1. Introduction

In the first EUCEET volume, the author included a contribution entitled "Civil Engineering in the context of the European Higher Education Area - the role of EUCEET". [1]

The syntagme "The European Higher Education Area" is associated with the Bologna Declaration, issued on 19th June, 1999, in Bologna, at the end of a Conference of the European Ministers of Education from 29 European countries. The first EUCEET volume refers to the first two years of the Thematic Network Project EUCEET (European Civil Engineering Education and Training), 1998-1999 and 1999-2000, which marked indeed, the start of what is commonly called today as the "Bologna Process".

Is beyond the scope of this paper to examine the Bologna process in its complexity. Its goal is to assess, based on the reports from 26 countries, included in this volume, the impact of the Bologna Process on a specific field of higher education, civil engineering education and, by extension, on the civil engineering profession as a whole.

2. Civil engineering education in Europe in 1999-2000, prior to the Bologna process

The theme assigned to the Working Group A of the Thematic Network Project EUCEET I, chaired by the author, was: "Curricula in European civil engineering education at undergraduate level". The Working Group A was founded and started to function at the first EUCEET I General Assembly, held in Barcelona on 21-22 February 1999 and concluded its work at the end of the second year of the Project, on 31st August 2000. It might be said, therefore, that activities undertaken by WG A coincided in time with the first steps in the Bologna process.

A questionnaire was prepared by the WG A and circulated among various institutions offering civil engineering education in Europe, asking information on both the organization of studies and on the curriculum. A total number of 113 answers were received from 26 countries. Since data thus obtained refer to the academic year 1999-2000, the situation they depict can be rightfully qualified as being "prior to the Bologna process".

EUCEET I survey confirmed the existence in the civil engineering education of Europe of two basic systems:
- the continental system
- the anglo-saxon or two-tier system

The continental system is characterized by two programmes put, in most cases, in parallel
- of long duration (4,5-5-6 years);
- of short duration (3-3,5-4 years).

A variant inside the continental system is the "tree" or "y" system, in which the two programmes have a common trunk of 1-2 years.

In fig.1 are represented various types of education belonging to the continental system.
In the **anglo-saxon system**, the programmes are put in a ladder. The first step is of 3-4 years duration leading to a Bachelor of Engineering or Bachelor of Science degree or a Master of Engineering (MEng) degree (only when of 4 years). In Ireland, most civil engineering degrees are of 4-years duration (BEng/ BE/BAI), although there are some 5-years degree courses that build on a Diploma after 3 years. In Scotland, the BEng degree requires 4 years.

In figure 2 are represented various types of education belonging to the **anglo-saxon system**.

The results of the survey undertaken by WG A of EUCEET I showed that in the academic year 1999-2000 in 21 out of the 26 countries civil engineering education belonged to the **continental system** (in AT, BE, BG, CZ, DE, DK, ES, FI, FR, GR, HR, HU, IT, NL, NO, PL, PT, RO, SE, SI, SK) and in 5 countries to the **anglo-saxon system** (EE, IE, LT, LV, UK).

From the 81 answers belonging to the **continental system**, 58 referred to the long duration programmes (56 of 5 years and 2 of 6 years) and 23 to the short duration programmes (16 of 4 years, 3 of 3.5 years and 4 of 3 years).

From the 32 answers belonging to the **anglo-saxon system**, 7 referred to programmes of 3 years, 24 to programmes of 4 years and 1 to a programme of 5 years.

As for the higher education institutions providing civil engineering education in Europe, they belong, according to the terminology commonly accepted at the level of the European Commission, to two distinct sectors:

- **university sector**
- **non-university sector**

In the **university sector** are found Universities, Technical Universities and (only in France) Grands Ecoles.

There is a much larger diversity of institutions in the **non-university sector**, such as: Fachhochschulen (AT, DE), Hogeschoolen (NL, BE-Flanders), Instituts Superieur Industriels (BE-Wallonie), Engineering Colleges (DK), Polytechnics (FI), Technological Education Institutes - TEI (GR), Technical Colleges (HU, IE), Polytechnic Institutes (PT), University Colleges (NO, RO, SE), Polytechnic Schools (ES) etc.

All Higher Education Institutions belonging to the **non-university sector** were aimed, in the pre-Bologna phase, to provide short duration, professionally oriented programmes of 3-3.5 or max 4 years duration.

### 3. The Bologna process - a chronology

#### 3.1 Sorbonne, May 25th, 1998

In fact, the Bologna process was triggered one year before Bologna. Minister of Education of France, Italy, United Kingdom and Germany signed in Paris on the occasion of the 800th anniversary of the Sorbonne on 25th May 1998 the "Sorbonne Declaration in harmonization of the architecture of the European higher education system". The Sorbonne Declaration stated that a two-cycle system "seems to emerge" and "should be recognized for international comparison and equivalence". It mentioned also the need to have first cycle degrees which are "internationally recognized", as "an appropriate level of qualification" and a graduate cycle with "a shorter master's degree and a longer doctor's degree", with possibilities to transfer from one to the other.

One can consider, without any doubt, that the basic requirement of the Bologna process, the adoption of a system based on two main cycles, undergraduate and graduate, had its roots in the Sorbonne Declaration.

#### 3.2 Bologna, June 19th, 1999

In "The Bologna Declaration on the European Higher Education Area" signed by Ministers of Education from 29 countries (15 EU countries: AT, BE, DE, DK, FI, FR, GR, IE, IT, LU, NL, PT,
ES, SE, UK; 2 EEA countries: IS, NO; 11 accession and candidate countries: BG, CZ, EE, HU, LV, LT, PL, RO, SK, SI, MT and Switzerland) six main action lines were defined:

1. Adoption of a system of easily readable and comparable degrees
2. Adoption of a system essentially based on two cycles
3. Establishment of a system of credits
4. Promotion of mobility
5. Promotion of European co-operation in quality assurance
6. Promotion of the European dimension in higher education

3.3 Prague, May 19th, 2001

The Communiqué of the Conference of Ministers of Higher Education in Prague "Towards the European Higher Education Area" has 33 signatory countries (29 Bologna signatory countries, plus Cyprus, Turkey, Liechtenstein, Croatia).

