CIVIL ENGINEERING EDUCATION AND THE BOLOGNA DECLARATION: A GREEK RETROSPECTIVE

V. J. MOSELEY[1] and S. E. DRITSOS[2]
[1] Self employed civil and structural engineer, [2] Department of Civil Engineering, University of Patras, 26500, Patras, Greece
e-mail: dritsos@upatras.gr

EXTENDED ABSTRACT

Although the Bologna Declaration appears to be adopted almost throughout Europe and its environs, Greece strongly objects to its implementation. Some reasons (which may equally apply to the rest of Europe) are as follows: Education was founded in ancient times and represents a global way of thinking encompassing virtue, morals, ethics, etc. It is believed that multidisciplinary civil engineers with a broad education in many matters are required and engineers with strong personalities are needed that are able to take responsibility. Specifically, Greece is the most earthquake prone country of Europe and every civil engineer must have a strong structural engineering background in seismic design. While other European countries may consider earthquake engineering as a subject for specialisation, this complex topic is the core subject encompassing a whole section of studies. Much of the infrastructure in Greece is still to be built. Every structure, no matter how small, by law requires earthquake effects to be taken into consideration. The Greek individualistic nature demands that every building is different and manifests itself in the existence of very few large civil engineering companies. Rather, the norm is a single person or two or three persons working together in a small office. Greece has a particularly unskilled workforce in the construction industry. These reasons promote the need for all civil engineers to be highly educated and to be capable of dealing with all the various demands of civil engineering.

Amongst other things, the Bologna Declaration involves the implementation of a two-tier process in civil engineering. Before the Bologna Declaration, an integrated system existed throughout most of mainland Europe. For financial reasons, competition for university places in Greece is extremely high and only the best of the very best are accepted. The two-tier system essentially creates a second-class civil engineer with a three-year qualification. This may not be suitable for the best of the very best students. Any university education must be geared towards the projected demands of the workplace. A European wide standardized education is an attractive idea with many advantages but any individual country must firstly look after the needs of its own population. When considering the special needs of Greece, it is believed that a two-tier system is not capable of educating civil engineers to the appropriate levels of knowledge and expertise required.

This paper details the reasons for Greece's strong objection to the Bologna Declaration before going on to investigate if other European countries experience of the experiment has been successful or not. At first glance, it is found that the principles of the Bologna Declaration have been implemented in nearly all education systems throughout Europe. However, further investigation reveals that there is considerable concern over the application of the Bologna Declaration to civil engineering education. That is, relevant civil engineering education societies and associations as well as academics and students in many European countries are calling for a return to the integrated continental system for civil engineering education, if this has not already been instigated.

KEYWORDS
Bologna Declaration, Civil engineering education, Continental system, Two-tier system

1. INTRODUCTION

Greece's opinion on the Bologna Declaration can be summed up by the words of Prof. Themistocles Xanthopoulos stated during the opening session of the first General Assembly of EUCEET II in 2003: "*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..." (Manoliu, 2004). However, it is the authors' opinion that Prof. Xanthopoulos is incorrect to use the word "compulsory", as the Bologna Declaration is an intergovernmental agreement and participation is, therefore, voluntary (Wikipedia, 2011).

This is not just the opinion of Greek academics. During the period 2006 to 2007, steps were taken by the then Greek Government with opposition consent to implement the Bologna Declaration. The consequences were that the "*universities were taken over by the students, massive protests, police violence and riots*" (Wikipedia, 2011). The student protests in Greece resulted in the Greek Government abandoning its plans for Bologna Declaration style educational reform.

Greece's opinion on the Bologna Declaration remains today as: "*at the CLAIU-EU Conference "Engineering Master Degrees in Europe" hosted by the Royal Military Academy, Brussels, the new Rector of the university, Prof. Konstantinos Moutzuris, reiterated the same position*" (Manoliu, 2010).

As can be gathered from above, Greece objects to the main purpose of the Bologna Declaration, which is the adoption of a system essentially based on two main cycles. To recap, the Bologna Declaration advocated a move from the "continental" system to the "Anglo-Saxon" system for European university education. At the time, the "continental" system was prevalent in mainland Europe while the "Anglo-Saxon" system existed in the United Kingdom and Ireland. It is only fair to note that Estonia, Latvia, Lithuania and Turkey had "Anglo-Saxon" type educational systems at the time of the Bologna Declaration. The system was newly introduced in the first three countries in the wake of independence from Russia.

