologies offer not only tools to facilitate learning and teaching, but also openness in space of time and distance.

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2. Themes of Activity 5

2.1 Study on Virtual University Initiatives in Europe

The aim of theme 1 was to explore existing approaches and problems of virtual campus and virtual university initiatives in Europe. The theme was co-ordinated by the Swiss Federal Institute of Technology Zurich (ETH Zurich). A survey was carried out with the primary aim of providing a brief overview of the developments in Europe in this rapidly evolving field. The survey was also designed to deliver insights into the different institutional approaches to virtual campus or virtual university initiatives. A secondary aim was to support the development of a network of institutions with compatible aims. Co-operation with other institutions can help create new ideas for applications for working in cyberspace. A network of virtual university initiatives with shared interests could provide all participants with added value.

The survey was sent to circa 100 institutions and organisations in engineering education field across Europe. The survey was limited to the partners of the Thematic Network E4. The aim could thus not be to gather statistically valid, quantitative information about all European virtual campus and virtual university initiatives. However, due to the broad range of the partner institutions in the E4 network, the results give an overview of the *kind* of initiatives currently under way in Europe.

In a first step of the survey we approached the contact persons from the E4 partner organisations to find out if they have virtual campus, virtual university of e-learning projects in their institution, and, if yes, who the contact person is. This question was sent by email to 150 people. Seven persons immediately responded that their institutions do not have any such activities going on at the moment. A further three institutions responded that they do not have such activities going on at the moment, but that they were considering starting some in the near future. Twenty-six institutions replied that they did have virtual campus/e-learning activities and provided a contact person. The survey questionnaire was sent to these 26 contact persons, with sample replies for ETH World as an example. By the end of 2001, 13 answers were returned. Most of these higher educational institutions, faculties or departments have a clearly formulated strategy at some level for their virtual campus projects. Universities and other institutions are mainly interested in developing services for students and academic staff. New technology plays an important role in this development (Hagström & Lampinen 2003).

The respondents of the survey considered the possibility to structure teaching and learning in flexible ways to be the main benefit of online learning materials. Equally, they valued the possibility to improve teaching quality and learning habits. E-learning was seen as both as a tool for teaching and learning and for developing the quality of them. The respondents form large universities mentioned the virtual campus project as a means for bringing universities and the society together (Hagström & Lampinen 2003).

One of the main objectives of the virtual campus initiatives surveyed is to support learning and teaching on campus. Most of the institutions also offer some continuing education courses online. The large universities (more than 30,000 students) emphasised offering supportive technology for virtual activities. In the medium (between 10,000 and 15,000 students) and small size universities (less than 10,000 students) support is broader, for example, support for teaching and learning for on-campus students and staff members. The motivation for virtual campus projects is similar in all three groups. One common theme is knowledge management and exchange. Another is the chance to communicate more easily internally and externally, along with community building and furthering social interaction (Hagström & Lampinen 2003).

The survey demonstrates that it is not enough to create and develop virtual campus initiatives. It is equally important that the developers and users of the virtual campus are motivated to do the work and to use the different possibilities. Virtual initiatives show potential for supporting quality education and research. In addition, they can help to steer the universities in the direction of future demands (Hagström & Lampinen 2003).

The report of the survey can be found on Activity 5 web page
http://virtualhut.fi/E4_Action5/E4_A5Survey.pdf (published on 12 March 2003) and is attached as Annex 5 to the present report.

2.2 Good Practices in the Use and Support of New Teaching and Learning Technologies

The theme "Good practices in the use and support of new teaching and learning technologies" focused on to finding good practices in Europe. The theme was co-ordinated by the TU Ilmenau, Germany. A questionnaire about "existing new learning and teaching methods in Europe" was sent to all participants in the E4 project (100 different institutions and about 150 private individuals) by e-mail. Ten of the addressees could not open the file. Some significant information may be lost because of that. After becoming aware of the situation, the TU Ilmenau sent the questionnaire to some institutions by ordinary fax to avoid more loss of information. Altogether 23 responses were received from eight different countries. Eleven of the responses represented universities, two polytechnics. Table 1 summarizes the responses by listing the institute, the title of the learning and teaching method, and an Internet link. The questionnaire and a summary of the responses can be found on the Activity 5 web page http://virtual.hut.fi/E4_Action5/New_learning_and_teaching_methods.doc (published 28 March 2003).

The main findings were that the new learning and teaching methods are currently (2002) in the development stage and only a few solutions can be found in Europe. Partnerships in this field are not very common or widespread, universities are developing their own methods and knowledge, and information on good practices is shared less frequently. There are, however, many commercial e-learning platforms on the market, some of them developed in universities, but the wide choice and the high cost of licences makes it more difficult to reach the right solution. Engineers also do not like to use the e-learning software where the platform is often closed and access to the e-learning environment requires a password. The use of e-learning platforms is limited among teachers. Currently, the communication between students and teachers is realised at a simple level. Many teachers, as well as students, think that ICT-based tools are complicated. Many educational institutions have future plans for the infrastructure and ICT tools for e-learning, and are actively developing their curricula and have run pilot net-based courses. In spite of that, ICT in teaching and learning is in its infancy.

The definitions stated below present a view of the future where ICT is not only a technical tool for assessing learning and teaching but also a learning environment:

> "ICT in education
> … What does ICT development mean? It means educational reforms, collaborative and investigative learning practices and up-to-date curricula. Innovations can be introduced by teachers networking, internationalising and co-operating with their colleagues, both at home and abroad. Most productive innovations can be reached through team work, especially international collaboration, in the educational field …"
> (Halonen 2002).
>
> "ICT is vital to the effective operation of all spheres of activity in university: teaching and learning; research; management and administration. The strategy provides a framework for the definition of the ICT needs of the university and a prioritised programme of work for the continued development, support and maintenance of facilities to meet these needs".
> (Ford & Phillips 2001).

The results of the questionnaire have also been discussed at the SEFI conference held 4-6 April 2003 in Valladolid, Spain "New teaching and learning methods: how effective are they?" (http://bosz.its.tudelft.nl/cdwg/valladol.htm).

Table 1. Responses concerning "new learning and teaching methods" in detail

Institution	Title of the method – contents	Internet links (if available)
Helsinki University of Technology, FIN	• Web based teaching methods • Computer aided mathematics teaching • 3 courses of e-learning • Common training portal for Finnish students	• http://130.233.158.46/eopetus/default.htm • http://math.hut.fi/matta/index_en.shtml • http://www.tuta.hut.fi/studies/e-learning • no address available
Espoo-Vantaa Institute of Technology, FIN	• NetPro-international network based learning environment project • Network based joint venture course on software production	• http://netpro.evtek.fi • http://www.asia-itc.org
Aristotle University Thessaloniki, GR	• Operational programme of Education and Initial Professional Training	• http://www.civil.auth.gr
University of Technology Eindhoven, NL	• PhD education and research • Education at Master's level • Architecture and urban planning • Building a network university (education at Master's level)	• http://www.uso.tue.nl
Engineering University of Florence, IT	• Web based authoring environments – on-line teaching and learning	• http://www.netform.unifi.it
Polytechnic Budapest-Banki, HU	• Life long learning in technical teacher training	• http://www.banki.hu/~tkt • http://www.tanarkepzo.poliod.hu/leonardo/index.htm
Donat Faculty University Miskolc, HU	• Modernisation of existing modular system	• Contact: elkerika@gold.uni-miskolc.hu
Technische Universität Ilmenau, DE	• Modularisierung des Studiums • Digital Teaching Workspace DTW • Bildungsportal Thüringen	• http://www.blk-bonn.de/papers/heft101.pdf • http://www2.uni-jena.de/svw/compsy/digteach • http://www.bildungsportal-thueringen.de

Technische Universität Dresden, DE	• RETScreen – renewable energy project analysis software (with a partner in Canada) • Energy and Environment (training course) • Verbundprojekt Bildungsportal Sachsen • Multimediale Lehr- und Lernumgebung Maschinenbauwesen	• http://www.leonardo.tu-dresden.de • http://www.bildungsportal-sachsen.de • http://mlu.mw.tu-dresden.de
Bauhaus Universität Weimar, DE	• POLE-Europe – project oriented learning environment (co-ordinator: University of Applied Sciences Aargau /CH) • M^2 – new learning media and project oriented networking studying in the sector of media science, media design, media technology and media management • Mobility-traffic simulation game	• http://www.pole-europe.ch • http://www.uni-weimar.de/m2 • http://verkehr.bauing.uni-weimar.de/forschung.php?thema0mobility1
Technische Universität Berlin, DE	• Project workshops • Study reform projects/ Funding programmes	• http://www.tu-berlin.de/presse/div/pw.htm http://130.149.52.108/srp_pw.html
Technische Universität Graz, AT	• Teaching of structural analysis	• http://www.mursoft.at/ruckzuck/ruckzuck.htm
Technical University of Denmark, DK	• web platform for teaching and learning –Campus Net	• https://www.campusnet.dtu.dk

2.3 Training for Engineering Teachers on Facilitation of ODL – Information and Communication Technology in Teaching and Learning

According to the current views on general learning theory, it is clear that student-centred learning and meaningful activities centred on real life problems are the key elements in developing the ability and increasing the competitiveness of future experts. The still widely prevailing educational model – top-down dissemination of knowledge from teachers to students – does not promote the development of expertise in the complicated information society. A general change in the learning paradigm, incorporating ICT, as well as a change in the methodological approach in the teachers' training, is indispensable.

The theme three (3) "Training for Engineering Teachers on Facilitation of ODL" focused on to facilitate the actions of the distance learning, to study the impact of computer assisted learning and the role of multimedia courseware in European higher education institutions.

One of the actions of the theme was a inquiry for the higher education institutions in Europe considering the training for engineering teachers on facilitation of ODL. The inquiry was carried out as a questionnaire survey. The questionnaire was distributed among the participants of the 2002 SEFI Annual Conference which took place in Florence 8-11.9.2002, during the E4 Plenary Session. Because of very few responses the members were invited to provide some more answers. The questionnaire was also virtualised in order to have more responses. The questionnaire contained a total of three questions. The guiding principle was to consider the programs at the national level and at the university level.

- What kind of programs do you have at the national and at the university level for teachers' education on facilitation of ODL in Higher education (preferably in Engineering)?
- Have there been some surveys/analysis about these programs/models in your country?
- Please write a link or some contact information of these programs.

The results show that the virtual university projects, especially the training for engineering teachers, are still at the development stage. The responses were few and the answers on very general level. No noteworthy results are possible to report on the basis of the obtained responses.

Because of the very few and too general level of information received, we describe more detailed two Finnish teacher training programmes as examples and first, as an introduction, the readiness to use ICT and the national level strategy in Finland.

2.3.1 Readiness to use ICT in Finland

Finland took the lead (2002) in the comparison of the use and application of ICT. The Global Information Technology Report is the most comprehensive assessment of "networked readiness" – how prepared an economy is to capture the benefits of technology to promote economic growth and productivity. The report benchmarked the performance of, and monitors progress in networked readiness in, 82 countries. Table 2 lists the top ten countries.

Table 2. Top ten list 2002. Readiness to use ICT
(Global Information Technology Report, http://www.weforum.org/)

Country	**Points**	**Order**
Finland	5.92	1
USA	5.79	2
Singapore	5.74	3
Sweden	5.58	4
Iceland	5.51	5
Canada	5.44	6
United Kingdom	5.35	7
Denmark	5.33	8
Taiwan	5.31	9
Germany	5.29	10

In recent years, Finland has paid much attention to using ICT in teaching and learning. The Ministry of Education is responsible for realising the principles of the information society that the Council of State has laid down regarding the use of new technology in education institutions.

The Ministry of Education strategy stresses the changes caused by the information society. Every educational institution prepared a strategy for ICT in teaching and learning by 2002.
(Ministry of Education 2003). Personnel of the educational institutions (especially for teachers and planners) are to be trained in 2000-2004. The objective of the training is to ensure that not less than half of the teachers are able to use ICT in their own work. The ope.fi programme is designed for all teachers from elementary school level to university level. The teacher training has been implemented according to a three-level model. The first step comprises basic knowledge about ICT and the pedagogy behind the effective use of ICT in education. The second and third steps are for more advanced teachers and include skills, which are not considered necessary for all teachers today. The polytechnics, universities, the National Board of Education and municipalities are responsible for organising the training. (Ministry of Education 2003).

2.3.2 Information and Communication Technology in Teaching and Learning – the National Level Programme for Teachers in Finnish Universities

The Finnish Virtual University (http://www.virtuaaliyliopisto.fi) is a project organisation promoting and developing networking in universities. One of its national projects is a training programme for teachers in Finnish universities called "TieVie". The focus of the programme is to enable teachers to use ICT in teaching and learning more effectively. The training groups have participants from every Finnish university (21), thus the programme is national and interdisciplinary. The project co-ordinator is University of Oulu (http://www.oulu.fi). Five Universities are responsible for the planning and implementation of the programme. Helsinki University of Technology is accountable for the unit[2] "How to Plan Web-based Teaching".

In 2001-2003 389 teachers in 21 separate Finnish Universities in all passed the programme: 360 participants began the "TieVie-Teacher Training Programme" (5 cu)[3], of whom 20 dropped out and 256 passed the course; 145 participants began the "TieVie-Trainer Development Programme" (10 cu), of whom 9 dropped out and 120 passed the course. The following "TieVie-Teacher Training Programme" started in April 2003 and there are 95 participants in this programme. The next "TieVie-Teacher Training Programme" will start in September 2003 and 120 teachers will begin training. In 2004-2006, the role of the "TieVie-Teacher Development Programme" will be emphasised more and the universities will handle more of the basic education themselves ("TieVie-Teacher training Programme", 5 cu) (Tenhula 2003).

Helsinki University of Technology organised one pilot course in ICT in teaching and learning (TieVie II) in 2001. In all, 10 teachers passed the course. In the national TieVie-course, 27 engineering teachers or planners from Helsinki University of Technology participated: 20 teachers or planners passed the "TieVie-Teacher Training Programme" and 7 the "TieVie-Trainer Development Programme" in Helsinki University of Technology in 2001-2003 (Lauhia 2003).

The "TieVie-Teacher Training Programme" consists of a personal e-learning production project and the methods used are national workshops, virtual study modules, collaborative working independently and in groups. The "TieVie-Teacher Trainer Development Programme" is more designed for teachers wishing to become trainers or mentors for other teachers in their own universities. The structures of the programmes are illustrated in Figures 1 and 2. During both courses, the participants have their own teaching development project that could be from a different point of view depending on the participants' interests and work (training, strategy, mentoring, technology). The methods used are working online both independently and in groups, participating in workshops and writing short reports on current topics. Both

[2] In this paper, 'unit' means: the courses consists of smaller units.
[3] cu = credit unit: one cu = 40 working hours.

groups publish their own portfolio at the end of the module. The students can also take some shorter courses (local technology workshops) focused on the use, for instance, of video technology and other information and communication tools in teaching. These courses are organised by separate universities based on the needs of the teachers and their teaching development projects.

Because of the programme and the informal and formal networks, there is a very good chance of changing the ideas, making the good practices visible and sharing the knowledge and experiences with other teachers throughout the Finnish universities. The project will last at least until 2006. In 2004-2006, the national organisation will focus on the role of the "TieVie-Trainer Development Programme" and the universities will handle more of the basic education themselves ("TieVie-Teacher Training Programme").

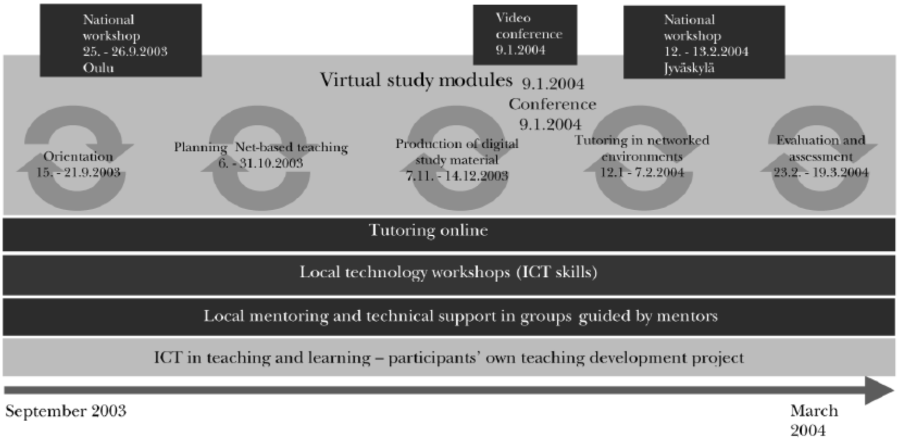

Fig. 1. The structure of the "TieVie-Teacher Training Programme" (Tenhula 2003)

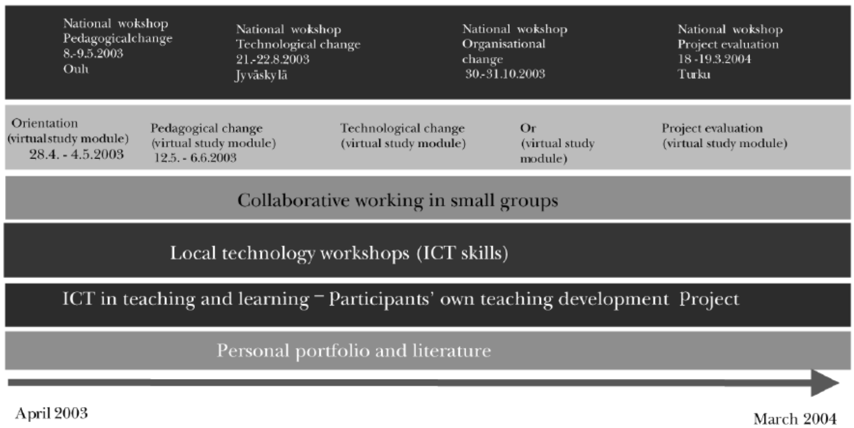

Fig. 2. The structure of the "TieVie-Trainer Development Programme" (Tenhula 2003)

2.3.3 Programme on Higher Education Pedagogy – the University Level Programme for Engineering Teachers

Helsinki University of Technology provides the training programme "Programme on Higher Education Pedagogy" for engineering teachers. The programme consists of 15 credit units, and it is divided into five modules (see Fig. 3). The study groups consist of approximately 25 engineering teachers from assistants to professors. The main aim of the programme is to provide participants with a chance and a challenge to analyse, improve and evaluate their own teaching and pedagogical thinking. The approach of the training is both intensive and process-oriented. The methods used are net-based discussions groups, personal assignments like writing a learning diary, making one's own portfolio, group work, one's own development project, as well as traditional face-to-face sessions. At the end of the programme, the participants write a report on their development project (approximately 20 pages). The reports are published annually. In all circa 100 engineering teachers have passed the programme during the years 1999–2003. (Ahonen & Lauhia 2003.) The Program started for the first time in August 1999 and it lasted until the end of November 2000.