To the 6 action lines from Bologna, 3 more action lines were added:
7. Lifelong learning
8. Higher education institutions and students
9. Promoting the attractiveness of the European Higher Education Area

3.4 Berlin, September 19th, 2003

Number of signatory countries of the Communiqué "Realising the European Higher Education Area" reached 40 (33 Prague signatory countries, plus 4 Tempus-Cards-Albania, Bosnia-Herzegovina, FYR Macedonia, Serbia-Montenegro, 1 Tempus Tacis - the Russian Federation; and Andorra and The Holy See).

To the 9 Bologna and Prague action lines, one more was added:
10. Doctoral level (third cycle) included in the Bologna process

Other important ideas in the Berlin document:
- commitment to having started the implementation of the two cycle system by 2005
- commitment for the design of an "Overarching Qualification Framework" for the European Higher Education Area.

3.5 Next step: Bergen, 2005

It is anticipated that the Bologna process will expand further to the East, including as potential signatory, at the conclusion of the Conference in Bergen in the summer of 2005, 6 countries participating in Tempus Tacis, which are party to the European Cultural Convention: Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine. In addition, 2 small European countries are expected to be represented at the 2005 Conference of European Minister of Education: Monaco and San Marino, making the number of signatory countries to increase from 40 to 48.

3.6 Not only Conferences of Ministers of Education

The Bologna process does not mean only the Conferences of Minister of Education, convened every two years since June 1999, no matter how substantial and rich in consequences are the Declarations or Communiqués they produce, but also a long chain of meetings, seminars, workshops, in which are engaged various stakeholders. The most notable events, undoubtedly, were the Conventions of the European Higher Education Institutions organized by the European Universities Associations - EUA. The first EUA Convention took place in Salamanca in March 2001, in preparation for the Prague Conference, the second one in Graz, in May 2003, in preparation for the Berlin Conference, the third one will be hosted in 2005 by Glasgow, in preparation for the Bergen Conference.
4. The Bologna process - why and how

In a rather limited period of time, changes brought by the Bologna process are significant, to not say dramatic. To better understand why and how these changes took place, it is worth to quickly review some aspects of the process.

4.1 Compatibility with a world wide spread system, a prerequisite for enhancing the competitiveness of European higher education

In a comprehensive document presented in Bologna on June 18th, 1999, in the eve of the meeting of Ministers of Education [2], and brought to a final version on 18th August 1999, dr. Guy Haug, an outstanding expert on European higher education matters, made the following plea in favour of the introduction of two-cycle system in Europe:

"What the British and the US system, as well as those of the numerous countries which took inspiration from them (in the Commonwealth, Latin America and Asia and more recently in former communist countries) all share in common is a basic structure differentiating undergraduate and (post) graduate studies. Their definition, organization, content, respective role and size may be very different according to country and subject; the line of divide between them may be blurred and their articulation may be shifting. But the broad distinction between an undergraduate and a (post) graduate level is so widespread around the world that not also having it would make continental Europe an ever more isolated island of relative incompatibility. The Sorbonne Declaration was more than justified to promote a move in this direction".

Another source for the lack of competitiveness of many European higher education institutions, resides in the long duration of studies, put into evidence by the comparison between the legal (formal, nominal) duration of studies and the actual one. In the EUCEET WG A survey, the percentage of the overrun period, as a mean value of received answers for different programmes, varied between 5% and almost 40%, but for some countries the common overrun period was quite high (45% for Italy).

According to dr. Guy Haug [2], amongst the negative consequences of this phenomenon are:

- high drop out rates, especially in the first years, as shown in surveys carried out by OECD;
- late entry on the labour market (at the age of 28 or even 30 years), which is increasingly seen as a competitive disadvantage in the labour market, when graduates from other systems start their career, at age of 22 or 23, when obsolescence of knowledge is quicker than ever and when employers see time management as an indicator of future performance;
- lack of attractiveness for foreign students;
- unnecessarily high costs for students/families and public resources;
- undemocratic aspect of systems where the sheer length of studies may discourage in particular students from less favoured social backgrounds and constitutes a formidable obstacle for lifelong learners;
- additional difficulties to attract students to such areas as science and technology, where enrolments fell in many countries, resulting in foreseeable skill shortages in key economic sectors."

Governmental push towards the reduction of the real duration of studies and, hence, of the costs, a major trend noticed in recent years, could explain the growing attractiveness of models featuring shorter first qualifications followed by postgraduate studies for a smaller number of students.
4.2 The general needs of higher education vs. the specific needs of engineering education

The action line 2 in the Bologna Declaration, defining the objective to promote the adoption of a two-cycle system of higher education, is the one that poses greatest challenge to engineering education.

Indeed as shown at p.3, in most European countries "short duration programmes" (3 ... 4 years), in which the content is more application oriented, developed in parallel, and were usually provided by separate institutions, with the "long duration programmes" (4.5-5-6 year), characterized by a strong theoretical base and a marked research orientation. The clear differences in content and orientation between the two types of programmes explain why the requirement for a transfer from the "short" to the "long" programme asked explicitly for additional time to be spent in order to correct the deficiencies in basic knowledge, i.e. to overcome the handicap of a weak theoretical background. This could not be the case for other fields, where going from "short" to "long" programmes of studies could require only for the time to be made up.

Asking if the engineering education is concerned, Prof. Torbjorn Hedberg, former SEFI President, made the following pertinent comments on the Bologna Declaration [4]:

"The Declaration talks about higher education and universities without making clear whether the intention is that it should be applied to all kinds post-secondary education or if there are some sectors that could be excluded. The authors of the Declaration seem, however, primarily to have had the general non-professional university education in mind - the classical faculties of arts, letters and science - and not professional education, such as law, medicine, pharmaceutics, teacher training and engineering. As it turns out, nobody seems to think that medical studies should be reorganized according to the model proposed by the Declaration. The same arguments as for medicine also apply to engineering education ..."