The Bologna Declaration dates from 1999. When considering the "continental" system, reasons for the Bologna Declaration and the desired shift from a "continental" system to an "Anglo-Saxon" system included international unattractiveness of courses, high drop out rates, excessive costs, considerable student overrun times, late entry on the labour market, etc. (Manoliu, 2004).

2. CIVIL ENGINEERING EDUCATION IN GREECE

Education in Greece was founded in ancient times. Many educational concepts developed thousands of years ago in Greece serve as the pattern for modern day education at every level throughout western civilisation and elsewhere. At the highest level, the Academy and Lyceum of Plato and his student Aristotle provided the model for today's modern universities. Quite simply, education in Greece is based on thousands of years of tradition.

The authors have given in detail the case for Greece's objection to the Bologna Declaration and a brief summary of the main points follows (Dritsos and Moseley, 2010):

Much of the infrastructure in Greece is still to be built. In addition, most of the serious earthquakes that occur in Europe occur in Greece. In this context, it is to be noted that the Fifth EUCEET Volume does not list earthquake engineering as a core subject (Majewski, 2006). Therefore, most European civil engineering students do not even study the topic. This could be considered as surprising as, if cost and fatalities are considered together, it is clear that earthquakes represent the greatest natural hazard known to humanity. In Greece, earthquake engineering is the core civil engineering topic and must be studied over and above the other civil engineering subjects. Furthermore, the complex topic of earthquake engineering encompasses a whole section of studies and does not only cover new construction. As relevant knowledge has increased, anti-seismic guidelines, codes and specifications have been continually upgraded, particularly in recent years. Consequently, the vast majority of the structures and building stock in Greece (and therefore, in other earthquake prone regions of the world) is inadequately designed and is in danger of experiencing serious damage or even collapse during a strong earthquake. Anti-seismic strengthening and/or repair are little known topics in Europe outside of a few earthquake prone countries. This problem is not going to go away and is only going to get worse as time goes on. A Greek civil engineer must be well acquainted with the subject of seismic retrofitting. This is because the design and planning of an intervention is infinitely more difficult and complex than that of designing a new construction. The subject of anti-seismic strengthening and/or repair represents a unique challenge to the civil engineering profession and requires a high degree of judgement and prudence.

There are very few large civil engineering companies in Greece and the norm is for one to three persons working together in an office. Here, specialisation is an exception as Greek civil engineers must be familiar with all aspects of the industry. Therefore, there is a need for highly educated civil engineers capable of dealing with all the demands of civil engineering.

In Greece, no two buildings are the same and the public demands something architecturally different for every structure or building. Therefore, all new construction starts from scratch and it is not just simply a matter of copying and adapting the last design. Greek law states that earthquake effects must be taken into consideration when designing a new project, no matter how small.

Greece has a highly unskilled workforce and constructional tradesmen receive no formal training. Although such workers may in time gain considerable experience, the basic technical background is always missing. The role of the civil engineer as supervisor in this situation is critical due to the need to keep standards high, particularly with regard to the high seismicity of the country.

Clearly, due to its peculiarities, Greece requires multidisciplinary civil engineers that have been broadly educated in many matters. This promotes the need for an integrated civil engineering education system. In other words, the two-tier system is opposed in Greece as a compulsory and universal division of all engineering university studies.

In Greece, it is believed that there is a requirement for any educational system to produce civil engineering personnel with different individual qualifications. Many of the functions of the civil engineer can be provided for by a two-tier educational system. The first cycle, leading to a Bachelor's degree, should produce a lower level type of civil engineer. The second cycle, leading to a Master's degree on top of the Bachelor's degree, should produce the more specialist type of civil engineer. However, in addition to the two-tier educational system, there is a need to keep the integrated system, traditional to many European countries, to produce the high-level civil engineer or "Master Engineer" with solely a Master's degree.