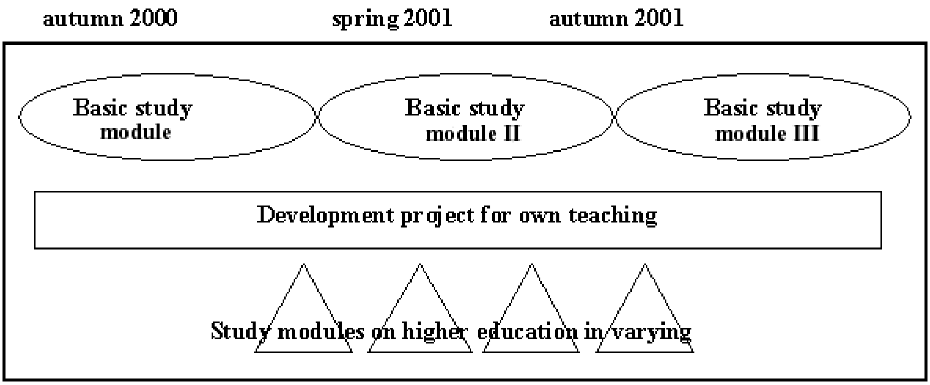

Fig. 3. The structure and schedule of the Program on Higher Education Pedagogy 2000 (Lauhia 2003)

2.3.4 Summary

The teacher training programmes, which are described above, are here as examples. They try to demonstrate what kind of training activities are needed in order to promote the use of ICT in engineering education. The programmes have some features, which can be recommended as necessary characteristics for similar programmes elsewhere. First, it is important to note that using ICT in teaching needs new kind of pedagogy. Therefore, the teachers have to be trained both in pedagogy and in ICT tools. Another important feature is that the programmes can be used as a means for networking teachers and promoting co-operation. In the case of Finland, this is done by national programmes, in which teachers from several universities participate. And finally, the training has to be connected to actual problems of the participating teachers. This can be done for example by participants' personal development projects. This way the theory is put into practice in a way, which is relevant to the teacher in question.

In the case of Finland, the main purpose of the teacher training programmes is to increase the knowledge of ICT in teaching and learning, not only as a tool but also as a learning environment. Several learning theories are included especially in the programme run by Helsinki University of Technology. The programmes are blended and they consist of seminars, face-to-face group work, net-based individual assignments and group work as well as own project. During the TieVie programme the participants can become familiar with several kinds of e-learning platforms. That helps the participants to compare and evaluate the strengths and weaknesses of the platforms. During the online parts the tutors are facilitating the participants as needed. The modules are designed by separate universities and that is why also the implementation of the modules varies. It makes possible to the participants also to compare and evaluate the contents and the implementations and utilise the good practises in their own projects.

2.4 Experiences of Net-based and Transnational Courses

The main goal of theme 4 "Transnational pilot courses on both 'common core' and specialised engineering discipline subjects" focused on collecting experiences of net-based and trans-national courses through the active institutions of Helsinki University of Technology, Finland, TU Ilmenau, Germany and Bauhaus-University of Weimar, Germany. The initial aim of the theme 4 was to start and evaluate trans-national pilot courses using innovative learning and teaching methods. However, no pilot courses were launched, and thus the theme concentrated on reporting on experiences of net-based and trans-national courses. Two of the reported courses "Environmental Law and Economic Law" and "Literature and Cinema" were implemented through the EUNITE-network (European University Network for Information Technology in Education, http://www.eunite-online.org).

2.4.1 Environmental Law and Economic Law

The activities of the web-based course "Environmental Law and Economic Law" first started in spring 2002. The course is part of the activities of the EUNITE-network, and it has been co-organised by Helsinki University of Technology, Finland, and University of Granada, Spain. Professor Ari Ekroos, Helsinki University of Technology, Institute of Law, is responsible for the delivery and management. The course is accepted in the MSc degree in engineering, but it can also be included as a minor in other Master's degrees in Finnish Universities through the JOO[4]-agreement. The language used is English. This year about 33 students from Helsinki University of Technology and Uni-

[4] JOO-agreement = flexible right to study in a university in Finland other than one's own.

versity of Granada are taking part in the web-based course. The programme includes three subjects (for this year's subjects see the course home page):

- Introduction to environmental law (Objectives, Principles, Provisions, Planning, Permits, Control, Authorities, Enterprises, Citizens, Courts, Definitions).
- Supranational Environmental law (Definitions and distinctions; International Environmental law; EU legislation).
- National Environmental law (Common general issues; Harmonisation, Liability, Crimes, etc.).

The programme consists of a short description, guidance and www links. The students choose three subjects, study them, write four to five pages on each, write one page abstract on each, upload the abstract to the discussion forum, write at least four comments on the forum and, finally, fill in a learning diary (dates, tasks, learning evaluation). The interaction, teaching and learning take place on the web.

Feedback

The students gave feedback on the course in spring 2002. The scale used was as follows: 5=very true... 1=not true. They evaluate the easiness, effectiveness and support and also their own feelings considering the time and energy they used, communication, etc. The students said that they found the web easy to use (4.3), they found discussion easy to use, emails easy to use (4.6), the course was using the web effectively (3.4), etc. What the questionnaire to students did not ask was whether they had achieved their own goals, had learnt something new and what the added value was that the students got compared with the traditional learning methods.

The experiences of the teachers were positive (in general), because of the wider perspective on the European legislation. Tutoring the students, commenting and discussion were experienced to be effortless but very challenging. The neutral reflection was that preparation takes time and the cultural differences are obvious. The negative experience was that the students commit very differently and the information was fragmented (Ekroos 2003).

More information can be found:
http://www.hut.fi/Yksikot/Talousoikeus/Kurssit/EUNITE, ari.ekroos@hut.fi

2.4.2 Literature and Cinema

Also the course "Literature and Cinema" is a part of the EUNITE activities. It is an introductory course which aims at familiarising the students with the main problems occurring in the field of comparative film/literature studies. The Faculty of Arts, KU Leuven, Belgium, and the Faculty of Arts, University of Granada, Spain, are responsible for the delivery and management of the course. It is technically organised by the Institute of Cultural Studies of the KU Leuven, which hosted the course on its web site. The languages used were: English, French, and Spanish. The course material is multilingual, and communication between students and teachers mixed these three languages.

The course took place during the second semester of the academic year 2002-2003. There have been ten tutorials and the students have had to use a wide range of interactive devices (discussion forum, two videoconferences, chat). The course is divided into eight lessons, each session being the final part of a one or two-week period of personal and ODL learning. During this period, the students prepare the material for the upcoming session, with each session being partly devoted to the presentation of the work done by the students and to the feedback given by the teacher and by the other students (peer assessment). Although the scope of the course is partly theoretical, it also entails a number of case studies.

The face-to-face sessions in Leuven and Granada were given in Dutch and Spanish. For their exam, the Belgian and Spanish students had to write a paper together, which was the basis for a further discussion in each of the universities during a short final oral examination. Both institutions have guaranteed a strong local tutoring. Thanks to the Erasmus teaching exchange programme, the Leuven teacher (Jan Baetens) has been able to go for one week to Granada, where he has supervised two sessions with the Spanish students. His Spanish counterpart (Domingo Sanchez-Mesa) has played a very active and interactive role in the ODL tutoring of the Belgian students.

Feedback

The students evaluate the course collectively and found out some positive aspects. First of all, the students considered the course a positive experience. Second, the students liked the chance of sharing the learning experience with the students of the other university, i.e., Granada. They also liked the challenge of using foreign languages. The students stated also some weaknesses and make proposals. First of all, they proposed planning the structure for the collective work more effective. They also stated that the language was the problem during the course because not all of them had the ability to use a foreign language. That is why language was perceived several times as a barrier. Finally, one of the problems was the Internet connection: not all of the students had access to the Internet from their homes.

More information:
Jan Baetens
Instituut voor Culturele Studies
http://www.arts.kuleuven.ac.be/cultural_studies
Faculteit Letteren K.U. Leuven
Blijde Inkomststraat 21
B-3000 Leuven
tel: 32 (0)16 32 48 46, fax: 32 (0)16 32 50 68

2.4.3 Developing Interpersonal Skills and Global Competencies in ICT and the e-Business Environment

The online course "Developing Interpersonal Skills and Global Competencies in ICT and the e-Business Environment" piloted on the Edulink e-learning platform (http://www.edusolutions.fi) in autumn 2002. Industrial Information Technology Laboratory at the Helsinki University of Technology, and especially its education unit, was responsible for the delivery and the management of the course. The course is an accepted part of the MSc degree in engineering and can also be selected by students as a minor in other Master's degrees at Finnish universities through the JOO agreement.

Overview

Ben Nothnagel, an Attorney at law and international trainer together with Inkeri Laaksonen, an adult education specialist, designed and developed the training concept and the final product. Nothnagel developed the content and acted as the programme tutor while Laaksonen acted as a programme mentor. In Net-based studies, and especially when using investigative learning theory, the instructor's role has changed. The role of the instructor has evolved into more of a guide. This does not, however, mean that the instructor is completely passive. As a network tutor, the instructor actively follows the group's activities, provides feedback on personal exercises and answers individual or group questions. The course material is compiled using text material, Internet sources, video-clips and animation. The language used is English, which was selected to support the main focus of the course (CD-ROM: video-clip, Module I).

The main focus of the course is to provide students with the knowledge, tools and processes necessary to continuously develop the individual competencies required to compete in the international marketplace. The key words used to describe the course are: cultural awareness, individual competencies, international marketplace and internationalisation process.

The course is divided into three modules:

- Module I: Orientation,
- Module II: Internationalisation awareness, and
- Module III: Interpersonal skills development.

The underlying focus of the course is to develop awareness by the students of

- their individual ability to apply knowledge,•
- their effectiveness as a member of a group, and
- to assess the impact of their own behaviour on the individual and group performance.

During the orientation, students familiarise themselves with their learning environment and its functions and analyse their current state of learning with the help of a SWOT analysis. After an initial analysis, the students set a learning target and select the methods to achieve this target. As the course advances, the students review the analysis and the targets set and evaluate whether the methods have worked or whether it is necessary to revise both the targets and the methods. Students return to the SWOT analysis once more at the end of the course, when they evaluate the realisation of their targets, the development of their expertise and the efficiency of the selected methods.

Pedagogical basis

The pedagogical basis of the course is rooted in investigative learning. Investigative learning is the act of searching for meaningful information when existing information is not sufficient to solve the problem. Investigative learning is based on the cognitive learning theory, the aim of which is to explain and model the intelligent action of human beings. For its part, investigative learning enables the growth of expertise through problem solving. In online learning, for example, an individual might use the other members of the group or outside sources to search for meaningful information and create the knowledge to solve the problems. Intra-group exchange of information also refers to the sharing of expertise within a virtual community (see, for example, Schrage 1990).

Feedback

The feedback from the students was predominantly positive. Some technical problems like problems with the chat-tool interfered with the real time tutoring during the course. The technical support was also changed in November and there were some technical problems, which the university was responsible for. One of the good things was that it was easy to contact the learning environment when travelling in Europe or elsewhere. The mentor of the programme contacted the environment from Austria all autumn and the teacher from other European countries while travelling. The positive feedback of the teaching method was noteworthy because of the totally net-based implementation:

> “Now that the course has ended, it is time to analyse my development during the course. At the beginning, I didn’t have any strengths related to this course, because my knowledge of the subject was so slight. Now I think that my so-called weakness has turned into a strength. Because of my weak knowledge of the subject at the beginning of this course, I have been very open-minded and have discarded any prejudices. Time spending was a problem for me at the beginning. I improved my time spending during the course and the impact on my learning was quite easy to notice. New things were a lot easier to understand and learn when I improved the way I spent time on those things, for example, searching for information, participating in group discussions and chats, and evaluating “new” information”.

> "Although this course offered just a quick glimpse into the world of international skills and global competencies in ICT and the e-Business Environment, it has been very important for me. The course gave me basic knowledge about the subject".

> "This course has been very interesting from beginning to end, so in my opinion, I have achieved the goals that I set in the beginning of the course. I think that one of the reasons for achieving my goals was the right choice of training methods".

SWOT Analysis as a Self-Assessment Tool Reporting

According to Lincoln and Guban (1987), assessment is divided into historical periods where, for example, intelligence, capability and talent tests reflect the first "assessment generation" after World War II. In the 1960s – the era of the third "assessment generation" – behaviourism prevailed in the assessment of activities and quality in relation to the set objectives. Today, the assessment systems include often both external assessment and self-assessment or, for example, peer assessment. Many educational organisations presuppose that the students plan their own activities and development, set their own objectives and follow up the process. (e.g., Goedegebuure et al. 1990; e.g., Lehtinen & Rui 1995; e.g., Tynjälä 2000). The objective of the SWOT analysis of personal exercises and the learning targets set by the student based on this analysis, as well as of the student's responsibility for choosing the learning methods, is to make the student aware of his or her state of learning and the opportunities available to reach the personal targets for each course. The SWOT analysis is also used to encourage the student to use self-analysis as a tool for reaching other personal goals. The idea behind the SWOT analysis is that awareness of one's own strengths and weaknesses promotes learning and the development of expertise (Hakkarainen, Lonka & Lipponen 2001, 88).

In the online course, there were twenty-one active students who received the credits. All of them gave feedback and answered the following questions. The students' feedback is summarized in Fig. 4.

1. Did the SWOT analysis help increase your awareness of your own strengths and weaknesses in this subject?
2. You set your own learning objectives and chose the methods to reach them. Was that useful / meaningful for your own development process?
3. Have you already used some kind of self-assessment method?
4. Will you use this method in the future?

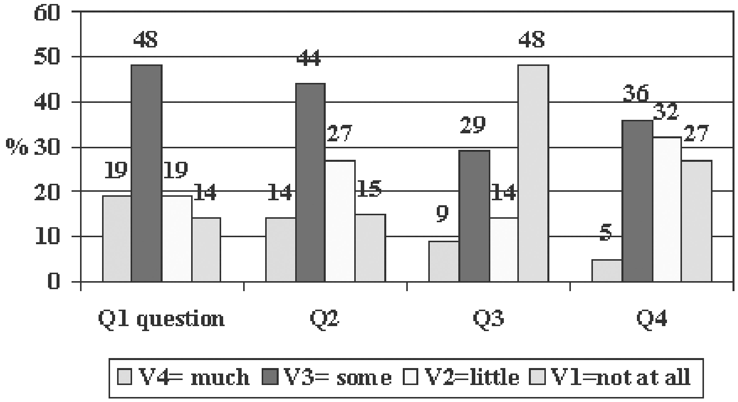

Fig. 4. Results of the SWOT analysis questionnaire

The questionnaire and the results were meant to increase the focus on personal assignments in the online course "Developing Interpersonal Skills and Global Competencies in ICT and the e-Business Environment". The objective of the SWOT analysis of personal exercises and the learning targets set by the student based on this analysis, as well as of the student's responsibility for choosing the learning methods, is to make the student aware of his or her state of learning and the opportunities available to reach the personal targets for each course.

It seems that the target of using SWOT analysis as a self-assessment tool has been attained. As a self-assessment tool, SWOT analysis has its place in increasing awareness of one's own strengths and weaknesses and thus promoting learning and the development of expertise. What we could develop is the group work process so that it would give more added value for the students. This means that instead of using only investigative learning we could develop the online course by using the philosophy and the methods of problem-based learning (e.g., Poikela & Poikela, 1997; e.g., Poikela & Poikela 2001; Smith 1983; Smith 1993) to support the student in constructing the knowledge in online groups more effectively.

More information: ben_noth@pp.htv.fi, inkeri.laaksonen@uta.fi.

2.4.4 POLE

"POLE Europe" is a course proposal for European universities which integrates the academic teaching institutions with construction companies by including students, faculty and industry mentors in the educational process. "POLE Europe" is a new methodology, developed by the University of Applied Sciences, Aargau, Switzerland (http://www.fhnw.ch), to respond to the growing requirements of the highly complex, segmented and competitive construction market. It is anticipated that "POLE Europe" will not only revolutionise learning and teaching at the universities of the future, but also have a strong impact on decision making and construction processes in practice. This new pedagogical approach is based on the concept of problem-based learning (PBL), which means that teams of architects, engineers and construction managers work on real-world problems (that have been scaled down to match the academic time frame of a semester) under the lead of construction process managers and the guidance and mentorship of faculty and professionals. "POLE Europe" will prepare the students for a highly interactive and globally dispersed planning, design, fabrication and construction environment.

Motivation of POLE

Looking at today's construction industries, it becomes obvious that the combination of discipline-specific contributions of architects, engineers and construction managers is still difficult and that synchronous project development most often remains a foreign concept. Furthermore, the exchange of project information leaves much to be desired when talking about sharing electronic information or visualisation material.
The primary goal of the Project Oriented Learning Environment "POLE Europe" is to foster interdisciplinary processes by providing the methodological accompaniment, as well as the technological (i.e. Internet-based) backbone for the project. Secondly, it is anticipated that such a process, in which synchronous work in a team is the core issue, will generate an understanding and appreciation of the different disciplinary partners and professions, all necessary for a successful outcome.

The vision of this Project Oriented Learning Environment (POLE Europe) results from the growing requirements of the highly complex, segmented and competitive construction market. Professionals in the fields of architecture, engineering and construction management all over the world demand that the competencies of the students be improved and broadened. The proposed learning environment "POLE Europe" and the associated methodology will enable students to exercise their acquired theoretical knowledge on real-world problems.

In multidisciplinary, collaborative teams, the students will experience the relationships between the different disciplines and understand the construction process in a social, economic and cultural context. Working in POLE, students will be both exposed to the latest information technologies for communication and collaboration, as well as be able to exercise modern tools for discipline-specific solutions. POLE involves practitioners as mentors in the real-world learning process. They participate in the course from their own desks using modern collaboration and communication technology, which enables them to concentrate on mentoring within just a short timeframe.

The students, on the one hand learn to identify the needs and limitations of today's construction industry and develop their solutions accordingly and, on the other hand, POLE prepares them for an understanding of technology transfer. The mentors, at the same time, get hands-on experience of the impact of new technologies in the construction process. This aspect undoubtedly is of strategic importance for success in future markets.

POLE Project 2002
Overview

Students from Bauhaus-Universität Weimar worked on the POLE project 2002 together with students from TU Delft (Netherlands), Politechnico Milano (Italy), Universität Aalborg (Denmark), Swiss Federal Institute of Technology Zurich (Switzerland), FH Luzern (Switzerland), Hochschule für Kunst und Gestaltung Zürich (Switzerland), FH Trier (Germany) and with the initiators from Fachhochschule Aargau (Switzerland). The goal of the POLE project 2002 was to develop a campus hotel.

Thirty-six students, who were organised in six different teams, participated in POLE 2002. The students belong to different faculties such as architecture, civil engineering and construction managers. Each team has to manage its own design project from beginning to end. Thus, the inter-culture and interdisciplinary exchange of information and minds was a very important aspect.

Schedule

The POLE project started with a three-day opening meeting in Switzerland. After that, the students worked at their own universities for three months. During that time, they contacted each other via the Internet, videoconferences and telephone. Furthermore, two special dates for Internet reviews were arranged. At the end of the project, all results were presented during a five-day final meeting in Switzerland.