4.3 A common misunderstanding: Bologna Declaration is NOT for a 3-5-8 system

Unlike the Sorbonne Declaration, where the call for a two-cycle system was made but without an indication about the duration, the Bologna Declaration specified that the first cycle should be at least 3 years.

However, replacing on purpose "minimum of three years" with "exactly three years", some academic circles capitalized on the assertion found in the "Attali report" to the French government about the emergence of a single European model of higher education based on a sequence of studies and degrees of 3-5-8 years, with 3 years for a Bachelor's degree, another 2 years for a Master's and 3 more for a PhD. On this model, Guy Haug [2] had the following comments:

"No significant convergence toward a 3-5-8 model was found. Whether traditional or newly introduced, bachelor type degrees require 3 to 4 years, and many European countries without bachelors have first degrees in 4 years; there is however a high degree of convergence towards a duration of about 5 years for master-level studies; but there is no 8-year standard duration for doctoral degrees. In addition, whereas the U.K., the US and most countries in the world-except in continental Europe - apply two-tier (undergraduate - postgraduate) systems, the length of studies and the degree structures vary considerably within and between these countries, and duration tends to be expressed in academic credits rather than in years".

4.4 The "anglo-saxon" model and the Bologna Declaration

The "anglo-saxon" system, such as it is in UK and Ireland represents obviously, a two cycles or two-tier system. However, there are a large variety of first degree programmes offered by universities of these countries, with differences related not only to the duration but also to the profile of the curriculum. Revealing these differences, the Engineering Synergy Group for Tuning [5], observed: "The Bachelors degrees, although like a short 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 normal 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 of other European countries.

The diversity of the undergraduate programmes offered by U.K. universities implementing the two-tier system of engineering education finds, nevertheless, a correspondence in the routes for professional registrations established by the SARTOR III recommendation of the Engineering Council in collaboration with engineering professional institutions, including Institution of Civil Engineers and Institution of Structural Engineers. The "educational base" required to become "Chartered Engineers" is either a 4-year Master of Engineering (MEng) degree or a 3-year Bachelor of Engineering (with Honors) plus an additional one-year of further learning (named "Matching sector"). The "educational base" required to become "Incorporated Engineer" is a 3-year Bachelor of Engineering degree.

4.5 The BA-MA-DO structures or the full implementation of the Bologna action lines 2 and 10

The three tiers (cycles, levels) which result from combining action lines 2 and 10 of the Bologna process, lead to what is now recognized across Europe as BA-MA-DO structure, shown in fig. 3.

Knowing that one academic year corresponds to 60 ECTS credits, a Bachelor degree requires 3 to 4 years and a Master degree 1 to 2 years. As for the doctoral studies, having as main objective to elaborate and defend a doctoral thesis, they require usually 3 to 4 years (full time work) and are not always credit-rated.

4.6 First, second and third cycle degrees in engineering education

The meaning of a doctor's degree is quite straightforward. Instead, there is no general use of the terms Bachelor and Master, even when the two-tier system is introduced. Is, therefore, more realistic to speak in terms of degrees: first cycle, second cycle and third cycle degree.

Since the implementation over all Europe of a BA-MA-DO structure in engineering education is a rather long term objective is better to use the scheme in fig.1, where, in fact, the continental system (fig. 1) and the two-tier system (fig. 2) were put together. The long one-tier study programmes of 5 years are named "integrated" programmes, leading straight to a Master-level degree.
4.7 The Bologna process and the continental system of engineering education

As far as engineering education is concerned, it is obvious that the continental system is the one to be affected by the Bologna process. As shown at p.2, the system comprises long duration programmes, more scientifically oriented, and short duration programme, more application or vocationally oriented. Both types of programmes must change when a two-tier system is adopted. Different ways in which such changes occurred or will occur and their implications will be discussed in the chapter 5.

4.8 Three recommendations of CESAER and SEFI

CESAER (The Conference of European Schools for Advanced Engineering Education and Research) and SEFI (The European Society for Engineering Education) organised jointly in February 2003 a seminar at Helsinki University of Technology concluded with "Communication of CESAER and SEFI on the Bologna Declaration" [ ].

There are 8 recommendations of CESAER and SEFI in this Communication, from which the first three are the most relevant for our discussion:

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 to second cycle Master level.
3. The specific qualities of the presently existing application oriented first cycle degree must be recognized and safe-guarded, with bridges to second cycle programmes being provided.

4.9 EUCEET position on the implementation of the Bologna Declaration in civil engineering education

At a meeting of the Management Committee of EUCEET II which took place on 19th September 2003 in Ciudad Real was raised for the first time the opportunity of adopting a position statement on the implementation of the Bologna Declaration in civil engineering education. The
general lines of such a statement were defined and a draft was circulated among the MC members in the months following the Ciudad Real meeting.

At the next Management Committee meeting, held in Paris on 16th February 2004, the following statement was adopted with clear majority:

"EUCEET is supporting and encouraging the application of the idea of two-tier education system in Civil Engineering as suggested in Bologna Declaration.

The adoption of a system based on two main cycles, whenever takes place, must take into consideration the specificity of the civil engineering education and profession. Civil engineers perform and provide services to the community with significant implications for public safety and health. As a consequence, the first cycle in civil engineering education shall be relevant to the labor market and shall ensure graduates with a level of competences tuned to the substantial responsibilities of the profession. A duration of 4 years (or the equivalent of 240 ECTS credits) seems to fit that purpose.

A 4-year duration of the first cycle in civil engineering education is aimed also at facilitating transnational recognition of degrees and professional mobility of European civil engineers. In this respect, due consideration had to be given to the fact that various alliances between engineering organizations, such as Washington Accord and the Engineers Mobility Forum have established that the required academic component of the qualification of a professional engineer should be 4 or 5 years full time study in University.

The existing integrated 5-year curricula in civil engineering, leading straight to a Master's degree, is also compatible with the letter and spirit of the Bologna Declaration and with the vision of a European Higher Education Area."