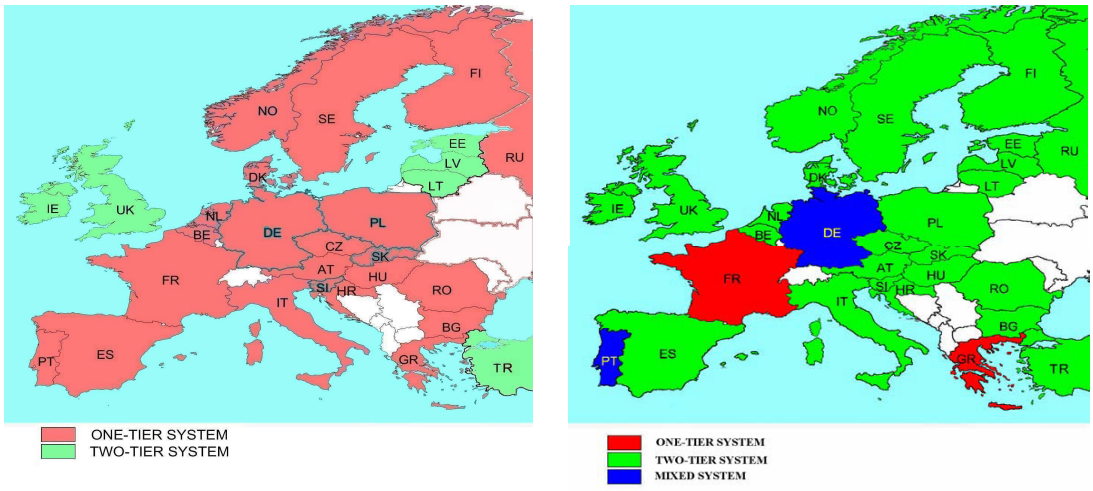
A Bachelor plus Master's degree obtained from a two-tier system cannot be considered as equivalent to a Master's degree obtained from an integrated system. Civil engineers with the latter type of qualification need to have not only a strong and very firm background in many sciences such as mathematics, physics, materials, etc. but also require a global education and a broad knowledge of other disciplines such as the environment, sustainability, etc..

3. EXPERIENCE FROM OTHER EUROPEAN COUNTRIES

The following two basic systems were present at the instigation of the Bologna Declaration: ""*the "continental" (or binary*)" (or one-tier or integrated) "*system characterized by the coexistence, in most European countries, of two parallel types of engineering education: of long duration, with nominal duration in almost all cases of 5 years and of short duration, with nominal duration of 3…4 years"* and *"the "anglo-saxon" (or two-tier) system, with undergraduate courses leading to Bachelor of Engineering degree after 3 years (in England and Ireland) and 4 years (in Scotland), followed by postgraduate studies leading to a Master of Sciences degree (1-2 years)*" (Manoliu, 2001).

Figure 1 presents the distribution of European civil engineering education systems at the time of the Bologna Declaration (Manoliu, 2004) and 10 years after the Bologna Declaration (Manoliu, 2010).

From a comparison of Figures 1(a) and 1(b), the case for Greece looks black, as Greece appears to almost stand alone in its opposition to the Bologna Declaration. Besides Greece, only France retains the "continental" system. This is due to the style of civil engineering education in France which involves two preparatory years prior to studies in the "Grandes Ecoles" and: "*adoption of a two-tier system is, practically, impossible*" (Manoliu, 2010).



(a) (b)

Figure 1: Distribution of European civil engineering education systems (a) at the time of the Bologna Declaration (Manoliu, 2004) and (b) 10 years after the Bologna Declaration (Manoliu, 2010).

Surprisingly, support from outside Europe for Greece's stance comes from America as: "*The American Society of Civil Engineers (ASCE) supports the concept of the Master's degree as the First Professional Degree for the practice of civil engineering at a professional level*" (Manoliu, 2001). Stating as the reason, the ASCE comment continues with: "*Four years of formal schooling were considered the standard for three professions (medicine, law, engineering) 100 years ago, and while medicine and law education lengthened with the growing demands of their respective professions engineering education did not. Perhaps this retention of a four-year undergraduate engineering education has contributed to the lowered esteem of engineering in the eyes of society, and the commensurate decline in compensation of engineers relative to medical doctors and lawyers*" (Manoliu, 2001). Presumably, America is one of the Bologna Declaration target countries from where Europe can expect prospective students. Here, it should also be noted that: *"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"* (Manoliu, 2010).

Inside Europe, Italy was the first country to introduce reforms concerning a move from an integrated system to a two-tier system but some problems were encountered. That is, the Consiglio Nazionale degli Ingegneri, which represents the engineering profession in Italy, did not recognize the new three-year course as a professional degree (Manoliu, 2001). In fact, there were moves in Italy to partially return to an integrated system (Manoliu, 2004). In addition and more recently, the National Council of Engineers representing all engineering associations in Italy has asked the Minister for Universities to re-introduce the "old" five-year integrated system (Manoliu, 2010).

The ASCE and Consiglio Nazionale degli Ingegneri positions were echoed in Germany as follows: "*There are also serious doubts, at international scale, on the capacity of the Bachelor degree to provide a real qualification for the engineering practice. The American Society of Civil Engineers (ASCE) sees the Bachelor degree inadequate as a professional degree for today engineering practice. The same opinion is shared by the German construction industry and by the Conference of Faculties of Civil Engineering*" (Manoliu, 2001).