Experiences

Positive: All the students agreed that such interdisciplinary and international work is an integral contribution to their education and the development of their personality. The students remarked that the experience of English as colloquial language was also a very positive aspect. The insight that engineers and architects work differently in various European countries is another positive result of the international co-operation.

Negative: There was some difficulty using the Internet infrastructure and with the communication within the groups. Sometimes, e-mail was not answered quickly enough so that the process was delayed.

2.4.5 Summary

Four different courses have been introduced here as examples of net-based courses. The first of them, “Environmental Law and Economic Law”, is a standard online course given simultaneously in two different universities in two different countries and having a local tutor in each university. The second one, not related to engineering studies, named “Literature and Cinema”, is an example of a similar multilingual course: three languages were used in the course. The third course, “Developing Interpersonal Skills and Global Competencies in ICT and the e-Business Environment” is an example of a course independent of the time and place: both the mentor and the teacher managed their duties from several other locations than the university campus. The fourth course, “POLE Europe” is an interdisciplinary multinational course which combines the skills of professionals from several fields by the means of problem-based learning.

Information and communication technology offers the tools for putting into practice the change of the learning paradigm. The tools are, however, not used as widely as it could be supposed. The transnational courses where the students can use ICT tools are still at a developing stage. Many of the existing courses are at a pilot stage and thus give significant experience for future implementations. The students have reported that the language can be a problem when there are students from several countries: there can be understanding problems as well as cultural differences (material, tutor, other students) and it is, for example, not easy to change views or have a discussion within the groups or between individuals. Language problems are hard to solve with the tools we have today without the traditional tools: there should be mentors/tutors for every groups to facilitate the students during the learning process. Another reported problem is the Internet connection: not every student has Internet connections at home.

It should also be mentioned that the e-learning production process is heavy and takes time and needs innovative teachers and planners. The above mentioned courses differ from each other but have the same problem: how to produce the course that will give added value both to students and teachers. The basis (learning theory, group processes, tutoring, assignments etc.) should be planned very carefully. That means co-operation between different kind of professionals like educationalists, teachers, contents providers and technical staff.

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3. Students' Views of New Learning Challenges

The new learning methods in engineering teaching – problem-based learning (PBL) and project learning – are not really new, but currently there is more interest in widely adopting these methods in engineering teaching. One reason is that the methods combine two important factors, theory and practice. Problem-based learning and project learning also train students for real working life situations. European students of technology and university staff have had discussions concerning new learning methods in engineering studies and ICT in teaching and learning. Under Activity 5, three International BEST Symposia (IBS) have been forums for such discussions: IBS were arranged in Trondheim, Norway (1-3 March 2001); Helsinki, Finland (27-30 September 2001); and Chania, Greece (20-24 March 2002).

Trondheim, Norway

Problem-based learning was discussed during the IBS in Trondheim. The participants agreed that it should make careful investigation before using PBL in teaching. They also gave attention to the essential question which all the teachers and planners should take into consideration: it must be reconsidered very carefully which of the courses are PBL friendly:

> "Basic fundamental courses for example cannot find much practical use for a PBL based program. Basic Mathematics courses for once are found to be rather difficult to be approached in a typical problem based learning form. However it should be mentioned that the traditional way of teaching these courses should also be changed in such a way that the practical uses of the material handled become more evident. As a result the educational process for these theory-rich courses can become an insightful and more fulfilling experience. One way of doing that could be by altering the system with one final exam at the end of a semester. It would be far more motivating if there were credit based practical exercises during the whole semester that would lift some of the evaluation burden from the final exams."

As a comment one may state that the opinions of the participants of the IBS indicate some problems in understanding the PBL philosophy and methodology in a right way. The reason could be that PBL has perhaps not put into practice as it should. One of the reasons could be that the teachers are not familiar enough with the PBL method. The assignments can be poorly planned and as a result of that the assignments can be too time consuming or too unclear. Also the tutoring can be poorly structured and the students do not get support if needed. The feedback is also needed during the hole learning process to get the students to better realise their strengths and weaknesses concerning the subject.

The motivation also was under discussion during the IBS. The discussion group agreed that the students can be motivated to participate and operate actively within a PBL environment.

Motivating aspects were found as follows:

- Firstly, the thematic variety of the courses available to the discretion of the student would offer the unique chance to the students to take personal responsibility for their work.
- Credit based incentives are always welcome and PBL based evaluation can provide a better overview of the quality of work produced and the effort invested in the project by the student than traditional exams. This way the student is required to take initiatives and be creative, thus revealing his true potential.
- To motivate the students to learn by using PBL they have to get help in the beginning. There should be an active participation from the student in the topic selection process. To have the ability to choose the mainline of one's course would increase the motivation of the student a lot.
- Finally, is should also be taken into serious consideration that the evaluation of the undergraduate does not depend solely on the efforts made by the student on the examination day.

Helsinki, Finland

In the discussion report of the BEST Symposium in Helsinki, the participants summarised some important views on ICT in teaching and learning. First, the question was raised as to whether ICT should be a substitute for the current system or just complement it. The participants thought that e-learning was very useful and could really help in the learning process, but at the same time there were many aspects which made it difficult to begin e-learning. The participants felt that ICT in teaching and learning cannot be a substitute for the traditional lectures or exams. They also made a distinction between learning and looking up information and finally agreed that e-learning could be defined as "A new interactive method of learning using a computer network and other ICT". Second, the situation in Europe differs in many ways. The main problems are the attitudes of the teachers and the variable quality of the infrastructure. It was also mentioned that the new fields of engineering do not yet have much information on the Web even if the situation is rapidly changing.

The participants listed some goals of e-learning technologies:

- to make communication between students and teachers quicker and easier,
- to make learning accessible all the time,
- to make learning more attractive and reachable for more people,
- to enable access to a wide range of information from anywhere,
- to awaken the interest of already existing distance universities.

Some positive aspects were mentioned during the discussion: ICT provides the opportunity to learn new things at home, choose what is useful and important for the student, get information faster and wider, learn in one's own time, etc.

Some constraints were also found: there is a tendency to print everything, no social contact, students must pay costs when studying at home, possible language problems, and finally, ICT is not useful for every course.

From the teachers' point of view, there were both positive and negative aspects. A positive aspect was that by using ICT it is possible to reach more students and follow up on their progress. A negative aspect was that by using ICT there is too much work for the professor especially in the beginning.

Finally, the speakers focused on real interaction and the promotion of equality when using ICT in teaching and learning. They agreed that interaction in e-learning is real like a telephone conversation. The positive thing is that even shy students can more easily state their opinions and communicate with others when using ICT in teaching. It should, however, be noted that some misunderstandings are possible when working online.

Equality was also an important area of discussion. The participants referred to both economic and cultural equality:

- Between countries: e-learning could obstruct equality, because the Third World has a problem with the transition from one system to another, mostly because of the lack of infrastructure. Even between European countries the "equality gap" seems to be increasing. The participants thought that the governments have a very big role to play in solving this problem.
- Inside the same country, there seems to be a problem with the difference in infrastructure between rural and urban areas.

Chania, Greece

The IBS in Chania concentrated on Internet recourses and virtual libraries. The goal of the participants was to discuss ways of making learning more effective and interesting with the use of e-tools. Such tools include discussion groups, e-books and virtual libraries, e-notes, and web resources.

As an outcome the participants drafted the outlines of an ideal technical university course. The ideal course should foster earning and understanding while maintaining the students' interest in the subject. Being actively involved and interactive was seen as the best way to learn. Thus, the course should consist of both lectures (theory) and laboratory work (practice). The participants emphasised the importance of receiving all the information concerning the course during the very first lecture. The material of the lectures should be made available in the Internet.

The reports of the BEST Symposia can be found on the Activity 5 home page, http://virtual.hut.fi/E4_Action5/archives.htm.

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4. Conclusions

4.1 Change of Learning Paradigm

According to the current views on general learning theory, it is clear that student-centred learning, meaningful activities centred on real life problems are the key elements in developing the higher abilities and increasing competitiveness of future experts. The still widely prevailing educational model – top-down dissemination of knowledge from teachers to students – does not promote the development of expertise in the complicated information society. The same view can be seen in the reports on the discussions of the students and academics concerning the Problem Based Learning and Project Learning (collaborative learning) (see, for example, http://virtual.hut.fi/E4_Action 5/symposiumreport.pdf).

A general change in the learning paradigm, incorporating the ICT, as well as a change in the methodological approach in the teacher's education, is indispensable. ICT as a tool is usually less of a problem, especially in engineering education, where the application can be part of the learning process. The greater challenge is to affect the attitudes of both teachers and students.

4.2 Thematic Network as a Working Method

While the open Thematic Network (TN) is a good idea, there is a major problem. The members are often from different subject areas, represent many kinds of institutions and not all the participants can spend the same amount of time on the project. Usually the participants must take part in the thematic network in addition to their daily work, leading to a lack of time and often a lack of motivation. Moreover, the various subject areas do not necessarily give any added value to the participants to develop their own teaching area.

In light of the above mentioned, the TNs in the area of ICT in teaching and learning should obviously focus on more detailed subject areas. They should also pay attention to the different cultures, the infrastructure of information technology and how widespread the use of ICT in teaching and learning is in the educational institutions in different European countries. Sharing the expertise and good practices between the educational institutions in Europe is one of the most significant tasks. However, the development and creation of knowledge could be promoted by planning the thematic network programmes more carefully and by taking into consideration the weaknesses that have arisen especially during this TN project.

4.3 Stage of Virtual University

According to the results of the Virtual Universities Initiatives and the new teaching and learning methods questionnaire, the virtual university projects are still in their infancy in Europe. They are at the development stage. The goal and emphasis of the ICT is in campus-based learning. This comes up especially concerning the questionnaire delivered under the theme 3. No noteworthy results are possible to report. There are, nevertheless, many ongoing initiatives with respect to innovation in education using ICT. These initiatives, however, do not mean that there is a clear development towards online (Internet) courses. There is no evidence that Internet courses are considered to be the future. E-learning and innovation with ICT leads to very different perceptions. Some institutions consider software development and computer rooms to be e-learning. Other institutions consider e-learning to be virtual communities, virtual co-operation etc. A clear distinction has been made and this makes it very difficult to see where we are, where we are going and how we link the various initiatives. ICT in relation to 'virtual' administrative processes (enrolment, examinations, announcements) is becoming increasingly important.

It is not possible, however, to form any very detailed conclusions from the questionnaires under Activity 5. Some influential factors can be stated. First of all, the traditional learning paradigm, based on positivism, is still very predominant. Second, it also requires a great deal of time to change the traditional face-to-face lectures into the blended programs or completely net-based implementations. Third, the e-learning environments (technical platforms, software) are also not very acceptable in technical universities because teachers and also many students think they are not good enough and that the software is too complicated. They prefer instead of the commercial e-learning platforms the open code systems. This also influences the motivation of the teachers to develop the courses using ICT. Fourth, the enthusiasm towards e-learning varies greatly. Very broadly speaking, in the northern countries e-learning is perceived as a great opportunity. In the more southern countries, there are more doubts (we do not want to replace the teacher).

One of the major challenges, in both national and international context, is to facilitate the re-use of content and virtual co-operation (for example, students from University A who want to do a minor at University B). This requires synchronisation of systems (systems that can 'talk' to each other) and the use of Learning Content Management Systems whereby arrangements are made between institutes concerning how the content will be developed and structured (for reuse).

4.4 Obstacles of Development

One of the most important obstacles for new developments in teaching is the lack of time and financing. That means that the teachers should develop their own work and keep abreast of the times, learn new things and tools while teaching. Usually the time is limited and the teachers do not have enough resources. It should, however, be mentioned that many kinds of activities concerning the ICT in teaching and learning are going on. Many times something is missing: the pedagogical experts who are abreast of developments and latest research results in educational area.

4.5 Pilot Courses Show Reality

The pilot courses, nevertheless, give a view of reality in engineering education. It is possible to create the knowledge, share the expertise using ICT tools, and make studying more flexible for students. It takes time, money, much motivation and courage to lead the traditionally based teaching and learning into a new era.

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5. Recommendations

These recommendations are not only based on the results of the questionnaires during this project but also on the experience and understanding of the partners.

5.1 EU Level Activities

> ”In the e-Learning Action Plan[5], “e-learning” was defined as “*the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services, as well as remote exchanges and collaboration*”. However, “e-learning” has become shorthand for a vision in which ICT mediated learning is an integral component of education and training systems. In such a scenario, the ability to use ICT becomes a new form of literacy – “digital literacy”. Digital literacy, thus, becomes as important as “classic” literacy and numeracy were one hundred years ago; without it, citizens can neither participate fully in society nor acquire the skills and knowledge necessary for the 21st century. Full development of the Internet’s potential to improve access to education and training, and enhance the quality of learning, is the key to building the European knowledge society” (COM(2002) 751 final).

EU policy for ICT in education calls for the effective integration of ICT[6] in teaching and learning. The expectations of the European Union policies and a rapid development of ICT are challenging the higher education institutions to rethink and develop the teaching methods in a creative manner. ICT provides not only new tools for delivery, but also challenges the teacher to find new adaptations of learning theories and obtain new skills to enable students to create the knowledge and develop their professional skills and, thus, increase their competitiveness in the European or global market. ICT will also gradually change the teaching and learning culture. (Pantzar 2001, 241-255; Webster 2001, 259-278).

The use of new technologies in education has been supported by the European Commission in many programmes (the first one was the DELTA programme[7]). As a new approach, a benchmarking of national e-learning strategies can be recommended, as proposed by Markkula (2003, see Appendix 4).

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[5] COM (2001) 172 final.
[6] The Council of Ministers endorsed the e-Learning initiative and the importance of ICT for education and training in its e-Learning resolution of 13 July 2001.
[7] DELTA – ESPRIT; COM(1987)359 final.

5.1.1 Supporting Change in Higher Education Institutions

In spite of existing financial support, the European Union should give more focused financial support to the higher education institutions to develop their teaching methods to achieve the requirements that the information society demands of professionals. The universities should rethink and develop their learning methods and increase the number of pedagogical specialists to develop the learning process. This need can be seen particularly in technical educational institutions, where the knowledge of substance is first and foremost and very often the learning methods are underestimated and where opposition to changes is often very strong. Therefore, more pedagogical expertise is needed to increase and disseminate the knowledge of the latest research results in the area of pedagogical and expertise development and, thus, form an important and significant area in support of learning and teaching in technical institutions throughout Europe.

5.1.2 Supporting Thematic Networks

The thematic network idea is very good but involves some significant problems. The main problem is that participants are not very committed due to scarce financing, lack of responsibility and lack of time. The participants take part in the projects while working full-time and often have neither the time nor the interest to work effectively to achieve the objectives of thematic networks. Moreover, there are often no pedagogical experts involved in the networks of engineering education, especially on the technical side. That often means a lack of current knowledge of pedagogical research and some misunderstandings of the new learning methods are possible. This can also be seen in the symposia where students and academics discuss the learning methods and innovations in learning and teaching. One significant point is that there is a need to increase the number of pedagogical experts especially in technical universities and institutions to solve such problems.

The proposal is that the European Union continues to support the thematic networks or other kinds of networks, where academics and students throughout Europe can meet and exchange ideas concerning the development of learning and teaching in and for the information society. The structure of the thematic network should be clearer and the objectives should be more precisely focused. The concentration on one particular theme and subject area could give more results and added value for the participants. Moreover, the project structure should be supported so that the network can hire a substance co-ordinator to make the network more active. That could make a backbone for the project and activate and motivate the participants to reach the set objectives.

5.1.3 Supporting Change in Engineering Education Institutions

Because of the requirements of the information society and the rapid change in the learning environment, more direct financial support is needed for higher education institutions and especially for technical ones. The short programmes for technical teachers or some optional possibilities to develop their pedagogical knowledge are insufficient, especially in technical universities. Therefore, the change in the information society and its requirements for higher educational institutions should be supported by its own programme which will make it possible to increase the number of pedagogical experts and strengthen and speed up the change from the traditional learning and teaching methods to the new methods thus increasing the added value to both students and teachers and, finally, develop experts by using new learning methods for the information society.

The proposal is that the European Union support the higher educational institutions, especially technical ones, to increase the number of pedagogical development projects where the new research results, new learning methods and the use of information and communication technology in teaching and learning will support the development of students' expertise and change the attitudes of both teachers and students by increasing the information and knowledge in the field of pedagogical research and practise. The project finance would create a foundation for the development whereby the multi-science co-operation throughout European technical universities would support the change and development and, thus, would give not only added value to both students and teachers, but also to the information society. It also means support to develop the digital learning materials by taking into consideration people and their ability to learn not just technical possibilities.

5.2 National Level Activities

On a national level, governments should support the development mentioned above by projects where pedagogical expertise has a significant role. The national level financing should be in line with the European Union financing support so that the programmes support each other. The technical institutions should have a special area because of the lack of pedagogical experts, the opposition to changes in teaching and learning and the technical approach concerning the development of the methods and information and communication technology in teaching and learning.

5.3 University Level Activities

5.3.1 Supporting Change of Learning Paradigm

Every university should commit to the learning paradigm change (including ICT in learning and teaching) by making a policy and supporting co-operation and open discussion within university. They also should pay positive attention and concrete support to the forerunners who often are underestimated, alone with their views and often meets opposition and isolation. The co-operation and networking between universities on national and international level should be strongly supported.

In engineering education, institutions should arrange for all teachers and planners including the assistants (students) to receive continued training where the main area should be not only new methods and technical possibilities, but also the strategy of the institution including the pedagogical and technical possibilities in teaching. Special attention should be paid to changing attitudes by increasing the knowledge of pedagogy and the e-learning production process. Another very important area is to get teachers to commit to the objectives where the new learning paradigm is prevailing. The institutional level programmes should be planned according to the latest results of pedagogical and expertise development research.

5.3.2 Establishing Development Groups

The higher educational institutions, especially in engineering education, should establish development groups where a pedagogical expert is involved in the activities. The groups could specialise to different kind of areas where the development is necessary. The information and communication technology should play a significant role in teaching development. Both technical and pedagogical experts should co-operate in this particular area. Co-operation is important so that not just the technical view dominates when making decisions regarding the kind of learning platforms or other technical solutions that will give added value to students, teachers, administration staff and, finally, the university.

The developing group should consist of both pedagogical experts and content experts. Students should also take part in such a development group work. This is very important for two reasons: firstly, students can give their view on development, but, at the same time, they can become familiar with the obstacles and opportunities, as well as new pedagogical development (theory and methods, research results). The development group should co-operate with other development groups on a national and European level. The development groups should participate in the students' symposia in order to disseminate the latest information on the field of pedagogical and expert development. Moreover, the continuing short seminars at the university level should be the norm. It will take more hard work to change the attitudes than has previously been the case. Financing for such co-operation should be arranged.

5.3.3 Supporting Teachers

More support should also be given to individual teachers. The new pedagogical knowledge is of the most importance, not just the information and communication technology in teaching and learning, but also the learning theory, methods and the newest research results. The pedagogical expertise is underestimated, especially in technical universities. The technical universities should take this deficiency seriously and change the situation by organising support for teachers more carefully, by increasing the number of pedagogical experts who are up-to-date on the changes in that research area, and by supporting teacher training.