4.10 A clear rejection of the Bologna action line 2 coming from Greece

In the opening session of the First General Assembly of EUCEET II, on 20th February 2003, the then Rector of the National Technical University of Athens, Prof. Themistocles Xanthopoulos, gave a talk on "Market Globalization, European University Education and the Bologna Declaration: Background Policy Analysis, Positions and Proposals" [6] in which the position in Greece regarding the Bologna Declaration was clearly expressed. Here are some opinions regarding the action line 2:

"Any splitting of the existing structure into two cycles, the undergraduate and the postgraduate, de facto downgrades the undergraduate cycle to that of the Schools of Higher Professional or Vocational Training, given that it is not possible to equip with substantial professional skills in the short period of this cycle without at the same time the shrinkage of the background scientific knowledge, that is without the actual betrayal of the scientific substance of the University degree.

It is, besides, at least unreasonable to claim that it is possible to decrease the duration of studies without downgrading their university nature, at a time of pressing demands, both from students and academic staff, for an increase of the duration of university studies due to the explosive increase of knowledge in the applied sciences and technology, as well as the recognition by the relevant professional bodies of the inadequacies of the Bachelor's degree, as a university diploma, in the labour market.

We reject explicitly the main objective of the Bologna Declaration, namely the compulsory and universal division of all University courses into two cycles ...

5. Civil engineering education in Europe in 2003 - 2004, four years after Bologna

Comparing the situation in the academic year 2003-2004, as revealed by the report included in this volume, to the one existing in 1999-2000, presented in the First EUCEET Volume [1], one can realize how numerous and important are changes which already took place or are going to take place in the near future.
Some comments are necessary on the changes brought by the implementation of the action line 2 of the Bologna Declaration, but before proceeding it is worth to remind in full extent the line 2:

"Adoption of a system of easily readable and comparable degrees, also through the implementation of the Diploma Supplement, in order to promote European citizens employability and the international competitiveness of the European higher education system. 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 maximum of three years. The degree awarded after the first cycle shall be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/ or doctorate degrees as in many European countries".

Table 1 presents the evolution of degree structures at university or university like institutions providing civil engineering education. A clear trend, from one-tier to two-tier, can be observed in the degree structures at universities. Since 1999-2000, the integrated, one-tier programmes leading straight to a degree equivalent to a Master degree, have been already replaced by two-tier programmes in the Czech Republic, Netherlands and Slovakia, but a similar move is expected in the near future in many other countries.

Data in table 1 are transposed in three maps showing the distribution of systems of civil engineering education in the university sector of Europe at three moments: 1999 - 2000 (fig.5), 2003 - 2004 (fig.6) and 2005 and beyond (fig.7).
### Degree structures at universities

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1. Only at the University of Architecture, Civil Engineering and Geodesy, Sofia
2. At certain Technical Universities
3. Only at the Norwegian University of Science and Technology, Trondheim
4. At certain Technical Universities
5. At certain Universities

#### 5.1 Shift from the integrated programmes to the two-tier programmes

##### 5.1.1 The 3+2 formula

Table 2 presents a synthesis of the formulas adopted (or to be adopted) when the change from the one-tier to two-tier programmes in the degree structures of the universities is made.

As one can observe, the solution preferred in most cases is to split the existing 5-year programme by introducing a Bachelor degree after the first 3 years.

One immediate question to be raised is in which way the newly created 3-year degree will fulfil the Bologna requirement of being "relevant to the European labour market as an appropriate level of qualification".
It appears that in almost all cases when the formula 3+2 is adopted, the new Bachelor's degree is considered primarily as a break or pivot point, suitable for mobility and to less extent for employability. On the other hand, there seems to be an implicit assumption that all or almost all of the students getting the diploma delivered after 3 years will continue studies at the same university, until the 3+2 programme is completed, in which case the employability matter is of no relevance.

Tabel 2

<table>
<thead>
<tr>
<th>Country</th>
<th>Formula adopted (or to be adopted)</th>
<th>New Bachelor's degree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3+1.5</td>
<td>3+2</td>
</tr>
<tr>
<td>BE Belgium</td>
<td>X</td>
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<td>NL Netherlands</td>
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<tr>
<td>SK Slovakia</td>
<td>X</td>
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</tr>
</tbody>
</table>

1 Only for the specialization "Civil Engineering and Architecture" at CTU Prague
2 At certain Technical Universities

5.1.2 The 4+... formulas

A different approach consists in building a Bachelor's degree being in itself "relevant to the European labour market", as required by Bologna.

In Latvia and Lithuania, a 4-year duration for the first cycle degree and a 2-year duration for the second cycle were adopted long before the Bologna process started.

In the Czech Republic, both the short duration programmes of 3-4 years and the long duration programmes of 5-5.5 year ceased to be offered beginning with 2003-2004, being replaced by a two-tier programme of 4+1.5 years.

In Romania, a 4+1.5 programme will be introduced starting with 2005-2006.

A preference for a 4 years duration for the first cycle in the university sector was expressed also in Hungary, Spain and Portugal.

Not only by duration, but also by the balance between the academic content and the skills orientation, the 4-years programmes offer to the graduates an option to enter the labour market. As a consequence, only a part of the graduates of the first cycle are expected to enrol for the second cycle.

One should mention, however, that 4+1.5 or 4+2 formulas are possible only when, by law or by other means, the cumulated duration of the first two cycles is not limited to 5 years.
5.1.3 Difficulties in implementing the two-tier model

In a private communication with a distinguished representative of a German Technical University [7], the author has received the following message which expresses in a concise and clear manner the dilemmas faced by institutions belonging to the university sector in Germany when trying to implement the two-tier system:

"The Standing Committee of German speaking Civil Engineering Faculties at Universities has serious problems with accepting the political request of producing a professionally qualified Bachelor after only 3 years of study.

