Perspectives of Engineering Education and Training in the near Future in Europe

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1. The Challenges for Engineering

- **Movement towards the harmonization of degrees**
- **need for continuing professional development**
- **increased mobility of engineers**
- **global quality assurance of education and training**

- changes in the curriculum
- adaptations of teaching/learning methods
- recognition of engineering qualifications (academic and professional)
- global accreditation schemes
- provision for continuing professional development
- valuing informal acquisition of competencies and knowledge

2. The Agents of Change
2.1. Bologna Process

- Sorbonne declaration of May 1998
- France, Germany, United Kingdom and Italy
- harmonize their higher education systems
- Three comparable degrees
- Twenty-five other countries plus four previous ones = Bologna declaration
- Coherent, compatible and competitive European higher education area.

- **Harmonisation of qualifications**
- **Readable and recognition**
- **Undergraduate-postgraduate articulation of qualifications**
- **Credit systems compatible (ECTS)**
- **Promotion of European co-operation**
- **Quality assurance**
- **Comparable criteria and methodologies.**

2.2. Quality Assurance

- **Diverse developments in engineering degree systems**
- **Profound reforms and others practically any changes**
- **Curricula and programs subject to doubts and uncertainties**
- **Suitability for the engineering profession**
- **Competition in the European space**
- **Some form of quality assurance.**

- **Changes in paradigm of teaching versus learning**
- **Outputs assessment**
- **Competences and skills**
- **Original forms of quality evaluation**
- **Curriculum development systems based on learning outcomes.**

2.3. Globalization

- **Mobility and employability**
- **Prospective or current engineer and future employer**
- **Build-up of the exact curriculum**
- **Flexible about external programmes**
- **Transfer between curricula**
- **Job opportunities in other countries**
- **Recognize qualifications and competencies from other countries.**

- Shortage of engineers
- Technology requirements and demographic trends
- Attractive career and without shortage of candidates
- Migration of skilled workers
- Recognition of qualifications (WTO)
- Outsourcing of engineering
- Global engineering is a trend with strong impact

2.4. Lifelong Learning

- **The developments in the engineering profession and activities have created the need for suitable training programs compatible with the needs of the professional development. This has created a series of diverse providers of continuing education and of types of courses. This diversity has implied a difficulty in establishing standards and quality assurance mechanisms. These types of engineering programs represent high investments for companies and for engineers. All the above reasons have led to need for recognition of work done or knowledge acquired by the participants in the continuing education programs.**

3. Questions for Engineering Education in the Near Future

- **The goal of initial education of engineers has been changing in the last years due to the factors cited above. The modern courses have a tendency to adopt a philosophy of ensuring that the graduating engineer will have some acquired competences and skills at graduation. These are defined by a synthesis of opinions from academics, professionals and employers. Traditionally the engineering courses were based on the content and contact hours. Currently they are defined by the learning objectives and by the learner workload. This is a shift of paradigm and leads to major changes in the form and content of courses.**

- **Competences and skills required for an engineer as professional (i.e. understand professional and ethical responsibility)**
- **Combination of mathematics and basic sciences, specific field and design**
- **General education courses**
- **Employers have different views on learning outcomes**
- **Amalgam of these expectations equals profiles of engineering programs**

What is SEFI?

European Society for Engineering Education

1973

SEFI is nothing but its **members**

470 (270 institutions) **in 42 countries**

and the contributions from its members

Members

- **Institutional members**
  - Institutions of a high level (post secondary) that offer a complete curriculum leading to an academic engineering degree.
- **Individual members**
  - Typically teachers of science or engineering or science. People engaged in international relations.
- **Industrial members**
  - Any industrial company, public administration or other organisation having an interest in supporting European Engineering Education.
- **Associate members**
  - Professional societies or other organisations interested in initial or continuing education of engineers. Student organisations.

SEFI's mission

To support and promote European Engineering Education

- by linking Engineering Education institutions and educators,
- by providing services to its members,
- by serving as an international forum and,
- by representing the European Engineering Education Community.

Objectives

- to act as a **link** between its members and other societies or international organisations;
- to promote the **European Dimension** in EE;
- to contribute to the **recruitment** of good students in EE;
- to **promote the position of EE** and engineering professionals in society.

Objectives (cont.)