5.3.4 Immaterial Property Rights

Universities should be active and keep abreast of the times concerning Immaterial Property Rights (IPR) questions and developments in this area. This is important because it is possible to have problems with the content that teachers have produced. It is a hot topic when making content in digital learning environments.

5.3.5 Administration Structure

The global dimension, which will grow more rapidly because of the development of information and communication technology, does not only affect the learning methods or the need to increase the number of pedagogical experts in technical universities and other higher institutions. It also means paying more attention to the administration structure, which should be ready to handle the increasing number of foreign students, not only in the traditional manner, but also by using information and communication technology more effectively (e.g. virtual ERASMUS).

5.3.6 Recognition System

One of the important questions, when offering students net-based courses is the recognition system between universities throughout Europe. When using ICT in teaching and learning, students want more net-based courses in the future when the infrastructure in universities throughout Europe is at a suitable level, and the pedagogical development and e-learning production process will be at the level where more completely net-based or blended courses (where the university supports the student) are possible. The universities should be active in solving the problem in the near future.

5.4 Co-operation with the industry

At all levels, the universities and industry should seek for co-operation so, that the new knowledge of the universities could be combined with the educational needs of the industry. ICT-based continuing education can help the engineers in the industry to update their knowledge and the wider demand for educational modules can help the universities to finance the new developments.

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Appendices

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Appendix 1: ACTIVITY 5, Main activities

On 28 February 2001, the web-based conferencing area of Activity 5 (http://virtual.hut.fi/E4_Action5/conferencing_instructions.htm) was presented. The main purpose was to have a virtual common discussion area (First Class Service: http://fc.dipoli.hut.fi/). Helsinki University of Technology was in charge of organising this virtual environment.

The opening meeting of the Thematic Network Enhancing Engineering Education in Europe (E4) was held in Leuven, Belgium, on 2-3 March 2001. During the meeting, the participants planned the Activities and thus this meeting was significant with regard to the whole project.

The first work group meeting of Activity 5 took place on 3 March 2001 in Leuven, Belgium. The main purpose of the meeting was to make plans for the first project year. Helsinki University of Technology, Finland, was responsible for the arrangements. In all, 12 partners participated in the meeting.

BEST held an IBS (International BEST Symposium) in Trondheim, Norway, on 1-3 March, 2001, where the students discussed their views on e-Learning and Problem Based Learning. The facilitator of the e-Learning group was Ms. Lucia Gregorio. The discussion report can be found in the archives of Activity 5 (http://virtual.hut.fi/E4_Action5/archives.htm).

One of the Activity 5 members, Klaus Bednarz, TU Berlin, Germany, participated in the international seminar on ICT in engineering education. The seminar took place in Galway, Ireland, on 2–4 May 2001 and was organised by SEFI Working Groups of ICT and Curriculum Development.

A web conference took place on the conferencing area (http://virtual.hut.fi/E4_Action5/conferencing_instructions.htm) 14-29 May 2001. The theme was “What is ICT supported ODL?” and the discussion aimed at promoting the use of ICT by getting experience of the tools. Helsinki University of Technology, Finland, was responsible for the arrangements of the web conference. The moderator of the theme was Ms. Sanna-Marja Heinimo from Helsinki University of Technology.

The inquiry on the use of “Web-site and conferencing area as one method for working” was open on web page during 7.6.-29.9.2001. The main aim was to find ways to improve the web based work. The expected benefits to gain insight to the difficulties of the new way of working. Helsinki University of Technology, Finland, was in charge of this activity.

The Helsinki Local BEST Group organised an IBS on 27-30 September 2001. The aim of the IBS was to bring academics and students to the same discussion forum and recruit more students to work together in Activity 5. The report "Studying in e-space and other challenges for e-learning" was written by BEST and published on the web page of Activity 5, http://virtual.hut.fi/E4_Action 5/symbosiumreport.pdf (published on 4 December 2001). The symposium report also includes two other reports from one of the previous symposiums: "PBL Problem Based Learning" (Report of IBS Trondheim 1-4 March, 2001, published on the home page on 9 October 2001) and "From the classroom to the internet: Pedagogical and technological aspects for e-learning" (Report of IBS Trondheim 1-4 March, 2001). Helsinki University of Technology, Finland, and BEST Educo were responsible for the arrangements during the symposium.

Activity 5 held a work group meeting on 29 September, 2001 in Helsinki, Finland. The main aim was to evaluate the work done and make the plans for second year of the project. The meeting was held in Helsinki at the same time with the Helsinki IBS.

A working group meeting of Activity 5 was held in Florence, Italy, on 7-8 December 2001. The structure and contents of the report 'Virtual Campus Initiatives' and the preliminary results were introduced at the meeting. The questionnaire was finally sent to all the participants in the E4 project. The participants discussed, in general, the use of commercial and non-commercial platforms and the expected problems like community building, suitability for basic infrastructure, time needed for development, etc.

A work group meeting of Activity 5 was held in Weimar, Germany, on 22 February 2002. The discussion topics were the questionnaire about innovative learning and teaching methods, exchange of information about virtual universities and development of information material about E4 in German. Frank March, TU Ilmenau, briefly summarised the responses to the questionnaire concerning good practices.

The International BEST Symposium "Enhancing the Modern Technical University" was held in Chania, Greece, on 20-24 March 2002. The report from Discussion Group 2 in the framework of E4 Action 5, "Innovative Teaching and Learning Methods" includes discussion of Internet culture, overview of different countries, e-tools like e-books, virtual libraries, forums, e-mailing groups etc. The report can be found on the home page of Activity 5:
http://virtual.hut.fi/E4_Action5/IBS_Chania_2002_RS.doc.

An Activity 5 meeting, held in Berlin, Germany, on 3 October 2002 and made the plans for the third year. The main idea was to concentrate on completing the ongoing activities.

One of the Activity 5 partners, Mr. Frank March, TU Ilmenau, Germany, acted as chair in the SEFI Curriculum Development Working Group (CDWG) seminar "New

Teaching and Learning Methods: How Effective are They?" on 4-6 April 2003 in Universidad de Valladolid, Valladolid, Spain. The Working session was "Assessment of ICT applications to engineering education".

The first work group meeting of 2003 was held in Berlin, Germany, on 21-22 May. The main purpose of the meeting was to decide the structure of the final report, set the deadlines for the themes and the final reporting and prepare the reports of the themes within Activity 5. Five universities, Helsinki University of Technology, Finland, TU Berlin, Germany, Bauhaus-Universität Weimar, Germany, TU Ilmenau, Germany and TU Dresden, Germany, participated in the meeting and, as a result of the intensive and positive workshop, the responsibility for writing the final report and the deadlines were decided. The minutes of the meeting can be found on Activity 5 home page:
http://virtual.hut.fi/E4_Action5/WGBerlin2003.doc.

Several Management Committee Meetings of the Thematic Network- Enhancing Engineering Education in Europe (E4) were held in 2001-2003. Professor, Vice-Rector Matti Pursula, promoter of Activity 5, from Helsinki University of Technology, Finland, participated in the meetings. Mrs. Anneli Lappalainen acted as a substitute for Professor Matti Pursula.

All activities can be found on the Activity 5 home page
http://virtual.hut.fi/E4_Action5/.

Appendix 2: ACTIVITY 5, Active Institutions

Helsinki University of Technology (http://www.hut.fi) played an active role in promoting Activity 5 during the project. In all, 56 eligible and one non-eligible institutions and three (3) associations expressed their willingness to take part in Activity 5 in the beginning of the project. In addition, six (6) institutions did not specify their areas of interest. Finally, there were six (6) active universities who admitted responsibility for the themes, participated in the work group meetings, symposiums and conferences during the project and, in the end, finalised the Activity 5 report in co-operation with the promoter.

Professor Matti Pursula, Vice-Rector, acted as a promoter of Activity 5. Ms. Anneli Lappalainen, Director, acted as a substitute for Matti Pursula in the Management Committee (MC) meetings. Ms. Johanna Hartikainen, Ms. Riitta Saarinen and Ms. Ulla Lehtonen acted as academic co-ordinators. Ms. Anna-Kaarina Kairamo acted as a co-ordinator for the theme 3 of Activity 5, "Training for engineering teachers on facilitation of ODL". Finally, Ms. Inkeri Laaksonen acted as a writer and editor of the final report.

Swiss Federal Institute of Technology Zurich (ETH) (http://www.ethz.ch), Switzerland, admitted responsibility for the first theme of Activity 5, "Study on Virtual University Initiatives in Europe". Mr. Anders Hagström and Ms. Miia Lampinen acted as co-ordinators concerning the theme 1. They also collected and analysed the research material and reported the results. The report can be found on Activity 5 web page.

Technische Universität Ilmenau (http://www.tu-ilmenau.de), *Germany,* admitted responsibility for the theme 3, "Good Practices in the Use and Support of New Teaching and Learning Technologies. Mr. Frank March acted as a co-ordinator. He also collected and analysed the study material. The material can be found on Activity 5 web page.

Bauhaus-Universität Weimar, (http://www.uni-weimar.de) *Germany,* admitted responsibility for the theme four (4), "Transnational pilot courses on both "common core" and specialised engineering discipline subjects". Mr. Raimo Harder acted as the theme co-ordinator.

Technische Universität Berlin, (http://www.tu-berlin.de) *Germany,* acted actively during the project by participating, for example, in working group meetings and some seminaries. Mr. Klaus Bednarz acted as a co-ordinator during the project.

Technische Universiteit Delft, (http://www.tudelft.nl) *the Netherlands,* helped in analyzing the responses of the questionnaire sent under theme 3, "Good Practices in the Use and Support of New Teaching and Learning Technologies". Mr. Joost Groot-Kormelink overviewed and summarized the responses.

Board of European Students of Technology (BEST)
(http://www.BEST.eu.org/education), participated actively in the European Thematic Network by organising activities like IBS-symposiums, where academics and students discuss current topics like ICT in learning and teaching, its disadvantages and benefits, problems and possibilities. This Thematic Network offered a good platform for sharing experiences, creating knowledge and giving important information for decision-making bodies.

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*Helsinki University of Technology, Finland (*http://www.hut.fi*)*
Helsinki University of Technology is a state university in Finland. It provides Master's and postgraduate education in technology and conducts related research of a high standard. The university co-operates closely with Finnish and foreign universities, research institutes and business. The principal aim of the university is to provide a broad range (in all fields of engineering) of training in engineering, architecture and technology and produce researchers capable of developing and applying technology and engineering skills in the service of an increasingly international Finnish society, taking into account the constraints imposed by sustainable development. HUT is a full member of many international academic organisations, like CRE, CESAER, FEANI and SEFI. It also has increased international distance learning with a virtual university project in co-operation with the Lifelong Learning Institute Dipoli, which also is involved in many interesting international information and communication projects like EuroPace (Satellite education) and the Europe-USA Atlas project.

Visiting Address:
Helsinki University of Technology
Otakaari 1,
02150 Espoo
Finland

Postal Address:
Helsinki University of Technology
P.O.Box 1000
FIN-02015 HUT
Finland

Phone: +358 9 4511
Contact persons:
Vice-Rector, professor Matti Pursula, matti.pursula@hut.fi
Director Anneli Lappalainen, anneli.lappalainen@hut.fi
Academic co-ordinator, Ulla Lehtonen, ulla.lehtonen@hut.fi

*Swiss Federal Institute of Technology Zurich (ETH), Switzerland (*http://www.ethz.ch)

Contact persons:
Mr. Anders Hagström, hagstroem@ethworld.ethz.ch
Ms. Miia Lampinen, miia.lampinen@ethworld.ethz.ch

Technische Universität Ilmenau, Germany (http://www.tu-ilmenau.de)
Founded in 1992, the Technical University of Ilmenau is one of the youngest universities in Germany. However, engineering education enjoys a long and rich tradition in Ilmenau. It started with the opening of the Thüringer Technikum (technical school) in Ilmenau in 1894 and continued with the Hochschule für Elektrotechnik (College of Electrical Engineering) in 1953 and the Technische Hochschule Ilmenau (Technical College of Ilmenau) in 1963.

The departments of Electrical Engineering and Information Technology, Computer Science and Automation, Mechanical Engineering, Mathematics, Natural Sciences, and Economics currently have about 7,300 students (WS 2002/2003) in fourteen courses of study.

In addition to intensive basic research, applied and industrial-oriented research (and the associated knowledge and technology transfer to industry) has become a trademark of the University. In joint projects with businesses, the conditions required for the introduction of new technologies and the development of new products are created. This is especially true in fields such as mechatronics, microelectronics, microsystems engineering, image processing, medical technology, information technology, communication technology, and environmental engineering. Current developments in international research form the basis for research profiles. The TU Ilmenau orients its research activities toward these profiles and, thus, documents its specific competence in these areas: micro and nano systems and technologies, optical engineering and photonics, bio-medical engineering, modelling and guidance of technical and non technical systems, decentralised energy systems, mobile multimedia information and communication systems, intelligent mobile systems and assisting robotics, effects of new media technologies on economic processes and information/communication reactions.

The University sets high standards for the quality of education and study conditions. The combination of a personal atmosphere with a good social environment is another trademark of the TU. In contrast to many other German universities, there is a good ratio of teachers to students. Many students can finish their studies within the standard period of study (9 or 10 semesters – depending on the course of studies), including 20 weeks' practical work experience.

Conferences, meetings, workshops, and colloquia are a permanent part of scientific life on the Ilmenau campus. The longest running of these is the yearly Internationales Wissenschaft-liches Kolloquium (IWK) (International Scientific Colloquium), started in 1956 and has been organised every year by the Department of Mechanical Engineering, the Department of Electrical Engineering and Information Technology, or the Department of Computer Science and Automation.

The University places great value on connections to foreign countries, especially the continuation of the traditional relationships to the Central and Eastern European Countries, as well as expanding scientific contacts in Western Europe, the USA, South America and Asia. TU Ilmenau is a member of CESAER, IAU and other famous associations at the international level. It runs an office for student placements in Europe under LEONARDO DA VINCI and has wide-ranging agreements under SOKRATES.

Postal address:
Technische Universität Ilmenau
Postfach 100565
98684 Ilmenau
Germany

Visiting Address:
Technische Universität Ilmenau
Max-Planck-Ring 14 (Rectorat)
98693 Ilmenau
Germany

Contact persons:
Rector, Professor Dr.-Ing. habil. Heinrich Kern, rektor@tu-ilmenau.de
Dr. Frank March, Head of the department of Academic Affairs,
frank.march@tu-ilmenau.de
Phone: +49 3677 692533 (rector)

Bauhaus-Universität Weimar, Germany (http://www.uni-weimar.de)
At the Bauhaus University in Weimar, Germany, the Chair in Traffic Planning and Traffic Engineering held by Professor Dr.-Ing. Ulrich Brannolte was established in 1997. It belongs to the Faculty of Civil Engineering, which is one of the most prominent of German faculties.

The main activities in traffic and transport concerning scientific research, as well as graduate and post-graduate teaching, are in the areas of transport and infrastructure modeling, patterns of traffic flow, simulation models, structures and basics of mobility, traffic safety, economic evaluations, large-scale simulations and transport telematics. Though the Bauhaus University in Weimar mainly focuses on road traffic, all other modes of transport are studied for systematic inter-modal considerations and system analyses. Currently, a group of 13 scientific employees are engaged in this unit headed by Professor Brannolte. The unit is actively participating in the work of professional institutions and committees on a national and international level and it is a partner in several research projects for public institutions and private industry. The unit is involved in international programmes for education, re-education and training using multimedia tools. The main working areas of the unit for Transport Technology and Transport Planning include traffic engineering, traffic flow modeling, traffic system analysis, traffic safety and environmental aspects.

Postal address:
Bauhaus-Universität Weimar
Geschwister-Scholl-Str. 8
D-99421 Weimar
Germany
Telefon: +49 (0) 36 43 / 58-0

Visiting Address:
Bauhaus-Universität Weimar
Geschwister-Scholl-Str. 8
D-99421 Weimar
Germany

Contact persons:
Professor, Dr. Ulrich Brannolte, ulrich.brannolte@bauing.uni-weimar.de
Dipl.-Ing. Raimo J. Harder, raimo.harder@bauing.uni-weimar.de

Technische Universität Berlin, Germany (http://www.tu-berlin.de)
The Technical University Berlin (TUB) is the largest technical university in Germany with 29.000 students, 36 per cent of them being women; 20 per cent of the students are from foreign countries. There are eight faculties with 50 degree programmes in the fields of engineering and natural sciences, economics and business, planning sciences, humanities, social sciences and teacher training. TUB is a full member of many international academic organisations like SEFI and CESAER and co-operating in teaching and research with academic institutions all over the world.

Postal address:
Technische Universität Berlin
Strasse des 17. Juni 135
D-10623 Berlin
Germany
Telefon: +49 (0) 30 314-0

Visiting address:
Technische Universität Berlin
Strasse des 17. Juni 135
D-10623 Berlin
Germany

Contact persons:
Professor Georgios Tsatsaronis, Inst. of Energy Technology, Marchstr. 18, D–10587 Berlin
Dipl.-Ing. Klaus Bednarz, klaus.bednarz@tu-berlin.de

Technische Universiteit Delft, the Netherlands (http://www.tudelft.nl)

Contact person:
Mr. Joost Groot-Kormelink, J.B.J.Groot-Kormelink@tudelft.nl

Board of European Students of Technology (BEST), and especially its Educational Committee, has been involved in educational matters since 1996. BEST has actively participated in the European Thematic Network by organising activities like symposia, where academics and students discuss current topics like ICT in learning and teaching, its disadvantages and benefits, problems and possibilities. This Thematic Network has offered a good platform for sharing experiences, creating knowledge and giving important information for decision-making bodies. More information about the BEST Educational Committee:http://www.BEST.eu.org/education.

Appendix 3: ACTIVITY 5, Active Participants

Name	Institution/country
Heikki Aalto	Tampere Polytechnic, Finland
Aris Avdelas	Aristotle University, Greece
Emmanuel Alvizos	Board of European Students of Technology
Klaus Bednarz	TU Berlin, Germany
Borut Dobricic	University of Zagreb, Croatia
Juan Mario García de María	Universidad Polítecnica de Madrid, Spain
Stefan Gnüchtel	TU Dresden, Germany
Lea Grbic	University of Zagreb, Croatia
Kim Hacklin	Board of European Students of Technology
Anders Hagström	ETH Zurich, Switzerland
Raimo Harder	Bauhaus-Universität Weimar, Germany
Johanna Hartikainen	Helsinki University of Technology, Academic co-ordinator, Finland
Nella Jansson	Board of European Students of Technology
Tiit Kaps	Tallinn Technical University, Estonia
Malgorzata Konwerska	Warsaw University of Technology, Poland
Joost Groot Kormelink	TU Delft, the Netherlands
Ulla Lehtonen	Helsinki University of Technology, Academic co-ordinator, Finland
Frank March	TU Ilmenau, Germany
José Mendes	Universidade do Minho, Portugal
Konstantin Meskouris	TU Aachen, Germany
Luca Podesta	University of Rome “La Sapienza”, Italy
Oscar Portela	Universidad Polítecnica de Madrid, Spain

Carsten Proppe	Institute of Engineering Mechanics, University of Innsbruck, Austria
Matti Pursula	Helsinki University of Technology, promoter, Finland
Umberto Ratti	University of Rome “La Sapienza”, Italy
Rein Ruubel	Tallinn Technical University Innovation Centre Foundation, Estonia
Riitta Saarinen	Helsinki University of Technology, Academic co-ordinator, Finland
Juho Tiili	Tampere Polytechnic, Finland

Appendix 4: Bechmarking National E-Learning Strategies

The generation of value networks plays an important role in the development of a networking economy. The value networks reflect co-operation between the various operators, and the qualities of new services and products can only be provided through the operators' collaboration based on their own competence and expertise. As such, the creation of content is a value chain's most profitable activity. This means that the added value providing communities, which also function as a market for their content production, constitute an interesting trend in future development (Markkula 2003).