On the other hand, 4 years of study for a B.Sc. are not feasible because in some German States a Dipl.-Ing. degree takes only 4 years plus Diploma thesis. In others it takes 4 and a half plus thesis. So, with 4 years for a B.Sc. the period of specialization would be zero or by far too short. At Fachhochschulen, it takes 3 years of courses plus half a year of practical work plus half a year for the diploma thesis to get a Dipl.Ing (FH) degree, which is well accepted by the German construction industry.

However, if this degree is to be equivalent to a B.Sc. at university level, according to the political concept, you would be entitled to enter a Master program at a University without sufficient theoretical background knowledge.

These are the major objections against the two-tier model in Germany".

5.1.4 The process can be reversible

A reform as complex and profound as the one taking place in European higher education could be neither a one way nor an irreversible process. Corrections and adjustments are necessary before reaching the planned outcomes. An example to illustrate this assertion is coming from Italy, the very first country to respond to the call of the Bologna Declaration for the adoption of a system based on two main cycles. By a law published in January 2000, a two-tier system was introduced in Italy based on the 3+2 model, with a three year course (180 credits) for a "Laurea" degree, followed by a two-year specialization course (120 credits) for a "Laurea specialistica" degree. A paper included in this volume describes the transition from the old system (in which two programmes, of 3 years and of 5 years, were put in parallel) to the new one [8].

Several years after the introduction of the new system, an adjustment is under way and concerns the first cycle. There will be one curriculum for the first year of study, after which a differentiation will be made between two distinct programmes: one more practically oriented, the other one more theoretically oriented. It can be assumed that only the graduates of the more theoretically oriented programme will have access to the second cycle. It results that the "Y" system adopted for the first cycle will, in fact, generate degree courses equivalent to "Academic Bachelor" and to "Professional Bachelor". The two-tier system is preserved, but employability is enhanced for the graduates of the first cycle who will make the option for the professional route. At the same time, considering that most, if not all, of the graduates of the "academic bachelor" will pursue studies for the last two years, it will be possible to design a better curriculum for the integrated route, which in fact will be also an "Y" (1+4).

Another example of reversibility of the process is provided by Estonia. In 1995, the integrated programme of 5 years was replaced by a two-tier programme 4+2. By a law applied starting with the academic year 2002-2003, the two-tier system changed to 3+2 for all engineering fields, except civil engineering where only the integrated route of 5 years was reintroduced. The explanation can be found in the report on civil engineering education in Estonia included in this volume [9], where is stated that "the former educational system was not capable of educating engineers with appropriate knowledge and expertise in the field of civil engineering".
5.1.5 Co-existence of the two systems

It is true that, due to its very general character, the Bologna Declaration did not make any reference to any specific field of higher education. The same applies to Communiqués from Prague and Berlin. When the implementation of the action line 2 was at stake, it was somehow self-understood that the so-called "regulated professions" at European level, such as medicine, veterinary medicine and architecture, could not make the object of a switch from the integrated programmes of 5-6 years to the two-tier programmes.

Since the engineering profession is not, unfortunately, a regulated profession at European level, it could not be left outside from the wave of changes brought by the Bologna process. As a consequence, as was clearly shown in previous paragraphs, the two-tier system is continuously spreading.

However, it was recognized at the early stage of the Bologna Process that "in a small number of disciplines or at a small number of institutions, longer curricula leading straight to a master degree could be accommodated" [10]. In other words, the integrated degree courses are compatible with the Bologna spirit and should not be replaced unless there are serious reasons in favour of such a replacement.

Among the countries where changes in the higher education system occurred as a consequence of the Bologna Process, there is at present at least one example of coexistence between the one-tier and the two-tier systems, offered by Norway or, more specifically, by the Norwegian University of Science and Technology, the only Norwegian institution with a broad offer in engineering [11], which continues to run integrated 5-year study programmes leading straight to a Master degree while, at the same time, admitting a limited number of students with a 3-year Bachelor degree (obtained elsewhere) for the last two years.

In Germany, where the legal frame for the adoption of a two-tier system was created before Bologna, the coexistence of existing integrated 5-year programmes (at Technical Universities or Universities) or 4-year programmes (at Fachhochschulen), with new degree courses for Bachelor and Master is for the time being possible.

Other examples of coexistence are coming from countries where the Ba-Ma system was introduced independent from the Bologna Process.

In Latvia [12], a two-tier system of 3 years for "Academical Bachelor", followed by 2 years for "Academical Master" coexists since 1995 with a "Bachelor professional study programme" of 4.5 years duration conferring the qualification of civil engineer. During this coexistence period, the "Bachelor professional" of 4.5 years proved to be much more attractive than the two-tier programme of 3+2, and the explanation cannot be separated from the recognition given by the labour market to the graduates of the integrated 4.5 years programme.

A situation somehow similar is in Russia [13], where a two-tier Ba-Ma route of 4+2 years, newly introduced in 1992, coexists with the integrated 5-year programme leading to "Diploma - Engineer" degree. Altogether, the structure is of Y type since the first two years of the Bachelor degree and of the "Diploma - Engineer" degree are common. The most popular proved to be the "Diploma-Engineer" route which, unlike the Bachelor route, was known and accepted by the employers.

One lesson can be drawn from the two last examples when both types of programmes, two-tier and one-tier, are present in the offer of the university: the factor which seems to control the option of the enrollees is the preference given by the employers to the programmes followed by the graduates, which, not surprisingly, goes towards the integrated programmes.

5.1.6 Not one, but a diversity of "Bachelor's" as a first cycle degree

Implementation of the Bologna action line 2 in the university sector and in the non-university sector as well, leads unavoidably to a diversity of first cycle degrees, named or not as Bachelor's degrees.
Several of such degrees were already referred to in some of the previous paragraphs.
- the more or less purely "academic Bachelor", in the 3+2 structure adopted by research universities, serving mainly as a "stepping-stone"
- the Bachelor "being in itself relevant to the European labour market" in the 4+...

In addition to these "new Bachelors", appearing as a result of the splitting of the integrated programmes, there are many others offered by the non-university sector, having a well established tradition and programmes recognized by the profession. In Denmark, for instance, a Bachelor degree after 3.5 years offered both in the non-university sector (at University Colleges) and in the university sector, is accepted for professional recognition by the Society of Danish Engineers, which is not yet case for the 3-year Bachelor in the 3+2 scheme introduced after Bologna by the universities.