Further German disagreement can be found as Raimund Herz (a distinguished representative of a German Technical University) is quoted as saying: "*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 be 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*" (Manoliu, 2004).

Further disagreement came from FEANI (FEANI is the European Federation of National Engineering Associations) as the FEANI Statement on Bologna and Prague Declarations says amongst other things: "*FEANI recommends that the existing European system of longer integrated engineering curricula leading straight to a Master's Degree should be maintained in parallel with a two-cycle Bachelor/Master system*" (FEANI, 2001).

FEANI is not alone as CESAER and SEFI (2003), in their second recommendation, state: "*In the context of the new first and second cycle degree structure, the engineering community of Europe agrees that in order to attain a high level of scientifically oriented competencies, 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 the Masters level as this preserves the coherence and efficiency of the formation*". CESAER is the Conference of European Schools for Advanced Engineering Education and Research and SEFI is the European Society for Engineering Education. The statement by CESAER and SEFI is reiterated in their second joint communication on the Bologna process when they state: "*The 3+2 model has become a standard reference in engineering. This should not exclude other possible paths towards the second-level degree, such as an integrated 5 years curriculum or a 4+2 scheme or a 4+1 model*" (CESAER and SEFI, 2005). Further evidence for this opinion can be found. For example, it has been stated that: "*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*" (Manoliu, 2004).

Finally, Prof. Torbjorn Hedberg, a former SEFI President, made the following relevant comments on the Bologna Declaration (Augusti et al., 2003): *"The Declaration talks about higher education and universities without making clear whether the intention is that it should be applied to all kinds of 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. EXPERIENCE FROM TWO-TIER SYSTEMS EXISTING AT THE TIME OF THE BOLOGNA DECLARATION

In Estonia: "*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"* (Manoliu, 2004). The reason for this is given as follows: *"the former educational system was not capable of educating engineers with appropriate knowledge and expertise in the field of civil engineering"* (Koppel and Laur, 2004).

From Latvia: "*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"* (Manoliu, 2004).

As in the case for Latvia, it is stated for Russia (although not an original two-tier country): "*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 ..... The most popular proved to be the "Diploma-Engineer" route which, unlike the Bachelor route, was known and accepted by the employers*" (Manoliu, 2004).

The reason for the Latvian and Russian experiences is given as follows: "*the factor which seems to control the option of the enrolees is the preference given by the employers to the programmes followed by the graduates, which, not surprisingly, goes towards the integrated programmes"* (Manoliu, 2004).

In Ireland (one of the countries quoted as being the model for the two-tier system), surprisingly, the Institution of Engineers of Ireland (IEI) is quoted as saying: *"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"* (Manoliu, 2004).

Finally, in the United Kingdom (the other country quoted as being the model for the two-tier system), Smith (2004) provides a list of Joint Board of Moderators accredited courses with Engineering Council endorsement that are considered as an appropriate educational base for those proceeding to Chartered Engineer status. In the United Kingdom, Chartered Engineer status is the requisite for practicing civil or structural engineers. It can be noted that most courses appear to be integrated 4- or 5-year courses. Perhaps this is the reason for the following comment concerning the United Kingdom's attitude towards the Bologna Declaration: "*the UK, as ever, remains ambivalent*" (Kerr, 2010).

5. YOU CAN ALWAYS RELY ON THE STUDENTS TO PROTEST

This time, the students appear to arrive late on the scene. The Greek student protests concerning the Greek Government's attempts to implement the Bologna Declaration during the years 2006 to 2007 have already been documented in the introduction above. Elsewhere, according to an article by Euobserver.com, (2008), student demonstrations

and occupations occurred in Spain in 2008. Students objected to the imposition of an "Anglo-Saxon" style tertiary education system on other countries. The article also states that: "*The Bologna Process has also provoked significant student opposition in Italy, Finland and Croatia*". It is to be noted that Croatia does not appear in Figure 1 above. Furthermore, Times Higher Education (2009) reports that in Germany and Austria in 2009, student protestors objected to tuition fees and "English-American"-style degrees introduced under the Bologna Process. The article also states that the protestors had the sympathy of some academics. Finally, Revolution (2010) claims that after a march and rally, a 10,000 strong demonstration including students from every European country occurred in artic conditions against an European Education Minister conference dinner in Vienna held to mark the opening of a Bologna Policy Forum. The European Education Ministers had previously met in Budapest in order to review progress on the Bologna Process. Writing in The Australian (2010), Steven Schwartz, the vice-chancellor of Macquarie University in Sydney, states that: "*Despite the arctic climate, protesters stayed out all night*".