Emphasising the said challenges, one may characterise e-learning as a swiftly expanding industry that will affect the national economy through the following two mechanisms: Firstly, provided that it is wisely administered and used, e-learning will provide constantly improving learning results, costs savings, and time-related benefits in education, training as well as in their organisation and implementation. E-learning offers profitability and flexibility benefits to its public and private user organisations, and organisations in the third sector. This is due to the fact that it enables learning to take place faster, cheaper, and with a higher quality of results. Thus, e-learning can have a direct influence on organisations' competitiveness. Secondly, extensive use of e-learning will generate new businesses specialising in digital contents, technological tools and systems, and in the supporting service sectors. The e-learning market is global and has an attractive volume enabling the birth of a new export sector for Finland. Exploitation of e-learning will bring about new occupations and provide employment for people in service companies and user organisations (Markkula 2003).

Currently, a real challenge is to launch co-operation between the various operators on a practical level, so as to significantly speed up development. This calls for a joint policy and "operation platform", to achieve results. Simultaneously, this can enable lifelong learning and the required support from the developing national e-learning-based work culture. The following actions are recommended to be included in the policy:

a. Lifelong learning, from theory to practice
b. Strengthening learning to learn
c. Making the school atmosphere encouraging
d. Adopting learning communities as a work culture
e. Providing all citizens with the basic preparedness to act in the information society
f. Adopting the use of knowledge management toolboxes
g. National Knowledge Agora or "Knowledge Sharing Platform"
h. Making content production methods available in the field of e-learning
i. Customised mass production on a process basis
j. Generating a functional e-learning market
k. Rising to the challenge of acting as a pioneer country in high-level competence (Markkula 2003)

Appendix 5: Survey of virtual campus and virtual University activities in Europe

Foreword
Within the framework of Activity 5, "Innovative learning and teaching methods", of the Socrates Thematic Network E4 – Enhancing Engineering Education in Europe, the Swiss Federal Institute of Technology Zurich (ETH Zurich) has carried out a survey of virtual campus and virtual university activities in Europe.
The primary aim of the survey is, on the one hand, to provide a snapshot overview of the developments in Europe in this rapidly evolving field. On the other hand, the survey was designed to deliver insights into the different institutional approaches to virtual campus or virtual university initiatives.
A secondary aim is to form a network of institutions with compatible aims. Cooperation with other institutions can help to create new ideas for applications for working in virtual space. A network of virtual university initiatives with shared interests could add value for all participants.
We would like to thank the Swiss Federal Office for Science and Education and ETH Zurich for supporting the work on this study.

Zurich, March 2002
Miia Lampinen & Anders Hagström

E-learning and e-teaching at European universities
Using the World Wide Web as a tool for learning and teaching at university has grown dramatically during the last decade. There are many virtual campus and virtual university projects going on, mostly focused on e-learning and virtual study. There are, however, also some broader projects, which look beyond e-learning to include the needs of researchers, services and administration.
There are several European Union initiatives related to e-learning, bringing together different education components. With its support for e-learning the European Commission seeks to mobilize the educational and cultural communities, as well as the economic and social players in Europe, in order to speed up changes in the education and training systems for Europe's move to a knowledge-based society. (European Commission 2000)
According to Scott (2001) much more has been promised in the field of virtual learning than has actually been delivered. The Internet may be faster and more far-reaching than the traditional ways of searching for information, but it does not necessarily teach the student what to search for and what to do with the information once it has been found. The virtual working tools need to be supported both technically and from the side of the department or institution, so that users can get the most out of the tools.
In 1999, Kozma presented a theoretical framework of learner activities. According to him, the learner is actively collaborating with the medium to construct knowledge.

In this view, learning is seen as an active, constructive process whereby the learner strategically manages the available cognitive resources to create new knowledge. It means that technology-mediated learning should be understood as a partnership with teaching and learning. (Doherty 1998). Sangrà (2001) identifies also other relationships between students, experts and sources of information. In his view, technological networks allow a more tight interaction between these three actors. The idea is to progressively build shared knowledge and to develop abilities.
Barberà, Badia and Mominó (2000) understand interaction not as the possibility of establishing a connection between different elements of a computational or technological system. Rather, interaction is interpreted as a kind of situated socio-cultural activity, or as a relational and discursive activity, which is carried out in a virtual context and that may help, or fail to help, the student in the learning process.

Survey of virtual campus projects in Europe
The Swiss Federal Institute of Technology Zurich (ETH Zurich) has launched a strategic initiative for establishing a third, virtual campus for the university, called ETH World. ETH World will provide services in the areas of research, teaching, learning and services for the established disciplines and activities that the ETH Zurich is renowned for. ETH World is an integral part of ETH Zurich, supporting its core processes and facilitating the change in paradigm required of successful higher education in the knowledge economy. Research collaboration, e-learning, community building and information management are some of the key areas of development within ETH World.
The approach of ETH World is thus a broad conceptual framework for tools, services and facilities for students, faculty and staff. The word "campus" is used to denote the environment for the people who study, carry out research or work at the university. These elements include e learning, research activities, administrative services or other functions, i.e. complementing and supporting life on the physical university campus. This holistic approach differs from many, if not most, virtual campus / virtual university projects, at least as they are describe to the outside. How these projects are embedded in the broader institutional framework is much less known. It was the wish to find out more about what colleagues across Europe are doing, that gave us the initiative to this inquiry.

The survey methodology
The inquiry was carried out as a questionnaire survey, the results of which are presented in this report.
The survey was limited to the partners of the Thematic Network E4, some 100 institutions and organization in engineering education across Europe. The aim could thus not be to gather statistically valid, quantitative information about European virtual campus and virtual university initiatives. However, due to the broad range of the partner institutions in the E4 network, we believe that the results give a representative picture of the *kind* of initiatives currently under way in Europe.
In a first step of the survey we approached the contact persons from the E4 partner organizations to find out if they have virtual campus, virtual university of e-learning

projects in their institution, and, if yes, who the contact person is. This question was sent by email to 150 people. Seven persons immediately responded that their institutions do not have any such activities going on at the moment. A further three institutions responded that they do not have such activities going on at the moment, but that they were considering starting some in the near future.
Twenty-six institutions replied that they did have virtual campus/e-learning activities and provided a contact person. The survey questionnaire was sent to these 26 contact persons, with a sample replies for ETH World as an example. By the end of 2001, 13 answers were returned.

The survey questions
The questionnaire contained a total of eleven questions. The first question asked for background information with the purpose of clarifying the kind of organization the answer was coming.
The other questions were:

- Do you have an overall strategy plan for your virtual campus?
- What are the main emphasis areas in your project?
- Please, describe the e-learning offered at your institution.
- What are the target groups for your e-learning courses?
- What support is there for the development of e-learning?
- Do you offer electronic tools to students to support the planning and management of studies?
- How is basic ICT infrastructure addressed in the project?
- What is the role of library and information management in the project?
- What activities are related to research and the needs of researchers?
- How is community building promoted?

In this summary we analyze the answers grouped into two categories:
The main questions:

- Why universities offer e-leaning?
- What are the implementations of the e-learning project?

Subsidiary questions:

- How has e-learning been understood?
- What aspects belong to the virtual campus projects?
- What are the target groups of the virtual campus projects?

Analysis of the results of the virtual campus survey

About the respondents
The respondent universities are of varied size and structure. They can be divided into three different categories:

1. Smaller universities, with less than 10 000 students. To this group also belong the answers that covered only one department of a university.
2. Medium-sized universities with between 10 000 and 15 000 students, and
3. Large universities with more than 30 000 students.

The resources of these three categories are different as are their structures for organizing virtual initiatives for students, faculty and staff.
The most common activity for universities is to offer their students virtual services, above all e-learning courses, but also other online services. Almost all respondents offer their on-campus students different kinds of online services; many also offer services for faculty and other staff members.
An interesting point in the replies was that in the groups of small and medium-sized universities e-based information management and knowledge production were mentioned, whereas in the replies of the big universities this was not the case. Electronic courseware was mentioned in every group but different learning environments, such as Blackboard or WebCT were mentioned by name in the small and medium-sized universities groups.
The questionnaire revealed that the main idea of the different projects is to support teaching, develop it and offer to the students new possibilities to mix traditional ways to study with the new technology and its possibilities.

Why universities offer e-leaning
Almost all of the respondents reported that their institution, faculty or department has a strategic plan for their virtual campus project: some with clearly formulated strategies, others with plans consisting of many smaller parts instead of one overall plan.
Services for students and academic staff are the most important areas that universities want to develop. With these tools are then e-learning and e-teaching being developed.
For example the Technical University of Crete has been developing electronic toolkits and thematic portals aiming at the creation of an integrated services on e-learning.

How e-learning is understood
All respondents mentioned as one of the main objectives for virtual campus project the support of learning and teaching *on campus*. Almost all institutions also offer some courses of continuing education online.
The large universities emphasized that they offer supportive technology for virtual activities. In the medium and small size universities support is broader, e.g, support

for teaching and learning for on campus students and staff members.
The answers to the question "why" are similar in all three answer groups. One common theme is knowledge management and exchange. Another is the possibility to communicate more easily internally and externally, as well as community building and creating social interaction.

Components of virtual campus / virtual university projects
The possibility to structure teaching and learning in flexible ways is considered the main benefit of online learning materials. A second important reason for the respondents is the possibility to improve teaching quality and learning habits.
Integration is mentioned in two answers: one answer mentions the integration between the different institutions, the other answer the linking together of pieces of information offering single-point access to the teaching and learning activities.
E-learning itself is understood as a tool for new kinds of teaching and learning, supported by different kind of actions. The large universities tend to see e-learning as something for developing quality. Another element mentioned only by the large universities is that virtual campus project can help to bring university and society could to each other.
The importance of relationships with other universities depends on how the virtual university project is organized. For these relationships the respondents from medium-sized university group appreciate the virtual form.
For example, the University of Karlsruhe is partner in a virtual campus project, ViKar (Virtueller Hochschulverbund Karlsruhe, Virtual University Consortium Karlsruhe) with six other universities. The idea is to offer services for all partners of the project. Together this collaboration network tries to develop multimedia material for studies; for example, they offer virtual postgraduate study possibilities in the Karlsruhe region.
The support offered depends on the size of the respondent university or faculty.
For example, the University of Innsbruck has groups for developing material for their e-learning programs.
An interesting observation is that small and medium-sized universities mention communication more often than the large universities. In their answers, for example knowledge management is mentioned, but not communication as such.
For example, the Faculty of Engineering of the University of Porto has several objectives in its project, from providing management information to enhancing internal communication procedures and supporting the educational activities.

Target groups of virtual campus projects
Almost all respondent answered that their main target group is on-campus students. Many universities also offer some continuing education courses online. A few universities focus on different target groups.
For example, the Polytechnic University of Madrid has focused its courses to the needs of Spain and Latin American countries.
The University of Innsbruck provides some services for local schools.
Students of all disciplines were most often mentioned as the main target group for e-learning courses. Staff as a target group was mentioned by in two answers: by the Aristotle University of Thessaloniki and the Technical University of Crete.

Implementations of e-learning projects
Developing teaching and learning is the main objective of all respondents. Evaluation as a part of the virtual campus projects is mentioned only by the large universities.
For example, the Polytechnic University of Valencia carries out on-going evaluation with the aim to support the teaching and research staff and to obtain as a result an improvement of student performance.
Evaluation of a course was mentioned also in medium-sized universities responses.
For example, the Delft University of Technology has an electronic course evaluation system.
The organization and structure of virtual campus projects vary with the size of the institution. According to the survey results the large and some of the medium-sized universities have set up their projects through official structures, e.g. with project groups or committees. The large universities have committees formed for the purpose to organize and supervise e-learning activities. In the smaller universities there tend to be many groups working with developing e-learning, but without a uniting organization. The interest of individual departments or persons is the most significant factor in these projects.
Several of the medium-sized and small universities mention the activation of students and staff. Support for the users belongs to every virtual campus projects. Suitable infrastructure is part of the support, which needs to be taken care of, regardless of the size of the university. The areas emphasized vary and depend on which tools and services are being seen as most important for developing the virtual campus.

Further discussion
The universities that responded to the questionnaire survey see virtual learning opportunities as important and worthy of development. What these can offer is generally valued higher than the efforts it takes to build the system.
Large universities probably have more possibilities and financial support for virtual campus activities. This can also been seen in the answers, in that the large universities offer more technical support than the smaller ones. Support for developing content is mentioned more often in the answers of the small or medium-sized universities.
Government financial support is often mentioned in the answers as an important support aspect. Questions about financial support for projects was not put directly in the survey, so this aspect is not addressed in all answers. On the other hand, some replies only describe how the financial support is organized, not mentioning any other kind of support.
The cooperation between universities is seen as important, for example, for developing the technical systems. There is no one system that is better than the others and every university has their own needs concerning the technical demands. Through cooperation the differences between various systems can be discussed, and perhaps that way the best solution for everyone's own needs can be found.
In the introduction of this analysis, some ideas were presented about where e-learning and virtual campuses are at the moment. A next phase would be to discuss how to add more value to students, faculty and staff members so that they would use and develop these virtual environments further.
As to Scott's claim that much more has been promised in the virtual learning field than has actually been delivered: how could content be generated that is more than

just "nice ideas", how to create materials that really are of value to the user?
How are Sangrà's ideas being addressed by today's virtual campus projects? How, in practice, are technical networks being used to support closer interaction between students, experts and sources of information with the idea of progressively building shared knowledge and develop abilities?
Activity 5 of the Thematic Network E4, together with the Board of European Students of Technology, BEST, organized a symposium about studying in e-space and other challenges for learning. The symposium report describes initiatives undertaken in e-learning. The symposium participants found that most of the virtual universities offer services just for their registered students, or a fee needs to be paid to gain access to the materials. They also observed that the Internet is the main platform for e-learning; hardly any other tools beside Internet and e-mail systems are being used. (E4 Activity 5 & BEST 2001, p. 50.)
Synchronous, real-time initiatives have mostly been neglected; asynchronous initiatives dominate. In the symposium reports the students state that e-learning should be seen as a tool for improving face-to-face education, not to substitute it. They remind us that real-time tools are very effective when wanting to avoid cultural misunderstanding, and for improving teambuilding. (E4 Activity 5 & BEST 2001, p. 52.)
Creating and developing virtual campus initiatives is not enough. Both developers and users need to be motivated to do the work and to use the different possibilities. Virtual initiatives can support higher quality in education and research. They can also help to change the universities in the direction of future demands.

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Universität Innsbruck (University of Innsbruck)

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	Universität Innsbruck [University of Innsbruck]
Name and email of contact person	Georg J. Anker georg.j.anker@uibk.ac.at
Position	Head of New Media and Learning Technologies Section, Centre for Informatics Services
Profile of the Institution	The University of Innsbruck's history goes back to the year 1562. Currently the University has 7 faculties and 120 departments and clinics. Faculties: Catholic Theology, Law, Social and Economic Sciences, Medicine, Arts and Letters, Natural Sciences, Engineering and Architecture. Today, with almost 2,500 staff and 30,000 students, it is western Austria's largest institution of higher education and research and serves as the home university for Tyrol, Vorarlberg, South Tyrol and Liechtenstein. The University of Innsbruck has seven faculties and 120 departments and clinics, enjoys an excellent teacher-to-student ratio and successfully melds culture, nature and science, all of which provide students and instructors alike with a friendly environment in which to learn, teach and conduct research. The New Media and Learning Technologies Section of the Center for Informatics Services at the University of Innsbruck is a service provider helping faculty to develop course materials for flexible study programs and supporting students to get access to such programs. It also sets up and maintains services like a learning platform, streaming media and videoconferencing technology. Besides this it is involved in faculty development. It also provides some services for the local school sector.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
The *Innsbruck Model for Flexible Study Programs* is the "philosophy" behind all virtual campus activities. It has been approved by the Senate of the university. One of the key actions to be taken is to set up a competence centre that supports faculty to develop highly professional online course materials. The New Media and Learning Technologies Section is the "nucleus" of such a competence centre.

3. What are the main emphasis areas in your project?
Flexible study programs are the framework for technology use. Such programs shall enable students to combine traditional learning with new forms of learning – e.g. by using media and technology for learning at a distance – and also by taking courses at other institutions. Another key issue besides making study programs more flexible is to improve traditional forms of teaching by supplying supportive technology like learning platforms or communication tools on a campus wide level. Introducing such tools also has positive side effects on faculty development and the quality of teaching. Finally, flexible study programs seem the adequate form of teaching for the "new clientele" of the university in the context of life long learning.

4. Please, describe the e-learning offered at your institution.
There are many initiatives at department level and initiatives at university level. At university level the *New Media and Learning Technology Section* (NM-Section) is the main service provider. It provides the following services: • **E-Campus** is a learning platform available for all students and staff. Currently there are about 22.000 registered users, more than 4000 users are enrolled in about 400 courses. The software used is Blackboard, training and support is provided by the NM-Section. http://e-campus.uibk.ac.at/ • **Learning material production teams** help faculty to develop online course materials. Such teams consist of educational designers, web and user interface designers, graphics designers, programmers and audio and video specialists. These teams – in cooperation with faculty members who provide content – do the course building and give advice on (new media) didactics. One pilot team has produced several courses during the last six months. Up to five such teams are planned in the near future. • **Streaming Media for teaching** (live and on demand) is available on a large-scale basis (server side). Also special streaming units (hardware and specialised personnel) are available for broadcasting and archiving live events like lectures. • **Videoconferencing Infrastructure** (seminar room based and mobile) is available for H.320 (ISDN) and H.323 (IP) videoconferencing. The room based videoconferencing system is connected to interpreter workplaces allowing teleconferencing interpretation services. • An **image database** will be available beginning with 2002.

5. What are the target groups for your e-learning courses?
Students in all disciplines. Some continuing education courses are also offered online. Besides, the university provides some services for institutions in the local school sector.

6. What support is there for the development of e-learning?
As mentioned above, specialised teams help faculty to develop an e-learning strategy for their courses and support faculty in producing highly professional course materials. These teams are also involved in faculty development. Another important aspect is to provide the university with the necessary infrastructure like a campus wide learning platform, streaming media and videoconferencing infrastructure, etc. There is also support for students using this infrastructure – e.g. a help desk.