Similar comparisons between existing Bachelor or Bachelor-type degrees, offered by the non-university sector and the new Bachelors created in the university sector, can be made in all countries where the two-tier programme of 3+2 is replacing the one-tier, 5-year programme, such as Netherlands, Belgium, Finland etc.

But even in a country such as England where, since the transformation of Polytechnics in Universities, the higher education system ceased to be binary and became an unitary one, there is a marked diversity of Bachelor programmes of equal duration (3 years), due to the inherent and great differences in the institutions providing the degree courses.

The conclusion is that one cannot speak in general about a "First cycle degree", be it called Bachelor or whatever, but only in the context of a given educational structure.

For the time being it can be stated that the large majority of bachelor degree course offered by higher engineering education institutions in Europe, both in the university sector and in the non-university sector, can be recognized as belonging to one of the following two categories:
- professional bachelor, more application oriented
- academic bachelor, more theoretical oriented

5.1.7 At Master's level, the picture is more complex

In first place, there are Master's or equivalent degrees provided in the continental system as the result of 5-year integrated programmes offered by universities or of the 2+3 type offered at the Grandes Ecoles in France. They can be named "Integrated Masters".

There are, of course, existing Master degrees offered in countries with centuries old traditions in the anglo-saxon system (UK, Ireland) or in countries in which the system was introduced in the early 90's (Baltic countries). They can be named "Consecutive Masters". To the same category belong the Masters resulting from the process of splitting the integrated programmes adopting formulas such as 3+2; 3.5+1.5; 4+1.5 or 4+2.

As for the nature of these Master's degrees, they can be Research Masters of Professional Masters in one specific field, but also "Conversion Masters" embracing two distinct fields, such as engineering + economics, engineering + law etc.

Programmes leading to Master's degrees can be organized in co-operation by several universities. These are "Joint Masters". A recent development in that direction is the "Erasmus Mundus" programme launched by the European Commission in December 2003 and whose implementation will start in the academic year 2004-2005. The purpose of the programme is not the creation of new Master courses but to provide support for existing courses to get the label "Erasmus Mundus Master Course". The consortium of institutions to apply for getting funds from the Erasmus Mundus programme should comprise at least 3 higher education institutions from 3 different countries, from which at least two Member States of the European Union. Graduate students participating in the programme, should study to at least two H.E. institutions and make use of at least two languages.
5.1.8 Several problems related to the second degree

There are a number of problems concerning in particular the new Master's degree courses.

One such problem is the access to the second cycle. The solutions can be very diverse, depending in first place on the type of the first degree and of regulations at country or university level. In the university sector, in situations in which the first cycle is seen as a break or pivot point suitable for mobility (in the 3+2 formula), it seems that the second cycle will be open for all candidates holding a relevant Bachelor diploma. In this context relevant means a diploma issued by the same university of by an institution of equivalent status.

The situation could be different when the first cycle, with a 4-year duration, or 240 credits (in a 4 + ... formula), is considered of being in itself "relevant to the job market". In such cases, it is likely that the access to the second cycle will be based on some criteria (entrance examination, professional record at the end of the first cycle, etc).

Universities will certainly set up their own rules when faced to the demands of graduates of a first cycle in an institution belonging to the non-university sector to pursue a second cycle and to get a Master's degree at the university.

The problem of access is intricately related to the one of funding. There are strong reasons to believe that behind the support given by governmental authorities to the Bologna process was the open or hidden conviction that, somehow, economies for the funding of higher education in the country will be possible. And ways of getting such result could be the reduction in the number of students enrolled for the second cycle degree, the reduction of the real duration of studies to their official length, or the extension of the gratuity of higher education only to the level of the first degree.

5.1.9 An increasingly blurred line of divide between the university and non-university sector in European engineering education

A visible and significant outcome of the Bologna process developed so far is the fact that the line of divide between the university and non-university system is blurring. In what follows there are a few examples in support of this assertion.

A novelty which the Bologna process is bringing about in civil engineering education is the extension of the Master's degree providers to the non-university sector.

The paper on civil engineering education in Norway [11], mentions the name of two University Colleges which are already providing education at Master level. Very probably, a similar pattern will be followed in other countries by institutions belonging to the non-university sector.

In Portugal, as shown in the paper included in this volume[14], while the Universities are not yet decided on the way in which to move to the two-tier system, the Polytechnic Institutes were authorised by law to offer by a 2-tier programme, resulting altogether in a "Licenciatura degree".

In Germany, even before Bologna, the Education Framework Law introduced in 1998 opened not only to Universities, but to the Fachhochschulen as well, the possibility to offer Bachelor and Master degree courses.

6. The reaction of the industry

A process of the extent and complexity as the Bologna process should interest other stakeholders besides the academics. For instance, the industry.

A first observation to make is that in most countries there is no a framework for a proper consultation and participation of the industry regarding the changes in the higher education.

Under such circumstances, it was hard to expect a reaction from the industry. On the other hand, too little time passed since the occurrence of changes, where they do occurred so far, to enable the industry to make a judgement.
Skepticism seems to be the word to best characterize the reaction of the industry towards the extension of the cycles system in engineering education in Europe. And "wait and see" attitude, until the cohorts of graduates of the new programmes will join the industry.

7. The reaction of the professional associations

Professional associations which are involved in the professional recognition of engineering graduates have strong reasons to watch the Bologna process.

In few countries, however, a public and official stance was taken. One such exception is the Institution of Engineers of Ireland (IEI) which launched in November 2003 a proposal called: entitled "A New Structure for Engineering Education in Ireland - Implementation of the Bologna Declaration" [15]. A five-year integrated Master degree is proposed, with a Bachelor degree (of "pivot" type) at the end of year three. Another proposal is for a three year engineering technology degree to run parallel, with possibility of transfer from engineering technology bachelor degree to year four of engineering master degree only on completion of bridging studies including mathematics. As one can recognize, in the vision of IEI the implementation of the Bologna Declaration means a move from the anglo-saxon system to the continental system, with programmes put in parallel.