- to contribute to the **development** and to the **improvement** of EE;
- to provide appropriate **services** and information about EEE;
- to improve **communication** and **exchanges** between teachers, researchers and students;
- to promote **cooperation** between industry and those engaged in EE;

Working Groups

- **Curriculum Development**
- **Continuing Engineering Education**
- **Engineering Education and Mathematics**
- **Engineering Education and Physics**
- **ICT and Engineering Education**
- **Women in Engineering**
- **Ethics and Engineering Education**
- **Project EUR-ACE**
- **Task Force on the Bologna Declaration**

TREE – Teaching and Research in Engineering in Europe

Contractor: Claudio Borri, Università di Firenze

TN co-ordinator: Francesco Maffioli, Politecnico di Milano

Line A - TUNING

Giuliano Augusti, Università di Roma La Sapienza

Line B - EDUCATION and RESEARCH

Aris Avdelas, Aristotle University of Thessaloniki

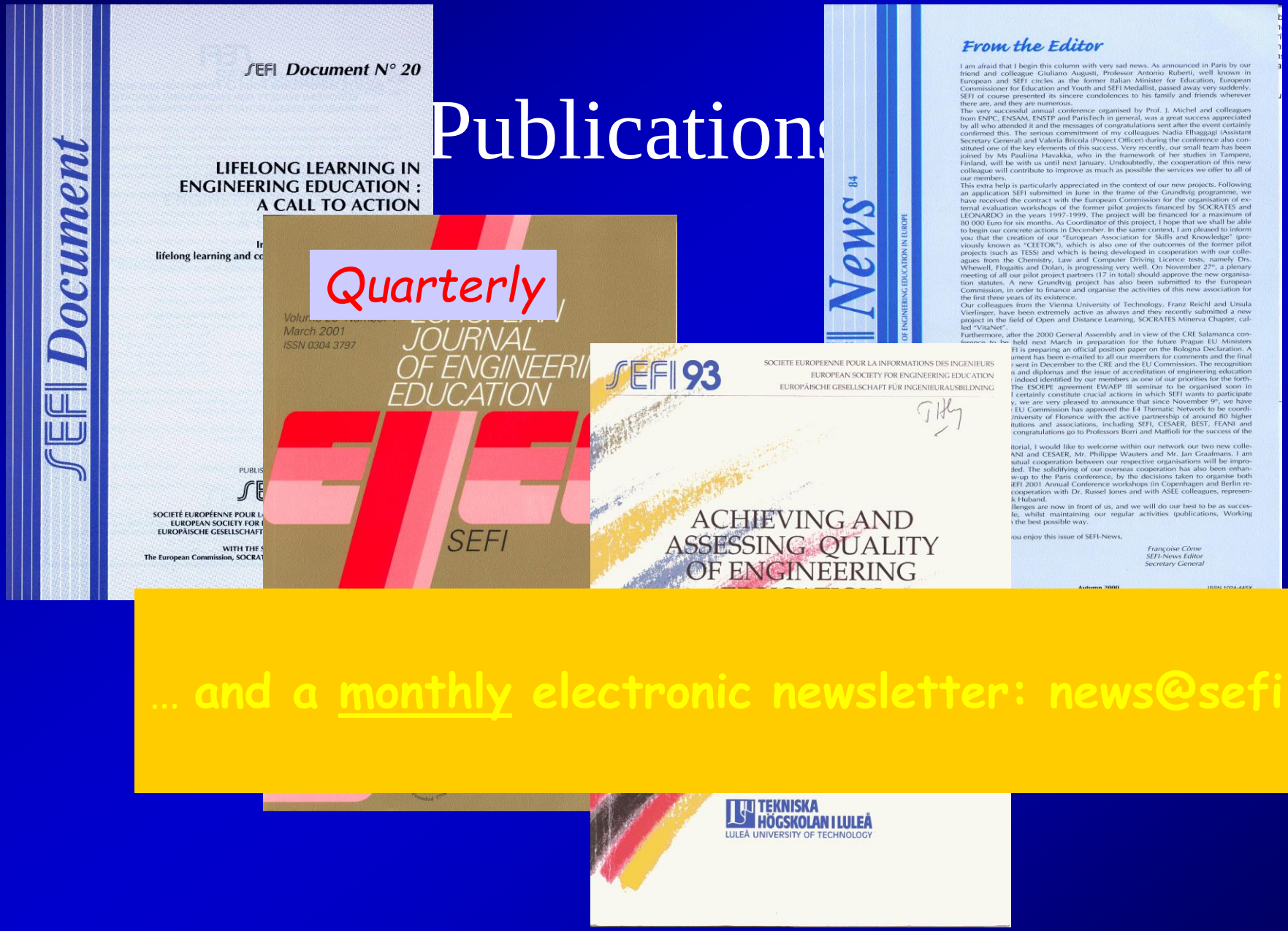
Line C - ENHANCING the ATTRACTIVENESS of EE