7. Do you offer electronic tools to students to support the planning and management of studies?
There is an online course catalogue for the whole university. In Social and Economic Sciences exists a tool for electronic course enrolment, which is about being integrated with the online learning platform. The online learning platform (e-campus) offers tools like calendar, notice board, task planner, digital drop box, communication tools, assessment manager, online gradebook, etc. These tools support both students and faculty in the planning and management of studies. If not restricted by instructors, also enrolling in (e-campus) courses can be done online.

8. How is basic ICT infrastructure addressed in the project?
The New Media and Learning Technologies Section is responsible for both, planning, setting up and maintaining the necessary central infrastructure and also for managing the learning material production teams and to support faculty development in this field. Services like maintaining hardware and system software are provided by the Centre for Informatics Services. This approach helps to address the ICT infrastructure issue in a highly "customer centred" way.

9. What is the role of library and information management in the project?
The University Library offers university members access to a wide range of electronic information sources and a nation-wide OPAC. In cooperation with the University Library and Libri Germany an integrated publishing project has been realized. In this project, online publications are made available on paper by using a book on demand service. Beginning with 2002 all students are invited to publish their doctorate thesis that way. Other important projects in cooperation with the university library address digitising books.

10. What activities are related to research and the needs of researchers?
Research projects in this field are carried out mainly by departments. Examples are the evaluation of learning platforms or projects on EML (Educational Modelling Language).

11. How is community building promoted?
Community building is supported by several tools and initiatives. The **e-campus** learning platform provides students with the necessary tools to form learning communities. **iPoint** reports daily online on events and matters concerning the whole university. It's target group are students, faculty, other staff, alumni, the general public and the media. Several departments have set up their own servers to allow students and staff to form online communities. Besides internet or intranet based tools there are several events a year allowing e-campus users and the e-learning community to share their experiences and to discuss improvements of existing e-learning infrastructure. Another important issue is networking and harmonizing infrastructure and policies with other local educational institutions and nearby universities like the university of Salzburg.

Technical University of Denmark – DTU

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Technical University of Denmark – DTU**
Name and email of contact person	Frede Morch, fm@dtv.dk
Position	Head of Centre – DTUs Learning Resource Centre
Profile of the Institution	As a modern technological university, DTU, the Technical University of Denmark, operates at a high international level in a wide array of activities in fields such as biotechnology, communications technology, nanotechnology and development of technologies for sustainable energy. The University's research and teaching is provided by 16 institutes, a number of major independent centres established as joint ventures between DTU and companies and research institutes in the region. Like all modern universities, DTU also operates a number of transient and dynamic centres in which the driving force resides in collaboration across different fields of research and organisations. The University embraces most of the engineering disciplines, and trains engineers to Bachelor, Masters and PhD level. In addition, the University offers a comprehensive continuing education programme, with a number of courses taught in English. The University has 6000 students preparing for Bachelor and Masters degrees, 600 PhD students and takes 400 foreign students a year on English-taught courses. DTU also has a permanent 400 of its Danish students away on varying length courses at foreign universities.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
DTU established a State-Of-The-Art virtual Campus autumn 2000, called CampusNet. DTUs strategy is to further develop this facility, which today serves +10.000 users with individually generated, automatically updated homepages regarding teaching and learning activities for each individual member. DTU has explicitly committed itself to the further development of CN in its recent development contract with the Danish Ministry of Education

3. What are the main emphasis areas in your project?

CampusNet (CN) offers a suite of synchronized and personalized services for each member

- ❑ Current update of data from the various data pools of DTU, especially data regarding studying and teaching activities.
- ❑ For each course CN offers

- Participants
- Calendar
- Timetable
- Messages
- Conference
- Chat
- File sharing
- Homepage

All these services are collected from the course-sites of each member, into one service pr. facility – e.g. one synchronised calendar, one timetable etc.
Furthermore CN offers the possibility to enrol to new courses, exams etc.
CN is accessible globally - all it requires is an Internet Access Point and a browser.

4. Please, describe the e-learning offered at your institution.
At DTU E-learning is decentralized to the 16 different institutes. CampusNet comprises the mutual and unique gateway to the local E-learning activities, and synchronizes communication, enrolment to courses/exams, gateways to teaching material etc.

5. What are the target groups for your e-learning courses?
Regular students, academics seeking life long education components etc.

6. What support is there for the development of e-learning?
CN is supported for all members, with open phone/mail response 10.00-16.00 each day. DTU allocates means fore further development of CN at the annual budgets. Two centres – LRC and CDM – offer didactical and technical support for E-learning developers. LRC: Learning Resource Centre CDM: Centre for Engineering Educational Development

7. Do you offer electronic tools to students to support the planning and management of studies?
Yes – CN does just that as a core facility.

8. How is basic ICT infrastructure addressed in the project?
In fact the ICT of DTU comprises the backbone of CN! One of the demands to CN is that it must not generate redundant data. Therefore CN only uses data from DTUs basic ICT, such as a number of databases, e.g. project databases, databases containing staff members, teachers and students, an on line course catalogue and several other bases. CampusNet re-use data from the bases, individualising and combining the flow into a personal homepage. CN is prepared for other potential institutional users, as it comprises gateways to various types of basic university data pools. DTU experiments with laptop for new students, and implementation of a Wireless LAN at Campus – all initiatives which enhances the usefulness of CN.

9. What is the role of library and information management in the project?
DTV – the Technical Knowledge Centre of DTU, has developed an advanced and comprehensive full text delivery service – see: http://www.dtv.dk/help/dads/index_e.htm In 2002 a Course DADS will be developed for CN, enabling the teacher to combine an individual full text service for each of his/her courses.

10.What activities are related to research and the needs of researchers?
Distance learning didactics and –technologies are research topics in the further development of CN. Furthermore CN is looking into how to improve the different services and modules of the system, e.g. the conference module, the message board, the calendar etc.

11.How is community building promoted?
One of the core qualities of CN is the fact that it knows its members, and requires an individual PW/Login procedure for access. Hence each member HomePage in CN is individually collected and updated, so that CN becomes thee single point access point regarding teaching and learning activities. At the same time, CN provides possibilities to build communities. Every member of the university can create groups and invite members to join the group. In this respect CN can be compared with other group-wise products, as a community building tool. DTU is planning to build alumina societies based on CN for previous students, which in this way will be able to keep contact, use further education offers etc. from their university.

Espoo-Vantaa Institute of Technology

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Espoo-Vantaa Institute of Technology (EVTEK)**
Name and email of contact person	Markku Karhu, markku.karhu@evtek.fi
Position	Programme Director, Information Technology, EVTEK
Profile of the Institution	Espoo-Vantaa Institute of Technology (EVTEK) (www.evtek.fi) consists of three different schools: EVTEK Institute of Technology, EVTEK Mercuria Business School and EVTEK Institute of Arts and Design. The total permanent staff of EVTEK is 500 and the total number of students about 5000. EVTEK Institute of Technology was founded in 1985 as a technical college. It was established as one of the first polytechnics in Finland in 1996. The study programmes in EVTEK Institute of Technology are designed in close co-operation with industry. Thus, the students receive both theoretical knowledge and practical experience in their chosen field. In the Institute of Technology there are twelve study programmes: Automation Technology, Biotechnology, Computer Engineering (English), Digital Information Provision (English), Building Services Engineering, Electronics, Land Surveying Technology, Logistics and Information Management, Surface Treatment and Materials Technology, Chemical Engineering, Computer Engineering and Media Technology. The total permanent staff of the EVTEK Institute of Technology is 201 and the total number of students about 3000. **Information technology:** The main goal of the Information Technology programme is to prepare students for engineering careers in information technology, software, electronics, computer, data and tele communications, and automation industry. The jobs range from systems, hardware and software design to consulting, product support and marketing. The programme provides a solid basis for understanding both hardware and software aspects of computer systems design and use. Data communication and measurement applications based on embedded microcomputer systems and real-time software. To support that aim, general information technology skills, are also provided. The programme provides R&D competence on: Software Engineering focused on Software design, Operating systems, User interfaces and Multimedia; Embedded Systems focused on Design methods, Measurement systems, Development tools; Computer Communication focused on Protocols, Local area networks, and Design and implementation. Some of the R&D projects are funded from public sources (Tekes, EU) and more than half of them are carried out on commission initiated by enterprises. **http://www.evtek.fi/indexeng.html**

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?

The strategy is more a sum of individual projects and approaches than a proper wide strategy. Individual projects are: 1) learning and training complex (with Espoo City and companies) Virtual polytechnic in Finland (consortium with 30 Finnish polytechnics).

3. What are the main emphasis areas in your project?

There are three domains where to work: platform, e-based courseware, e-based support and management. There are platform to support e-based learning but they are not yet good enough (WebCT is one but there are still room to improve it).

To develop courseware suitable for e-based learning is a huge task: on normal teaching hour requires 25 –100 hours of work to develop a good e-courseware. So far there is no resources for such an effort. E-learning and support is the easiest task.

4. Please, describe the e-learning offered at your institution.

In the IT department some courses are offered based on e-learning concept:

EVTEK is a member of Cisco Networking Academy which is world-wide consortium. Eight courses on networking are offered here (CCNA and CCNP). http://www.cisco.com/warp/public/779/edu/academy/

Individual basic language courses are offered at Web.

NETPRO project (EU) is about to develop Network-based project learning platform to manage assignments for students. http://netpro.evitech.fi/

Network Based Joint Venture Courses on Software Production is new project under Asia IT&C programme (EU) to develop e-learning courseware. http://www.asia-itc.org

Virtual polytechnic concept is starting in Finland and EVTEK belongs to one group to develop a Web based course on mobile technologies.

http://www.tpu.fi/virtuaaliamk/index_eng_tiedostot/v3_document.htm

5. What are the target groups for your e-learning courses?

On-campus students in all disciplines. Some continuing courses are offered online.

6. What support is there for the development of e-learning?

Most development projects are funded from a public source (EU or national Tekes) and a part is funded by EVTEK itself.

7. Do you offer electronic tools to students to support the planning and management of studies?

Students enrol to the courses online as well as their credits and grades are visible in the system (Winha). Students can update their personal data in the system. WebCT is used a learning platform but also other platforms are used.

8. How is basic ICT infrastructure addressed in the project?
Basic infrastructure is available but not always suitable: A problem for students is access: inside campus where the LAN is available the access does not cots anything but if they want access remotely, they have to pay pretty expensive costs to operators. This limit the Web-based courses to be usable at distance.

9. What is the role of library and information management in the project?
EVTEK library offers a wide range of electronic information sources. http://kirjasto.edu2.evtek.fi/en/

10. What activities are related to research and the needs of researchers?
Some similar (to virtual campus) development projects are ongoing to develop portals and to network companies (most SMEs). One project develops an extranet and its services for a consortium of companies working in the environment business http://uverkko.evtek.fi and another portal application for European SMEs with a title: E-Business Service Accounting Network http://ebsan.evitech.fi/ebsan/

11. How is community building promoted?
All such activities increase communication between partners inside and outside the campus but also between companies.

Helsinki University of Technology

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Helsinki University of Technology**
Name and email of contact person	Anna-Kaarina Kairamo, anna-kaarina.kairamo@hut.fi
Position	Project manager, Teaching and Learning Development, HUT
Profile of the Institution	**Short history:** Helsinki University of Technology (HUT) (www.hut.fi) is the oldest and largest university of technology in Finland, dating back to the nineteenth century. In 1849 the Helsinki Technical School was founded, marking the beginning of organised technical education in Finland. In 1872 the school became Helsinki Polytechnic School and in 1879 Helsinki Polytechnical Institute. In 1908 it was changed to Helsinki University of Technology and thus began the teaching of technology at university level in Finland. In the 1950's and 60's new premises were built to house the University of Technology in Otaniemi and the university moved from Helsinki to the neighbouring city of Espoo. **Excerpt from Rector's review** (www.hut.fi/General/review.html): "In our teaching, we paid particular attention to developing networked learning. HUT has played a central role in creating a national virtual university, a process that advanced during the past year to a point where we could complete a consortium agreement on virtual universities that applies to all universities in Finland. Officially, the Finnish Virtual University started in January 2001."

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
The strategic plan for the HUT electronic campus was first established year 1997 and revised spring 2000. This strategy can be found in Finnish at: http://www.hut.fi/Yksikot/Kehittamisyksikko/stra04.html. In relation to the strategy a discussion paper on ICT use in teaching at HUT was prepared during spring 2000. This paper can be found (also only in Finnish) at the address: http://www.hut.fi/Yksikot/Opintotoimisto/Opetuki/kirjoitukset/tvtopetuskayttoTKK.html

3. What are the main emphasis areas in your project?
HUT aims to effectively develop and use ICT based methods for knowledge production and management in all its areas of interest but especially in research. All distributed knowledge is converted to electronic format if possible. Teaching and learning are supported using the campus network and appropriate methods and software. Teachers and students are activated to explore the possibilities of new ICT supported learning environments. Learning will become more effective and economical and less bound to time or place. HUT invests also in the basic research in Information technology and so-operates with national and international universities and enterprises to support the product development in relevant areas.

4. Please, describe the e-learning offered at your institution.
In the graduate and post-graduate level the e-learning could be defined maybe as the ICT based methods that support the on-campus teaching. So far there are very few distance learning courses for off-campus students. There is a common course-management system which all teachers use. The same system has also a student user interface (see Question 7). In addition to that teachers use ICT tools in very different ways. A brief survey on the different ways of using ICT in teaching was conducted in January 2001 and the results can be found at: http://virtuaali.tkk.fi/TVT-kysely/index.html (in Finnish). In training for teachers and continuing education the fully web-based courses are more common than in graduate level.

5. What are the target groups for your e-learning courses?
On-campus students (for ICT supported on-campus courses), teachers and professional engineers (for web-based continuing education courses and ICT supported on-campus courses).

6. What support is there for the development of e-learning?

HUT provides training for the teachers and other personnel in adaptation on e-learning. The courses vary from software specific training to a 10 study week credits (equiv. to 15 ECTS credits) long comprehensive course. Some financial support and personal consultation is also available for people with e-learning projects. People with similar projects are also systematically brought together in order to establish inter-departmental networks and discussion forums. Also 2-4 seminars per year are arranged to inform all about the whereabouts of different projects and initiatives.

Teachers can also get support in installing and using computer programmes. No specific learning environment is chosen to be supported and people more often actually operate on "open learning environments" (i.e. combination of web-pages, email, news groups, chat, etc.).

The distributed learning centres around HUT campus highlight the special features and functions of the respective departments and laboratories in terms of organising and managing the learning centres. Issues addressed in the overall development of these centres include the facilities (equipment as well as connectivity and accessibility), possibilities for group work and workshop, and human support also via virtual means. Further research is needed in the area of support: defining the hours required (24/7?) de facto and type of support (equipment/application/content)

7. Do you offer electronic tools to students to support the planning and management of studies?

The students have their own interface to the course management system mentioned in q4. This is the way the students enrol to courses. In the same system they can also order course materials, enrol to exams and practise groups. A timetable is created according to the enrolments and students can also do long term plans by choosing courses for their own list and indicate e.g. semesters in which they are planning to take the chosen courses and decide to which "block" (major, minor) the course is going to go to.

There is also a web-site for students, which has hints and exercises related to study skills. (http://www.hut.fi/Yksikot/Opintotoimisto/Opetuki/tehopenaali).

8. How is basic ICT infrastructure addressed in the project?

Very little is systematically done in this matter. A situation is probably partly due to the fact that part of the infrastructure is centralised, but quite a lot of it is decentralised and is also developed and acquired faculty-wise addressing their needs.

9. What is the role of library and information management in the project?

The HUT Library offers the campus a wide range of electronic information resources acquired via consortium as well as own licence agreements. The Library has established an electronic publishing site for HUT dissertations, available at http://lib.hut.fi/Diss.

The metadata of other electronic publications by HUT faculty and researches is maintained by the Library via the current research information system of HUT. http://otatrip.hut.fi/tkk/julkaisee/search.html.

In order to ensure the student's adequate information literacy skills the Library runs courses "Searching for Scientific Information" – 1.0 study week (equiv. to 1.5 ECTS points) in the curriculum. The courses are designed for distance education purposes and promote the networked information resources. For international students the courses are available in English. http://lib.hut.fi/Opetus/Informatiikka.

To enhance the possibilities of geographically and time-wise independent library use the HUT Library launched its mobile services. At the moment the "library in your pocket" project takes advantage of SMS-messages but future plans include more sophisticated methods of communication as the mobile phones using advanced technologies become more common.

10. What activities are related to research and the needs of researchers?
The information needs of the virtual research university are met by the development of the electronic campus library. Close co-operation in this respect is done with the FinELib consortium to develop a researcher's portal to these information resources.

Universität Karlsruhe, Zentrum für Multimedia

<table>
<tr><th colspan="2">BACKGROUND INFORMATION</th></tr>
<tr><th colspan="2">1. Respondent and institution information</th></tr>
<tr><td>Name of Institution</td><td>Universität Karlsruhe, Zentrum für Multimedia</td></tr>
<tr><td>Name and email of contact person</td><td>Prof. Dr. Peter Deussen, deussen @ira.uka.de
Dr. Hartmut Barthelmess, barthelmess@ira.uka.de</td></tr>
<tr><td>Position</td><td>Zentrum für Multimedia (ZeMM)</td></tr>
<tr><td>Profile of the Institution</td><td>Main tasks:
1. Project «Virtueller Hochschulverbund Karlsruhe (ViKar)»
http://vikar.ira.uka.de
within the framework of the program Virtuelle Hochschule Baden-Württemberg
http://www.virtuelle-hochschule.de
Goals – (For details in German see the ViKar web site):

• Virtual campus of the 6 participating universities in Karlsruhe for additional course offering for the students of these universities
• Modularisation of courses
• Joint seminars und colloquia over an ATM ring

2. Maintenance of the Learning Servers for Computer Science studies
http://lernserver.ira.uka.de

3. Support within the University of Karlsruhe for the media development plan.
Regrouping all multimedia activities of the faculties within the University of Karlsruhe</td></tr>
</table>

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
See above + Transfer of course offerings into the normal activities of the institution.

3. What are the main emphasis areas in your project?
See above.

4. Please, describe the e-learning offered at your institution.
Course material for Computer Science studies at http://lernserver.ira.uka.de Recorded lectures Computer Science I, II, III: http://www.ubka.uni-karlsruhe.de/diva/video/sammlungen/

5. What are the target groups for your e-learning courses?
Students from the 6 universities cooperating within ViKar.

6. What support is there for the development of e-learning?
ViKar: Financial support during 5 years through the government of Baden-Württemberg. Other budgetary means, other projects means.

7. Do you offer electronic tools to students to support the planning and management of studies?
The ViKar Virtual Campus will integrate study guidance.

8. How is basic ICT infrastructure addressed in the project?
The learning server of the Faculty of Computer Science offers courses only on ICT topics ViKar develops materials on ICT; Mathematics; Networked Knowledge: Art – Culture–Technology.

9. What is the role of library and information management in the project?
University and Faculty libraries are integrated in the Virtual Campus.