In Italy, the Italian Engineering Board (Consiglio degli Ingegneri) was never in favour of a 3-year first level degree. However, a law allows holders of such a title to apply for the recognition as professionals.

In countries where new Bachelor's degrees are created by splitting the integrated 5-year programmes (3+2 formula) there seems to be a real concern of professional associations in respect to the length of the first professional degree. The prevailing opinion is that the first professional degree can only be the Master's degree.

8. Recognition and accreditation of civil engineering degrees - matters of concern

8.1 Definition of the terms

In a "Glossary of Terms Relevant for Engineering Education" [16], one can found several definition of relevance for the present discussion:

Recognition: "The provision by which a body or institution (the recognizer) considers another body or institution (the recognized) appropriate or competent for a certain purpose".

Academic Recognition: "A formal acknowledgement, by a competent authority of a higher education institution, of academic qualification 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 a 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)."

De facto Professional Recognition: "Refers to situation where the profession is not regulated. In that case, after the completion of a study programme, Engineers may be recognized on the basis of their academic degree".

De jure 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."

Professional Qualification: "The set of requirements necessary for access to a profession, especially a regulated profession".
Regulated Profession: "A profession which is subject to rules set by national legislation".

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".

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."

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".

ECTS: "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 assumptions that the global workload of an academic year of study is equal to 60 credits."

8.2 The present situation
8.2.1 Recognition

A system of recognition and accreditation of engineering degrees and professional qualifications was not implemented so far in Europe.

The legal framework for the mutual recognition of professional qualifications was established in the past 15 years by a number of Directives of the European Union. Thus, the Directive 89/194/EEC put the bases of 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. Other directives were enforced for certain professions such as medical professions and architecture.

In 2002 a new unified Directive, named "Directive of the European Parliament and the Council on the Recognition of Professional Qualifications" was proposed to the European Parliament with the aim of introducing a more uniform, transparent and flexible regime for the recognition of qualification in the regulated professions. The approval of the final session is pending, but efforts to introduce specific rules for civil engineers were not yet successful.

8.2.1.1 Professional recognition

Engineering profession is regulated by law in four European countries: Italy, Greece, Spain and Portugal. The admittance to the Professional Association in Italy and Greece is based on an examination for which are eligible only graduates holding an accredited degree. In Portugal, the examination is compulsory only for graduates holding a non-accredited degree.

In United Kingdom, the Engineering Council, established by Royal Charter, is the body that ensures national recognition of the engineering profession and sets standards of engineering education and training. The process of the formation of a professional engineer, as defined in the policy document Standards and Routes to Registration (SARTOR), 3rd edition, produced by the Engineering Council in 1997 [17], comprises three stages:

- **The educational base**, an accredited degree programme or equivalent, which is of 3 years for "Incorporated Engineers" (the support engineers or "know-how" engineers) and 4 years for "Chartered Engineers" (the top-class engineers or "know-why" engineers).
- **Initial professional development** (IPD), designed to improve the acquisition and development of skills, specialist knowledge and competence needed to practice in a specific area of engineering; the duration of this stage is normally 4 years.
- **Professional review** in which the competence achieved through IPD is demonstrated and assessed by the requirement for the candidate to write a report and to undertake an in-depth interview by two suitable qualified professional engineers; the review also requires the candidate to demonstrate a commitment to continuing professional development and a code of conduct and codes of practice.

After completing the process, the candidate is entitled to registration as Incorporated Engineer (IEng) or, if the case, as Chartered Engineer (CEng).

Similarly, in Ireland only membership of a Professional Institution gives the right to the title of Incorporated Engineer or Chartered Engineer.

One can consider that, although both in UK and in Ireland the engineering profession is formally free, due to the strict rules leading to recognition the profession is in fact regulated.

In most European countries, where the profession is not regulated, the right to award engineering degrees is conferred to specific higher education institutions, hence recognition within each country is practically automatic.

### 8.2.1.2 Academic recognition

It is expected that academic recognition across Europe will be enhanced by the development of the European Credit Transfer System (ECTS) into an over-arching pan-European credit accumulation and transfer framework, and by extending the use of the Diploma Supplement. In this respect, requirements were defined by the Prague Communiqué in the following terms:

"Ministers emphasized that for greater flexibility in learning and qualification process the adoption of common cornerstones of qualifications, supported by a credit such as the ECTS or one that is ECTS compatible, providing both transferability and accumulation functions, is necessary. Together with mutually recognised quality assurance mechanisms such arrangements will facilitate students' access to the European labour market and enhance the compatibility, attractiveness and competitiveness of European higher education. The generalisation of such a credit system and of the Diploma Supplement will foster progress in this direction".

### 8.2.2 Accreditation

In few European countries accreditation of engineering programmes enjoys a long tradition and a well-established practice.

The first example which comes in mind is France, where the title of "Ingénieur diplômé" is protected by law and only institutions accredited by a national "Commission des Titres d’Ingénieur" are allowed to award it. CTI was founded by law in 1934 and has 32 members (half of them representing institutions awarding an engineering degree, the other half representing industry managers, the associations and trade of engineers) appointed by the government for 4 years.

In UK, Ireland and Portugal the accreditation of engineering programmes is done by the professional associations.

In some Central-Eastern European countries the foundation, after 1990, of new public universities and, particularly, the appearance for the first time of a large private sector in the tertiary education, obliged authorities to create accreditation bodies. This was, for instance, the case in Romania, as described in [18].

In the last few years which witnessed, as a result of the Bologna process, the establishment of new programmes and degrees, the need of accreditation increased and so did the number of agencies, bodies, councils etc. authorized to apply accreditation procedures.

Following recent developments, in most European countries is set in place a national system for the purpose of quality evaluation or accreditation.