Chris Baker, University of Birmingham

Line D - SUSTAINABILITY

Markku Markkula, Helsinki University of Technology

Publications



… and a monthly electronic newsletter: news@sefi

The Bologna Declaration: SEFI ‘s view is:

- SEFI welcomes the important initiative taken by the European ministers of Education in signing the Joint Declaration in Bologna in June 1999;
- SEFI strongly supports the idea of the creation of a European Higher Education Area;
- SEFI shares the opinion of the Ministers concerning the need for a system of easily readable and comparable degrees, through a Diploma Supplement or otherwise;

SEFI's view (cont)

- **SEFI supports a wider use of the ECTS system as a proper means to promote student mobility;**
- **SEFI is convinced of the importance of increased mobility for students, teachers, researchers and administrative staff;**
- **SEFI is already committed to the idea of developing the European dimension in Education;**
- **SEFI shares the opinion of the European Ministers concerning the importance of European cooperation in quality assurance and accreditation;**

but

- any reform of the structure of European Engineering Education must take the particular conditions of this field of education into account,
- the existing European integrated 5-year curricula in Engineering are compatible with the idea of a European Education area

and

- the existing European system of longer integrated curricula leading straight to a Master's degree in Engineering should be maintained, possibly in parallel with a two tier Bachelor/Master system,
- the longer, as well as the shorter, more application-oriented, curricula correspond to a clear need and graduates from both types of programme have a good position on the job market,

and

- the specific qualities of the present, existing, application-oriented Engineering degrees should be recognised and safe-guarded,
- the creation of new 1-2 year Master's programmes in Engineering should be encouraged.

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Bologna to Bergen
(Madrid – June 2004)

1. PhD in Engineering

1.1. Innovation and new knowledge through research
- Academia and industry
- Diversity of format and content
- Emphasis to research work

1.2. Institutional norms
- Quality management and organization
- Duration of the studies (3 to 5 years)
- Additional education
- Schedule

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Bologna to Bergen
(Madrid – June 2004)

1.1. PhD in Engineering (cont.)

1.3. Technological innovation and new disciplines

Bridges between research and innovations in business, industries and government

Original research from candidate and adviser

1.4. Selection

Joint degrees, networks

Industrial programmes

1.5. Researchers

Creation of new knowledge through research

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2. Bachelor/Master Studies

2.1. The 3+2 model as standard reference
Other possible paths
Integrated 5 years, 4+2 scheme or 4+1 model

2.2. Two types of first-level degrees
Clearly-defined aims and objectives
First cycle as gateway
Wide choice of second cycle
Freedom for selection of students

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2. Bachelor/Master Studies (cont.)

2.3. Eliminate obstacles for mobility
Academic and professional levels
Competition between universities welcome

2.4. Mutual and unconditional recognition
Learning outcomes recognition
Examples at national and international levels

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3. Double and Joint Degree Programs

3.1. Trans-national recognition - primary goal
Double and joint degrees

3.2. Identification and compliance requirements
Legal and financial procedures
Importance of the diploma supplement
Indispensable for the implementation

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4. Further Development of ECTS

4.1. Disciplines in terms of learning outcomes
Paradigm change
Input (workload) to output (competences)

4.2. ECTS credits as workload measure/planning tool
ECTS credits depends on many factors
Programme design, teaching methods, student abilities and motivation
Further development and other type of indicators

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4. Further Development of ECTS

4.3. Whole set of competences
Mere addition of the ECTS credits
Outcome as integrated education
Proper curriculum
ECTS in Engineering not to standardize degrees

4.4. ECTS credits may not be in PhD
Curriculum based PhD-programme not acceptabel
Personal independence, research experience

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5. Quality Management/Accreditation/Autonomy

5.1. Quality/accreditation based on learning outcomes
- Competences, skills and knowledge
- Quality criteria for the learning outcomes

5.2. Quality management and quality assurance systems as decentralized as possible
- No extra burden for academic staff

5.3. Co-operation and dialogue
- Academic recognition professional accreditation
- Co-ordination to simplify procedures

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5. Quality Management/Accreditation/Autonomy (cont.)

5.4. Academic recognition – some common typical features

Self-evaluation procedure

Quality guidelines

External and/or an academic recognition body

5.5. European organization

Academic recognition and professional accreditation

Framework of European guidelines

Co-operate with and complement national bodies

Thank You

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