10. What activities are related to research and the needs of researchers?
-

11. How is community building promoted?
Through support for communication.

Aristotle University of Thessaloniki

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Aristotle University of Thessaloniki**
Name and email of contact person	Aris Avdelas, avdelas@civil.auth.gr
Position	Associate Professor, Institute of Steel Structures, Dept. of Civil Engineering
Profile of the Institution	The Aristotle University (AUTh), established in 1925, consists today of 41 Departments as well as many other units, such as laboratories, study rooms, libraries, clinics, etc., which make it the largest university in the country in terms of the staff (more than 4000), the number of students (more than 70000)and the facilities offered. The School of Engineering of the AUTh (created in 1955) includes the Departments of: Civil Engineering (the first to be established), Architecture, Rural and Survey Engineering, Mechanical Engineering, Electrical and Computer Engineering, Chemical Engineering and the Department of Informatics Mathematics and Physics. Each Department, except for the last one, gives it own Diploma.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
The Information Technology Centre Of Aristotle University of Thessaloniki, Greece, established in 1998, offers a variety of computer facilities, to the Academic Community. It runs client-server applications such as Matlab, Arcinfo, Sigmaplot, AutoCAD, Primavera through its campus distributed Andrew File System on HP-UX, Solaris and Windows NT platforms, as well as host-based applications such as Mathematica 4.0 and GCG on Solaris machines (SUN Enterprise 450 and 250). In addition all users have access to High Performance Computing facilities, currently a SGI power challenge XL with 14 R8000 CPUs and 1GB RAM shared, through ssh, ftp and -11 servers. All these systems are heavily networked in TCP/IP over FDDI, ATM, Fast Ethernet and base Ethernet. The University Information Technology Centre also provides technical support on computing to all university members via phone, email, or fax on working days from 9:00 to 17:00 and takes care of site licensing matters, central multi-platform backups, maintenance contracts, etc. Throughout the academic year ITC organises short-term seminars on popular software packages or the use of the University's Computer Infrastructure.

3. What are the main emphasis areas in your project?
As a part of the "Operational Project for Education & Initial Professional Training", funded by the Greek Ministry of Education and the Second Community Support Framework, many Departments have obtained financing, in an open national contest, in order to introduce innovative teaching methods and media in Higher Education. Also, in the framework of the same Project, the creation of ITC (see above) and the modernisation of the Central and Departmental Libraries (see below) have been realised.

4. Please, describe the e-learning offered at your institution.
The Telecommunications Centre of Aristotle University of Thessaloniki provides Distance-Learning services to all University members, since 1997. Modern videoconferencing equipment has been bought under the aegis of the Operational Project for Education and Early Business Orientation "Telecommunication Network ISDN, AUTh" with the cooperation of the Telecommunications Committee. The group videoconferencing systems installed can provide full duplex real time audio and video connections with remote sites. Thus, communication and cooperation among Educational Institutes or Organisations becomes easier, while the growing needs for alternative methods of education are also tackled. AUTh provides a pioneering among Greek Universities Network of six fully equipped Distance-Learning Classrooms, which are located in the following Departments: Dept. of Electrical and Computer Engineering, Dept. of Physics, Dept. of Medicine, Observatory, "Ippokratio" University Hospital, "AHEPA" University Hospital There is also a smaller group videoconference room in the Telecommunications Centre (Faculty of Law & Economic Sciences). The first two classrooms are equipped with a Vtel's model TC1000 (512 kbps, Quad BRI), while they are fully equipped with special peripherals. The rest of the classrooms are equipped with a PictureTel's model Venue (384 kbps, triple BRI). Apart from point-to-point connections, a Multipoint Conferencing Server (PictureTel's model, Montage) is also available, allowing up to eight simultaneous connections, with line speeds ranging from 56 to 384 kbps. Different other projects in the Departments

5. What are the target groups for your e-learning courses?
Undergraduate, Graduate and Postgraduate students. Teaching and administration staff

6. What support is there for the development of e-learning?
Many Departments have created electronic libraries of teaching material and data bases with material and links that can be useful to their students

7. Do you offer electronic tools to students to support the planning and management of studies?
Many Departments offer online facilities for the communication of the students with their Secretariats (inscription, course selection etc). All Departments have a homepage (usually in Greek and English, but often in other languages also-The main AUTh pages are offered in Greek, English, French, German, Italian, Spanish and Russian), where an electronic course curriculum with all the necessary information is offered.

8. How is basic ICT infrastructure addressed in the project?
Many Departments (especially in the School of Engineering) have created fully equipped computer rooms for the use of their students

9. What is the role of library and information management in the project?

As a part of the "Operational Project for Education & Initial Professional Training" funded by the Greek Ministry of Education and the Second Community Support Framework, the Project **"Modernisation of the University Library System" has been realized**. The main aim of the Project, whose second phase will start soon (as a part of the Third Community Support Framework), is the upgrading and the modernisation of the University Library System so that the University Libraries can meet the new advances in the area of Academic Libraries.

KEY OBJECTIVES

- Automation of the University Library System and formation of a university library network.
- Retrospective cataloguing of the printed material in the University Library System.
- Access to a CD-ROM Network.
- Education & Training of the Library System Personnel.
- Design of the Library System WWW Site.
- Reformation of places in the Central Library and the Departmental Libraries.
- Enrichment of Libraries with printed material (journals and books).
- Staffing of Departmental Libraries with librarians.

PERSONNEL

Fifty-eight persons, in the majority librarians, work for the Project.
The libraries of the Departments have also been funded in the framework of the same Project.

10. What activities are related to research and the needs of researchers?
The Research Committee (RC) is a collective, elective body of the University, legally charged with the administration and management of the "Special Account", which operates with the aim of transferring and managing research, technological and training programmes as well as other related services which are provided by the members of the Institution. The AUTh has realised, during the 12 years of the existence of the RC, 4,500 programmes, in which over 10,000 University staff and external cooperators have participated. The RC fully supports through its web site the research realised in the AUTh, offering online all the necessary material (forms, guidelines, etc). It also offers online access (with an access password) to the financial and administrative data of all research projects and the movement of their bank accounts. Announcements of new research projects (national and international), requests for research partners and other useful information is also posted in the site. Some of the services are also offered through mobile internet. The RC publishes also a magazine.

11. How is community building promoted?
Many Departments announce important events that may be of interest to their students and teaching staff in their web sites.

Technical University of Crete

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Technical University of Crete (TUC)**
Name and email of contact person	Nikolaos Matsatsinis, nikos@ergasya.tuc.gr
Position	Assistant Professor, Director of Decision Support Systems Laboratory (ERGASYA) of the Production Engineering & Management Department
Profile of the Institution	The Technical University of Crete was established in the city of Chania in Crete in 1977 and admitted its first students in 1984. Founded with the purpose of developing modern engineering disciplines, newly introduced in Greece, the university develops research in advanced technologies while connecting with industrial and production units of the country. In the T.U.C one can find the following pioneering engineering disciplines. Production Engineering & Management, Mineral Resources Engineering, Electronics & Computer Engineering, Environmental Engineering. Also 3 new departments are to be added in the near future. Architectural Engineering, Biomedical & Biotechnology Engineering, Fine Arts School. Almost 2200 students are studying in both under-graduate and post-graduate level, while the academic staff includes almost 120 professors, 40 technicians and 110 administrative employees

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?

The T.U.C in the framework of EPEAEK (Operational Programs of Education & Professional Orientation) funded by the ministry of Education, has been developing electronic toolkits and thematic portals aiming at the creation of an integrated services platform on e-learning.

3. What are the main emphasis areas in your project?

The development of specialised thematic internet-based portals used for educational and research activities. The main emphasis is given on the creation and development of complete Toolkits, with which curricula and educational material can be processed electronically and then rendered accessible to its intended recipients through the use of a communications medium such as the Internet.

4. Please, describe the e-learning offered at your institution.

In the past, a number of systems have been used for the support of Tele-education, such as WebCT and others. However, as the afford mentioned Toolkits are finalized, they will be put to use in the pilot-operation of an integrated e-learning platform in the next few months.
The project will offer courses in both under-graduate and post-graduate level.

5. What are the target groups for your e-learning courses?

The target groups include all under-graduate and post-graduate students as well as all academic staff of the University.

6. What support is there for the development of e-learning?

The T.U.C receives financial support from the Hellenic Ministry of Education in the framework of the afford mentioned EPEAK projects (Operational Programs of Education & Professional Orientation). In addition the University has been developing a number of related material through European Union funded projects, such as A.D.A.P.T.

7. Do you offer electronic tools to students to support the planning and management of studies?

As mentioned before, the integrated platform will include complete Toolkits developed for every kind of User. Toolkits for professors, as well as specialised toolkits for students, with which they will have the opportunity to organise their study material in a customised way, choose courses, take self-evaluating tests and so on.

8. How is basic ICT infrastructure addressed in the project?

The T.U.C is already planning the purchase of a number of powerful servers capable of undertaking the task of supporting the integrated e-learning platform. In addition the university will acquire various communications and video-conferencing material along with advanced scanning devices. The installation will be made in the Distance Learning Centre of the University, where custom-made for the purposes halls will be available.

9. What is the role of library and information management in the project?
The role of the library is fundamental in the effort. It is undergoing a full transformation in order to move on to an electronic existence. It will provide access to electronic journals, while being connected to the resources of all the libraries of Greek Universities. It will include portals, alert programs, and search engines that will connect to electronic material available by publishing houses all over the world.

10. What activities are related to research and the needs of researchers?
With the completion of the undertaken tasks to set up an integrated E-Learning platform, one of the next steps, will be the creation of Electronic Laboratories (E-Labs) which will provide fertile ground for further advancement in research and student training

11. How is community building promoted?
The internet-based communities are promoted through a number of portals available in the T.U.C network with the support of the Information Services Centre of the University. Extended mailing list systems are used to provide information transference effectively and expeditiously

Politecnico di Milano, Centre METID

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Politecnico di Milano, Centre METID, Metodi e Tecnologie Innovative per la Didattica**
Name and email of contact person	Prof. Alberto Colorni alberto.colorni@polimi.it
Position	Professor of “Ricerca operativa” at Politecnico di Milano and Director of METID Centre
Profile of the Institution	The METID Centre was established in 1996 as Politecnico di Milano academic centre. The METID Centre promotes and supports innovative technology instruments for university education and develops collaborative national and international projects in the within of computer science, telematic and multimedia. From 1997 METID has matured important experiences in distance learning field, providing online materials and services in the area of teaching, learning and research, and becoming today the most important centre for e-learning of the Politecnico di Milano with two important projects: the Online degree in Computer Engineering (the first online degree in Italy) and the Online Courses Project, an e-learning environment completely develop by METID for university teachers and students.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?

Our Virtual Campus is the environment for different projects, everyone with its own strategy plan structured in synchronous and asynchronous activities and teaching and learning resources and services (like the chat, the forum, etc.). And just the services are the focus of our strategy: we think that for a good distance learning it's not enough to offer online contents, but it's important to unify the content delivery with services to enforce the collaboration between users (between students and between students, teachers and tutors).

3. What are the main emphasis areas in your project?

The objective of our virtual campus is to create a virtual environment for collaboration and co-operation, supporting the education activities of everyone teaching and studying at Politecnico di Milano. Technology in education has to support different teaching methods corresponding to different didactical organisations with a specific use of new instruments (one can simply put online some materials, another can prepare some videos of his lessons, another can have his lesson directly online). This is what we try to offer in our virtual campus.

4. Please, describe the e-learning offered at your institution.

In the following a few examples of e-learning projects today operating at METID Centre:
Online Degree in Information Engineering (the first Italian online degree, developed with the collaboration of Como Computer Engineering Faculty and Somedia)
Online Courses Project (online courses for support the traditional didactic for all the teachers and students of Politecnico di Milano)
SFERA Projects (online Master in Net Business Administration aimed at post-graduated students)
VIMIMS Projects (European Project for a Virtual Institute for the Modelling of Industrial Manufacturing Systems, this project is developing with four academic partners: the DEP of Politecnico di Milano, the IFA of Hanover, the LAG of Grenoble, The Sztaky of Budapest)
Formambiente (online courses about natural environment for state Italian employees).

5. What are the target groups for your e-learning courses?

University students in engineering.
Post-graduated students in all disciplines.
Continuing education courses for employees in different fields.

6. What support is there for the development of e-learning?

The Italian Education Ministry and the Politecnico di Milano management offer financial, technical and didactic support for develop e-learning projects.
European Community is another important financial supporter for e-learning projects.
In this last years also private companies offer financial and technical support for develop educational projects in information technology.

7. Do you offer electronic tools to students to support the planning and management of studies?
Yes, one of the more important project designing by METID and using our e-learning platform is the Online Courses. With this project we structure virtual environments with additional online contents, synchronous and asynchronous activities, online management services, online test and examinations, for support all our university teachers and students. The METID Centre, in collaboration with Como Computer Engineering Faculty and Somedia, offer also the first Italian online degree in Computer Engineering.

8. How is basic ICT infrastructure addressed in the project?
The ICT infrastructure addressed in our virtual campus is an e-learning environment developing by our engineers (corsi.metid.polimi.it). Just for the online degree in Computer Engineering Projects we have a commercial e-learning platform (www.laureaonline.it).

9. What is the role of library and information management in the project?
The METID Centre offers to all university members access to video collections (realised by our technicians) of all academic live events. The METID Centre does not offer an organised electronic library, except for the didactic materials (lecture notes, images, simulations, videos) published on our platform.

10. What activities are related to research and the needs of researchers?
As university centre, our institute is always related to research and to researchers. In particular the virtual campus is a project experimenting innovative research tools and innovative didactic approaches, that involves university teachers, researchers and students.

11. How is community building promoted?
The METID web site (www.metid.polimi.it) reports events and matters concerning the Centre and the university life. The METID virtual campus promotes the community building among academic members (students, teachers, researchers, tutors) with specific services like notice board or forum, reporting daily news on campus events. The METID staff is arranging a set of evaluative instruments to provide updated feedbacks from all the academic members and the platform users, to make a future effective dissemination of all METID virtual campus activities.

Delft University of Technology

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Delft University of Technology**
Name and email of contact person	J. B. J. Groot Kormelink j.b.j.grootkormelink@tudelft.nl
Position	Policy Advisor, Staff Executive Board
Profile of the Institution	TU Delft was established in 1842. It is one of the 3 universities of technology in the Netherlands. Total number of academic staff members is about. 2500 The total number of enrolled students is 13.000 Around 800 persons are studying for a doctoral degree. Education is provided by 7 faculties in 16 degree programmes in all fields of engineering.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
Yes, the central board of the university approved in February 2000 a policy plan for the period 2000-2004 with respect to ICT in education

3. What are the main emphasis areas in your project? (policy plan)
• Selection of Blackboard as the central and standard electronic learning environment. • The development of a student portal (integration of various support systems like course evaluation, electronic inscription for examinations, rosters, blackboard, professional communities). The student portal will be ready in 2003. • Development of an adequate support structure (technical, educational) for teachers. • Creation of a University wide ICT in education community platform. • Implementation of high standard and ambitious ICT in education projects by Faculties

3. Please, describe the e-learning offered at your institution.
The main aim of ICT in education activities at TU Delft is to support teaching and learning of on campus students. TU Delft will not offer virtual (distance) courses for regular courses. However, DUT is also in the process of developing 'blended' learning for post-graduate students (life long learning). There are many initiatives by individual staff members In addition there are some 'big' projects' • Delft Special: an integrated approach to address information needs by students • Policy and Management: gaming, simulation, use of Blackboard in all subjects • Informatics and Electrical Engineering: new forms of on-line (diagnostic) assessments; use of Blackboard in all subjects • Civil Engineering: development of high quality e-learning courses for different target groups in fields in which the TU Delft is leading • Faculty of Architecture: interaction of various disciplines (design, production, maintenance) by the use of ICT • Digital didactics: development of a knowledge management system • Virtual International Design teams Design (Aerospace engineering, Industrial Design).

4. What are the target groups for your e-learning courses?
On-campus students in all disciplines. Some continuing education courses will be offered partially online.

5. What support is there for the development of e-learning?
TU Delft offers technical and didactic support for faculty wishing to develop e-learning. The system Blackboard is funded by the central board (maintenance, license) . The central board has reserved an amount of around Euro 900.000 per year for the co-financing of projects mentioned under '5'. Under discussions is the development of a ICT in education laboratory Under discussion as well is the founding of ICT in education consortium with other institutes for higher education in order to develop an adequate support structure.

6. Do you offer electronic tools to students to support the planning and management of studies?
In 2001, TU Delft introduced a pilot project for electronic inscription for exams. All faculties use electronic study guides. There is also a electronic course evaluation system. Under discussion is among other things a plan for 'digital portfolio's for students. All support systems will be integrated into a student-portal. (see under '2)

7. How is basic ICT infrastructure addressed in the project?
The basis infrastructure (network) is of a high quality and will be further upgraded next year so that it is in line with the standards developed by our national organisation Surf for the 'next generation internet'. Some faculties want to provide laptops for all students. All students living in student houses in Delft have or will have next year access to a Internet connection suitable for steaming video (next generation Internet). All first years students are being offered facilities like a interest free loans and software package.

8. What is the role of library and information management in the project?
The TU Delft Library (BTUD) , being also the national library for engineering, offers university members access to a wide range of electronic information sources and electronic magazines. BTUD is leading new developments in this respect in the Netherlands. All doctoral dissertations will be published electronically as from 2002 onwards.

9. What activities are related to research and the needs of researchers?
The focus is on an adequate network and ICT-tools for researchers taking into consideratio the field of research. ICT and nanotechnology are main fields of research at TU Delft.

10. How is community building promoted?
The student portal (i.e the community function within Blackboard) will support community building among students and professional groups. This functionality has, however, only been recently introduced (August 2001) In various magazines and newsletters , attention is being aid to ICT in education. **An Alumni Portal** is under construction.

20.11.2001

University of Porto, Faculty of Engineering

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**University of Porto, Faculty of Engineering**
Name and email of contact person	Carlos Cardoso Oliveira colive@fe.up.pt
Position	Chief Executive Officer of the GAUTI – Office for User Support on Information Technologies
Profile of the Institution	Issued from the Academia Politécnica, which was founded in 1837, the Faculdade de Engenharia da Universidade do Porto (FEUP) is a leading national institution of international reputation whose achievements in research and teaching have established itself in the forefront of the universities of engineering. The Faculty is committed to the highest standards of education, in furtherance of its mission to advance learning and knowledge, preparing professional engineers at an international level. The total staff of FEUP is about 800 workers in teaching, research and administration. The total number of enrolled students is about 5,700, about 10 percent of whom are studying for post-grade degrees. Education is provided by 6 departments in 9 undergraduate, 24 Master degree programmes and Doctoral degrees in 8 areas of engineering.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
SiFEUP is the strategic project of virtual campus development in FEUP. This award winning system (EUNIS award 2001 – www.eunis.org) started its developement in 1996 and is by now the core system for all campus activities. Several papers have been published in english about this system.

3. What are the main emphasis areas in your project?
Being a core system of all the activities in the campus, SiFEUP has several objectives, from providing management information to enhancing internal communication procedures and supporting the educational activities. The system provides information on courses, research, people, equipment and spaces for internal use and also for dissemination and reporting activities. It's based in the Oracle DBMS, and has a open architecture, that allows the integration with other systems, namely the Library Management System and the E-Learning System in use in the Faculty.