### 8.3 A concrete step toward a coherent system of accreditation in European engineering education
8.3.1 "Participation Projects" contributing to the realisation of the European Higher Education Area

In the spring of 2004, the European Commission launched, within the Socrates and Tempus programmes, a number of so-called "Participation Projects contributing to the realisation of the European Higher Education Area (Bologna process)". "Participation Projects", set up in order to monitor the Bologna process and test new ideas, were defined as projects in which all Bologna Signatory States may participate, as well as the countries eligible to become Signatory States in future.

A special feature of the "Participation Projects" was that they gave the possibility to bring together partners from both Socrates countries and Tempus countries.

Among the activities to be supported by the "Participation Projects" was the following one: "Developing European Cooperation in Accreditation in certain disciplines/ professional fields."

In September 2000 was established ESOEPE (European Standing Observatory for the Engineering Profession and Education), aimed to build confidence in systems of accreditation of engineering degree programmes within Europe, to facilitate systematic exchange of know-how in accreditation.

Most ESOEPE members decided to seize the opportunity of the Call for proposal for "Participation Projects" and to prepare a project having as a goal the development of European cooperation in accreditation in the field of engineering. So was born the project "EUR-ACE Accreditation of European Engineering Programmes and Graduates".

8.3.2 Aims of EUR-ACE

In the application submitted on 16th April 2004 to the EU Commission, the objectives of EUR-ACE were summarized in the following terms.

"EUR-ACE intends to propose a framework for setting up a European system for accreditation of Engineering education at the First Cycle and Second Cycle level (as defined within the Bologna process) with the following main aims:

a) providing an appropriate "European label" for accreditation educational programmes and their graduates;  
b) improving the quality of educational programmes in engineering;  
c) facilitating trans-national recognition by programme validation and certification;  
d) facilitating recognition by the competent authorities, in accord with the EU Directives;  
e) facilitating mutual recognition of agreements."

8.3.3 Use of the results of EUR-ACE

On the use of the results of the project, the application shows:

"In countries where a national accreditation system already exists, the relevant authorities might allow HEIs and professional bodies to seek and accepts European accreditation, as a complement or an alternative to the national accreditation. In countries at present without a national accreditation system, the European system may either be adopted directly, or to be used as a framework for setting up a national system. Moreover, European accreditation standards can be a useful means whereby pre-existing trans-national agreements for mutual recognition of engineering degrees and qualifications can be assessed; additionally, they can facilitate the establishment of new agreements of this type. Finally, the existence of a widely accepted European accreditation system will help put an end to the growing trend of European HEIs seeking accreditation by non-European bodies. Ont the contrary, a well - functioning European Accreditation system will lead to worldwide readability and acceptance and to possible cross-recognition between EU and other regions (e.g. the Latin American countries)."
8.3.4 Planned activities of EUR-ACE

The project is planned for 18 months, starting on 1st September 2004 and ending on 31st December 2005.

Five stages are previewed in the development of the project.

Stage 1: Defining common procedures, standards and templates (September 2004 - November 2004)

Stage 2: Testing EUR-ACE criteria and procedures in 10-12 European countries (December 2004 - February 2005)


Stage 4: Re-testing (May-October 2005)

Stage 5: Wrapping up the project (November - December 2005), leading to several outputs, among which:

- accreditation standards, distinct for First Cycle and Second Cycle degrees but not "branch specific"
- template for publishing the results of the evaluation/ accreditation procedures
- make-up and terms of reference of the organisations that should run the award of the European Accreditation
- database on accreditation procedures
- database on European-accredited engineering programmes

8.3.5 EUR-ACE consortium of partners

The applicant/ contracting institution for EUR-ACE project is FEANI (Fédération Européenne d'Associations Nationales d'Ingénieurs - European Federation of National Engineering Associations). The Coordinator (project manager) is Prof. Augusti Giuliano from Universita "La Sapienza” Rome, acting as Consultant to FEANI.

Besides FEANI, 13 other institutions are participating in the EUR-ACE project, namely:

- SEFI (Société Européenne pour la Formation d'Ingénieurs)
- CESAER (Conference of European Schools for Advanced Engineering Education and Research)
- EUROCADRES (Conseil des Cadres Européens)
- ENQHEEI (European Network for Quality of Higher Engineering Education for Industry)
- ASIIN (Accreditation Agency for Study Programs in Engineering, Informatics, Natural Science and Mathematics, Düsseldorf)
- C.T.I (Commission des Titres d'Ingénieurs)
- I.E.I (The Institutions of Engineers of Ireland)
- CoPI (Conferenza dei Presidi delle Facolta' di Ingegneria Italiane)
- UNIFI (Universita degli Studi di Firenze)
- Ordem dos Engenheiros, Portugal
- UAICR (Union of Associations of Civil Engineers of Romania)
- RAEE (Russian Association for Engineering Education)
- Engineering Council, United Kingdom

9. Concluding remarks

The impact of the Bologna process on civil engineering education is significant.

There is a clear trend toward the introduction of the two-tier system, which is expected to be the prevailing one in a few years.

One of the major results of this move is the appearance of a new kind of degree, the 3-year Bachelor's degree offered by Universities and meant as a stepping-stone in the route for the
completion of 5-year studies, leading to Master's degree. The new 3-year Bachelor's degrees, named sometimes "academic bachelors", do not compare with already existing, shorter and application oriented degrees.

Another result of the process is provided by the first cycle degree of 4-year duration introduced in some universities which, unlike the new 3-year duration degree course, is being by itself relevant to the job market, fulfilling the employability requirement.

Some existing, 5-year integrated degree courses, will continue to be present in the offer of some universities, in some countries in parallel to the new degree courses.

Changes are occurring in the non-university sector, too, although not with the same extent as in the university sector.

Compared to the situation existing four years ago, the present situation is more complex and, possibly, more confuse.

To speak in terms close to the Civil engineering profession, one can say that a "large scale experiment" was initiated, whose results will require many years to be properly assessed.

Let's hope that, through the active involvement of all stakeholders, academics in first place, students, professional associations, industry, public authorities a.s.o., the results will lead to a stronger and more competitive European civil engineering education.
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