6. ELSEWHERE IN THE WORLD

From a very brief Internet search, Table 1 lists the length of bachelor level civil engineering university education in some countries elsewhere in the World. It must be stressed that Table 1 is very much incomplete, unverified and may not be accurate as a proper in depth search was not possible due to time restraints.

Table 1: Bachelor level civil engineering university education in some countries elsewhere in the World.

Country (countries)	Study length
China	4-6 years
India	4 years
Japan	5 years
Latin America	4 or 6 years
Pakistan	4 years

As can be seen from Table 1, in every case found elsewhere in the World, it appears that bachelor level civil engineering courses are longer or much longer than those advocated by the Bologna Declaration. Although the actual numbers are disputed (Rogers, 2008), it appears that China and India alone graduate more civil engineers than the rest of the World put together. Therefore, it can be said that the norm for the length of bachelor level civil engineering university education in the World is 4 to 6 years of study. Consequently, there is a possibility that under the Bologna Declaration, European civil engineers will be educated to a lower level than those elsewhere in the World. It must be stressed that the above statements remain unverified until a full and proper investigation into this matter is performed.

7. DISCUSSION

According to the EUCEET Management Committee position statement concerning the implementation of the Bologna Declaration for civil engineering education: "*EUCEET is supporting and encouraging the application of the idea of two-tier education system in Civil Engineering as suggested in Bologna Declaration*" (Manoliu, 2010). In addition, the position statement recommends a 4 year duration for the first cycle (Manoliu, 2010). It is clear that if only Figure 1 from above is considered, then nearly all countries in Europe and its environs have moved from the integrated system to the two–tier system for civil engineering education. From Figure 1(b), it would be too easy to believe that the matter was clear cut and finished. Unfortunately, or fortunately in the case of Greece, Figure

1(b) does not tell the whole truth. From the arguments outlined in the preceding paragraphs, relevant authorities in the two-tier education system countries of America, Ireland and the United Kingdom recommend or appear to recommend through ambivalence the integrated system for civil engineering education. In addition, also from the arguments outlined in the preceding paragraphs, relevant civil engineering education societies and associations as well as academics and students in many other European countries are calling for a return to the continental system for civil engineering education, if this has not already been instigated. To be fair to the EUCEET Management Committee and its position statement concerning the implementation of the Bologna Declaration for civil engineering education, the door has been partially left open as it is also stated: "*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"* (Manoliu, 2010). As stated above by the American Society of Civil Engineers, 100 years ago, the three professions of medicine, law and engineering were considered equivalent. If nobody is considering Bologna Declaration style reform for medicine and law, why should not the same be true for engineering? Again, from above, the former SEFI President Prof. Torbjorn Hedberg has reiterated this same concept. Today, the World is facing the immense problems of over population, environmental destruction, global warming, sustainability, etc. and many of these problems have been unwittingly caused by civil engineers in their desire to change the shape of the World for the better. Only the civil engineers will come up with solutions to these problems if they can be solved and these civil engineers must be educated accordingly. In this light, should not the EUCEET actually be encouraging the integrated system rather than the two-tier system for civil engineering education? Again, from the words of the American Society of Civil Engineers quoted above, how civil engineers are educated "*has contributed to the lowered esteem of engineering in the eyes of society, and the commensurate decline in compensation of engineers relative to medical doctors and lawyers*" (Manoliu, 2001). Who better positioned than the EUCEET to champion the cause of reversing the decline of civil engineers and assist in returning the profession to the equivalent public esteem position to that presently held by doctors and lawyers?

8. CONCLUSIONS

Civil engineers need to have a global education and a broad knowledge of other disciplines such as the environment, sustainability, etc. This is required in order to address the negative impact that engineers may have in their social environment that in the past have unwittingly lead to many of the current World problems. This is also required in order to provide solutions to other problems that face the world today. Society requires engineers with strong personalities that are able to take responsibility and are capable of giving solutions to any civil engineering problem during both the design and construction stages are required. Any university education must be geared towards the projected needs of the workplace. However, a two-tier system alone is not capable of educating civil engineers to the appropriate levels of knowledge and expertise required. An integrated education system is necessary to run in parallel to satisfy the requirements of European society.

Greece objects to the main purpose of the Bologna Declaration, which is the adoption of a system essentially based on two main cycles. Elsewhere in Europe, there appears to be a small but growing voice calling for a return to the continental system for civil engineering education. This is contradictory to the present EUCEET policy. The EUCEET is ideally placed to fight the cause for an integrated civil education system for Europe and help return the profession to the position of public esteem it held 100 years ago.

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