4. Please, describe the e-learning offered at your institution.
The main aim of e-learning at FEUP is to support teaching and learning of on campus students. We are however considering the use of e-learning or distance learning for off-campus students, under the framework of our continuous training office that provides update courses in forefront engineering areas. There have been experiences with commercial e-learning systems, like WebCT and Luvit, and some continuous training courses have been developed. More than 10% of the 1300 courses offered in the Faculty already provide some online support, so we believe that e-learning will have a significant increase in the next years. The Office for User Support on Information Technologies is currently developing **myFEUP** which is an web based user interface for teachers and learners that leverages the potencial of cross-linking the data available at SiFEUP for educational purposes.

5. What are the target groups for your e-learning courses?
On-campus students in all disciplines of engineering. Some continuing education courses offered online.

6. What support is there for the development of e-learning?
GAUTI, the Office for User Support on Information Technologies is responsible for providing support to the teachers for multimedia content development and also manages the e-learning system of the Faculty. The Office has specialized human resources and multimedia equipment and provides its services to selected projects evaluated in a regular basis.

7. Do you offer electronic tools to students to support the planning and management of studies?
SiFEUP provides several tools for planning and management of educational activities. For example, students and teachers have online access to timetables, classroom information and mailing lists of courses. There is also an online reservation system for presentation equipment and workstation time. All the management level information, including grades is also available online.

8. How is basic ICT infrastructure addressed in the project?
SiFEUP development and maintenance is the responsability of the Computing Services Centre. The Director of the Computing Services is also member of the Management Committee of the Office for User Support on Information Technologies, ensuring a strong coordination of activities. There are several specific ICT infrastructure development projects: Wireless LAN, Extranet support, Video streaming and Public Information Systems .

9. What is the role of library and information management in the project?
The Director of the Library is a member of the Management Committee of the Office for User Support on Information Technologies. The Library Management System is being integrated with SiFEUP and e-learning systems, mainly concerning certification, quality control and metadata issues. The Library is also involved in Electronic Publishing activities.

10. What activities are related to research and the needs of researchers?
The SiFEUP provides several tools to support research: project information, curricula, published papers, all with search facilities integrated with the Library Information System.

11. How is community building promoted?
Community Builiding is still a largely unexplored area. Still, the system provides dynamic mail tools for group contact and Public Information Systems provide news and awareness to the community.

Universidad Politécnica de Madrid

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Universidad Politécnica de Madrid**
Name and email of contact person	Marinela García Fernández marinela@upm.es
Position	SOCRATES General Co-ordinator and Director for International Affairs
Profile of the Institution	The Universidad Politécnica de Madrid (www.upm.es) is a teaching and research public institution with more than 40,000 students and offering under graduate and graduate education and training to individuals and private enterprises in both modalities: in- campus and distance learning.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
Yes, we are thinking mainly in continuing and distance education developing online-delivery curricula for a variety of training and professional development programs specially designed for Spain and Latin American countries and needs.

3. What are the main emphasis areas in your project?
Continuing Education, especially graduate education and training for the working force from public and private areas. We offer also a wide range of distance learning services to our community such as videoconferencing, distance learning workshops and training materials. As we mentioned above, we are also implementing a project which will give academic coverage to Latin American countries.

4. Please, describe the e-learning offered at your institution.
We have developed, specifically for Internet, two areas: Technological Seminars and Graduate Courses. Some of the topics dealt with, for instance, Health Science (Telemedicine), Information Technologies, Architecture, Software Design and others related. Please visit our website (www.gate.upm.es) for a complete listing of all of the currently offered courses. We would like to add that the on-line courses and degrees (training and certification programs) are available in a wide variety of formats including videoconferencing, videostreaming and Internet.

5. What are the target groups for your e-learning courses?
• Under-graduate students • Graduate students • Working force from private and public areas

6. What support is there for the development of e-learning?
Universidad Politécnica de Madrid offers, through its “Tele-teaching Department”, different kinds of support such as technical and academic advice for those teachers who are approaching this field for the first time. To do our best we can offer all kind of facilities needed in this area, both academic and technological infrastructure.

7. Do you offer electronic tools to students to support the planning and management of studies?
We do offer them using a web based on e-learning environment called “Virtual Training” that has many electronic items such as e-mail, chats, and discussion lists through our University net’s infrastructure.

8. How is basic ICT infrastructure addressed in the project?
As we said in question number 7, it is addressed through this web based on e-learning environment.

9. What is the role of library and information management in the project?
Training materials for all courses can be accessed through this above mentioned web as well as our many web-links, therefore students can easily access all the necessary information they may need to complete successfully the programme.

10. What activities are related to research and the needs of researchers?
Online consulting, experts workshop via videoconferencing, virtual team project development.

11. How is community building promoted?
As a public institution, we have the commitment to become and remain as an open teaching and research institution that is available to the general public in this country. A commitment that represents a significant dedication to changing society through the wide range of educational modalities we are offering nowadays.

Universidad Politécnica de Valencia

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Universidad Politécnica de Valencia**
Name and email of contact person	D. Antonio Hervás Jorge ahervas@mat.upv.es; vupa@upvnet.upv.es
Position	Vicerrector del Vicerrectorado de Universidad Politécnica Abierta (Vice-Chancellor, Open Polytechnic University)

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?

The Virtual University of the Polytechnic University of Valencia (UPV) is a project managed by the Vice-Chancellor Office for Open Polytechnic University.
The aim of this project is to develop quality and efficient education using Information and Communication New Technologies (ICT).

3. What are the main emphasis areas in your project?

The Polytechnic University of Valencia. Through its Vice Chancellor Office for Open Polytechnic University is promoting the use of New Technologies in education. Virtual University is aimed at providing the Polytechnic University of Valencia with quality on-line courses complementing its educational offer . The Virtual University covers all those technical subjects which are usually thought in this University in all its educational levels: *undergraduate, postgraduate* and *PhD courses.*
The Virtual University is also in charge of *developing training and supporting activities for those lecturers interested in creating On-line courses.* With these and other activities such as *quality control* and *course management by means of the creation of the e-Learning Platform* the process of e-learning is enriched through the Virtual University of UPV.
Links:

- **UPV:** www.upv.es
- **Vice-Chancellor Office for Open Polytechnic University:** www.vupa.upv.es

4. Please, describe the e-learning offered at your institution.

The introduction of New Technologies in the teaching and learning processes facilitates the access to those educational activities of the Polytechnic University of Valencia by preventing time and distance as learning handicaps for University students wanting to gain knowledge on those subjects they need to get their University degree, PhD or postgraduate course.

- *Undergraduate courses*: it enables students to access the necessary knowledge to get their degree.
- *PhD*: It enables to acquire specific knowledge related to obtain PhD degree.
- *Postgraduate courses*: the educational offer of lifelong learning is a response to the needs found to be essential and seen as a priority in the current socio-economic environment, after noticing the interest the professional have on these courses.

Other projects being developed by the Vice-Chancellor Office for Open University related to e-learning and Distance Education are:

- *Electronic books:* Project developed by the Vice-Chancellor Office for Open Polytechnic University along with the Vice-Chancellor Office for Academic and Students Exchange. The aim of this project is to support the Teaching and Research Staff in the creation of interactive self-learning books oriented to their knowledge area.
- *Ongoing evaluation:* its main objective is to support the Teaching and Research Staff by means of a Platform permitting ongoing evaluation through the Internet obtaining as a result an improvement of the students performance.
- *Biodiversity Project:* Project involving the University community of UPV and the Biodiversity Foundation .This project is supported by the European Social Fund Its aim is to develop activities to train and sensitize on our environment.

According to the learning needs found in companies and professionals we are developing and creating and teaching distance courses over the Internet in order to give a response to the requirements of our socio-economic environment.

5. What are the target groups for your e-learning courses?
The students the UPV e-Learning Courses are directed to are: • Students in their 1st and 2nd year aimed at obtaining their University degree. • Students aiming at obtaining their PhD degree Undergraduate and postgraduate Students and professionals who need to update their knowledge to adapt to the social and work requirements of our society.

6. What support is there for the development of e-learning?
The Polytechnic University of Valencia through its Vice Chancellor Office for Open Polytechnic University offers the Teaching and Research Staff the required technical and pedagogic support to create educational activities through the advantages of using of New Technologies. In order to get this aim we have the support of the *Teleteaching Platform and the methodological and technical and pedagogic supporting resources* to create teleteaching courses and the *demanding controls warranting* courses quality. We also develop training activities for the teaching and supporting staff with the aim of optimising this process and setting the criteria to design , teach and monitor the teaching activities in Distance Education The Polytechnic University of Valencia offers financing support to this project and provides with the necessary Human Resources and Material through of Vice Chancellor Office for Open Polytechnic University.

7. Do you offer electronic tools to students to support the planning and management of studies?
The Virtual University of the Polytechnic University of Valencia counts with an advanced Teleteaching Platform for projects management permitting to have a control of the teaching processes developed through the Information Communication and New Technologies (ICT). The students can access the net and make the e-learning activities: • From the free entering computer labs available in the UPV Campus. Right now, there are 2937 PCs with access to the Internet in these labs. • From external personal computers connected to the net, like for example the ones they have at home the students. Apart from this, the The Virtual University of the Polytechnic University of Valencia has some author tools and computer applications which makes the teacher's creating process easier which fulfils the quality standards demanded by the UPV.

8. How is basic ICT infrastructure addressed in the project?
The *Virtual University* is an area belonging to the Vice-Chancellor Office for Open University which provides with: • Technical and administrative staff necessary to facilitate and coordinate all the activities related to Distance Education being developed. • Technology and Materials available for the Teaching and Research Staff. The Departments of the UPV provide with the necessary teaching staff to contents from their knowledge areas.

9. What is the role of library and information management in the project?
In the UPV web page you can access the data base of bibliographical stocks distributed in all UPV libraries. Moreover you can also access bibliographical stocks , data base and catalogues of other libraries. Project *"Publication of self-learning interactive books":* • The Vice-Chancellor Office for Open University along with the Vice-Chancellor Office for Academic and students Exchange. The aim of this project is to support the Teaching and Research Staff in the creation of interactive self-learning books oriented to its knowledge area.

10.What activities are related to research and the needs of researchers?
Through the The Virtual University of the Polytechnic University of Valencia courses we give the possibility to study those essential subjects to obtain the final degree. This degree warrants the researching capacity of the Phd student. We will pay especial attention to The PhD courses being thought to students living in South America countries. We will emphasize the fact that in order to create teleteaching courses we have been using some tools obtained from the research projects of the Polytechnic University of Valencia.

11.How is community building promoted?
The Vice-Chancellor Office for Open University shares its area of Virtual University with the University community. Apart from promoting learning activities, this Vice-Chancellor Office also offers grants for those students wanting to participate in the course creation directed to the processes of learning and teaching through ICT all along with Teachers and Researchers Staff. The Vice-Chancellor for Open University is open to different projects like the *"Biodiversity projects"* where several teachers , students, and technical staff from different Department and Services participate. The main objective of *The Virtual University of the Polytechnic University of Valencia* is to bring together University and society, whose relation already exists thanks to ICT by making possible new ways of interaction .

Swiss Federal Institute of Technology Zurich

BACKGROUND INFORMATION	
1. Respondent and institution information	
Name of Institution	**Swiss Federal Institute of Technology Zurich (ETH Zurich)**
Name and email of contact person	Anders Hagström hagstroem@ethworld.ethz.ch
Position	Project Manager, ETH World
Profile of the Institution	The Swiss Federal Institute of Technology Zurich (ETHZ) was established in 1854 as a polytechnic school. Until 1969 it was the only national (federal) university in Switzerland. Today it is part of the ETH domain, which is made up of the two technical universities in Zurich and Lausanne (EPFL) and four national research institutes. ETH Zurich has a total staff of over 7 500 working in teaching, research and administration. The total number of enrolled students is around 12 000, about 20 percent of whom are studying for a doctoral degree. Education is provided by the 17 departments in 25 degree programmes in the following main domains: engineering, natural sciences and mathematics, life sciences, and the built environment. ETH World ETH World is a strategic initiative of ETH Zurich for establishing a third, virtual campus for the university. ETH World will provide services in the areas of research, teaching, learning and services for the established disciplines and activities that the ETH Zurich is renowned for. ETH World is an integral part of ETH Zurich, supporting its core processes and facilitating the change in paradigm required of successful higher education in the knowledge economy. Research collaboration, e-learning, community building and information management are some of the key areas of development within ETH World.

VIRTUAL CAMPUS ACTIVITIES

2. Do you have an overall strategy plan for your virtual campus?
ETH World is the strategic project to develop a virtual campus for ETH Zurich. Some of the developments take place within this overall project, others run in parallel with the ETH World Management Committee in ac coordinating role. No written strategy for developing the Virtual Campus exists.

3. What are the main emphasis areas in your project?
ETH World is a strategic initiative to prepare ETH Zurich for the information age. Its objective is to create a universal virtual communication and cooperation platform, supporting the activities of everyone working or studying at ETH. ETH World will help to integrate the physical infrastructure and communication to form an "infostructure". In this environment research groups and teaching and learning communities can cooperate without limitation of time or place. ETH World also supports new processes for the management and services of the university. ETH World is being built through a growing number of individual projects, developing e-learning, research tools, information management, infrastructure elements and community building.

3. Please, describe the e-learning offered at your institution.

The main aim of e-learning at ETH Zurich is to support teaching and learning of on campus students. ETH does thus not offer integrated programs of e-learning or distance learning for off-campus students.
There are currently some 50 projects under way to develop e-learning at ETH Zurich. In the following are a few examples:

- **LearnIT@ETH** is an Internet based learning environment. Developed for a post-graduate course in urban and regional planning, the learning platform is now being applied also in other areas.
- **"Virtual Excursions"** is an interactive DVD-based e-learning system in ecology.
- The Project **ULI** ("Universitärer Lehrverbund Informatik") is developing a virtual university for computer science students in co-operation with ten German universities.
- **arc-line** (Architecture Online, http://arc-line.ethz.ch/) develops a first-year course in architectural design as a web-based communication and production network. Arc-line does not replace traditional modes of teaching, but enhances them with the possibilities offered by new technology.
- **CALICE** (Computer Aided Learning In Civil Engineering, http://www.calice.igt.ethz.ch) is an online learning environment for second-year courses in geotechnics and the theory of structures. Lectures, exercises, simulations, quizzes and test are made available online.
- The **Chemistry Contact Network** (CCN, http://www.cci.ethz.ch/) aims to expand chemistry teaching to a new, virtual level by generating new teaching and learning tools, including virtual lab experiments.

4. What are the target groups for your e-learning courses?
On-campus students in all disciplines. Some continuing education courses offered online.

5. What support is there for the development of e-learning?
ETH offers financial, technical and didactic support for faculty wishing to develop e-learning. The main source of financial support is the **FILEP** program for the development of teaching. A major part of projects funded under FILEP are e-learning related. There is also a national programme, "**Swiss Virtual Campus**" (www.virtualcampus.ch), funding the development of web-based courses involving at least three universities. The Network for Educational Technology **NET** (www.net.ethz.ch) supports developers and users in the use of information technology and electronic media in education. The **Center for Teaching and Learning** (Didaktikzentrum, www.diz.ethz.ch), in cooperation with the University of Zurich, provides courses for faculty on the use of new media for teaching and learning.

6. Do you offer electronic tools to students to support the planning and management of studies?
In 2001, ETH introduced a pilot project for electronic inscription. With the introduction of a credit system across the university over the next few years, this system will provide central support for all students. Focus group portals offer students and faculty central access to information for the planning and management of studies. Portals are offered for different target groups, eg. first-degree students, prospective students, professors and assistants (www.studium.ethz.ch, www.zulassung.ethz.ch and www.lehre.ethz.ch).

7. How is basic ICT infrastructure addressed in the project?
Ensuring that the ICT infrastructure corresponds to the need of learning, teaching and research is seen as vital for the success of ETH World. Coordination is ensured through the Director of the Computing Services being a member of the Management Committee. Specific ICT infrastructure development projects within ETH World include Neptun, Wireless LAN and Video streaming. The goal of project **Neptun** is to equip every ETH student with a laptop computer as a working tool for learning and research. Implementation started with a pilot project in four departments as of the winter semester 2001/02, to gather experiences as to how students can use their laptops. The **Wireless LAN** project puts in place the facilities for wireless, mobile computing in lecture halls and semi-public space (student restaurants, libraries, work areas). The aim is to improve communication in different areas: lectures, seminars, meetings, or independent work. The **Video Streaming** project (http://www.net.ethz.ch/streaming/) puts in place the infrastructure, through which lectures and important events can be made available over the Internet.

8. What is the role of library and information management in the project?
The ETH Library offers university members access to a wide range of electronic information sources. As a publication channel for material produced within ETH, the Library has established an electronic document server, the "**ETH E-collection**" (http://e-collection.ethlib.ethz.ch/). All doctoral dissertations are published electronically, but members of the ETH community can publish also other digital documents, such as lecture notes, laboratory publication series, and research and project reports. Another Library project, **E-Pics**, will establish an online picture information system for teaching and research, offering online access to image collections (http://www.e-pics.ethz.ch/). The system will make use of a multimedia search engine developed within ETH World in the project "Advanced Querying and Coordination of Multimedia Information".

9. What activities are related to research and the needs of researchers?
As the virtual campus project of a research-oriented university, ETH World places great emphasis on supporting research and the needs of researchers. Research aspects are being addressed through individual projects on the one hand, and through the development of research tools on the other hand. Projects include the Vireal Lab, (http://www.vireal.ethz.ch) a virtual-real laboratory for research and teaching in pharmaceutical sciences. Vireal Lab will build an environment combining virtual science worlds by equipping a special room with intelligent "roomware" technology – tables, chairs and whiteboards with built-in electronic devices that provide easy access to computer and network resources. As a step in implementing the goals of ETH World, a pilot project will start in 2002 to develop the research workplace on the virtual campus. Possible elements of this workplace will be information sharing and navigation tools and communication devices.

10. How is community building promoted?
A set of projects within ETH World aim at supporting the community building within the virtual campus and to the outside world. **"ETH Life"** is the daily web publication of ETH Zurich. It reports daily on events at and matters concerning ETH. "ETH Life" is aimed at all members of the ETH community – students, professors, assistants, other staff, and alumni – as well as the general public and the media. **The ETH AlumniOO Portal is the entrance for former students into the virtual world of ETH Zurich. The goal is to support the networking among alumni and between them and ETH.** **United Visions** (http://www.uv.ethz.ch/) is the joint online campus television of ETH and the University of Zurich, a WebTV channel focusing on life at the two universities. It broadcasts lectures and information on research projects, but it also covers parties and events. United Visions is a student initiative, with financial and infrastructure support by the universities. The project **metalogue** (http://www.metalogue.ethz.ch) carries out formative evaluation of all ETH World activities. The aim is to ensure effective dissemination and broad involvement and to provide regular feedback. Bringing in a work psychological perspective, the project will evaluate as well as influence the future design of ETH World.

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