The Institution of Engineers of Ireland

The Bologna Declaration and Engineering Education in Ireland

Seminar Proceedings
Tuesday, 20th November, 2001

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PROGRAMME

THE BOLOGNA DECLARATION AND ENGINEERING EDUCATION IN IRELAND

VENUE: **IEI LECTURE THEATRE, 22 CLYDE ROAD, BALLSBRIDGE, DUBLIN 4**

DATE: **TUESDAY, 20TH NOVEMBER 2001**

REGISTRATION AND COFFEE	**8.30 A.M.**
INTRODUCTION AND WELCOME – MR LIAM CONNELLAN, PRESIDENT IEI	**9.00 A.M.**
THE BOLOGNA DECLARATION – RESPONSE OF CESAER – PROF. W.G. JONES, MEMBER OF CESAER BOLOGNA WORKING GROUP IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE, LONDON	**9.30 A.M.**
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IMPLICATIONS OF BOLOGNA DECLARATION FOR ENGINEERING PROGRAMMES IN INSTITUTES OF TECHNOLOGY – MR PAT MCLAUGHLIN, HEAD OF SCHOOL OF ENGINEERING INSTITUTE OF TECHNOLOGY, TALLAGHT, CO. DUBLIN	**12.15 P.M.**
LUNCH	**1.00 P.M.**
PLENARY DISCUSSION – PANELLISTS: SPEAKERS FROM MORNING SESSION CHAIRMAN: DENIS MCGRATH, REGISTRAR, IEI THE OBJECTIVE OF THE DISCUSSION IS TO CONSIDER THE OPTIONS DESCRIBED IN THE IEI SUBMISSION TO GOVERNMENT PARTICULARLY IN THE CONTEXT OF ISSUES DEALT WITH IN THE PAPERS DELIVERED AT THE MORNING SESSION.	**2.30 P.M.**
CONCLUSION OF CONFERENCE	**4.30 P.M.**

INTRODUCTION

Through its Charter and legislation, the Institution of Engineers of Ireland has statutory functions and obligations in relation to the standard of engineering education in Ireland and how engineering programmes are internationally recognised.

The Institution executes these functions and obligations by accrediting engineering degree, diploma and certificate programmes and by entering into agreements with engineering professional bodies abroad which secure international recognition of our accredited engineering programmes.

For these reasons the Institution decided to consider the implications for engineering education in Ireland of the 1999 Bologna Declaration which was signed by 29 countries, including Ireland, in June 1999.

Our Accreditation Board established a Working Group and produced a submission to government – a discussion document – a copy of which is included in your conference pack and which can be accessed on our web-site at http://www.iei.ie/govsubmit/bologna.pdf.

We regard the Bologna Declaration as a most important development with serious implications for structures of engineering education in Ireland. In our submission to government we have highlighted what we regard as the issues and options to be considered. These relate generally to that part of the Bologna Declaration which relates to the Bachelor/Master degree qualifications. We believe this to be the central issue relating to engineering education. Please consider these options very carefully. They present us with challenges but probably more importantly a unique opportunity to examine how we educate our engineers and engineering technicians. Our government has signed the Bologna Declaration and is therefore committed to its implementation by the year 2010.

While it could be argued that our higher education system, in general terms, conforms to the provisions of the Declaration, it could also be argued that we ought not to complacently ignore the implications of how other countries are implementing it. The rate of implementation in some European countries is quite spectacular. In Germany and Italy the law has been changed to accommodate a 3 + 2 structure. The countries of Central Europe, in

restructuring their higher education institutions have embraced its provisions enthusiastically.

The Institution has been privileged to secure widespread international recognition for Irish engineering qualifications by being a signatory to a range of international agreements

including the Washington Accord, the Sydney Accord and the Dublin Accord. It is vital to Irish engineering professionals that our involvement in these processes should continue.

While the Institution does not hold any particular position on the provisions in the Declaration, we are concerned to ensure that Irish engineering education continues to be held in high regard in other European countries.

I wish you success in your deliberations.

LIAM CONNELLAN
CHARTERED ENGINEER
PRESIDENT

THE BOLOGNA DECLARATION

RESPONSE OF CESAER

PROF. W. GARETH JONES

THE BOLOGNA PROCESS

Radical changes are occurring in the pattern of university degrees across Europe. These changes are part of what has become known as the 'Bologna Process' which is the implementation of objectives set down by Ministers of Higher Education across Europe in the Bologna Declaration of June 1999. This paper describes the response of CESAER, a group of European engineering universities, to this process.

WHAT IS CESAER?

CESAER (Conference of European Schools for Advanced Engineering Education and Research) is a group, founded in 1990, of about 50 leading European universities of Science & Engineering. Membership is restricted to universities which have a strong profile in engineering education and research. It covers all countries of Europe including several Eastern European countries. Representation from the UK and Ireland is comparatively small - probably reflecting a lack of awareness of the importance of involvement in European issues. The main purpose of CESAER is to facilitate discussion of higher education issues and general policies in so far as they affect engineering in Europe. It arranges meetings and working groups on special themes, produces position papers and has an annual general assembly. On a few occasions it has acted as a pressure group towards policy makers and governments. The present President is Jaime Pages, Rector of Universidad Politecnica de Catalunya (UPC), Barcelona.

Some other European grouping of Engineering universities are:

CLUSTER (11 universities all of which are also members of CESAER)
SEFI (includes individual members as well as institutional members)
IDEA League (4 universities, Imperial College, Delft, ETH Zurich and Aachen)

THE MAIN STAGES IN THE BOLOGNA PROCESS AND CESAER'S INVOLVEMENT

THE SORBONNE DECLARATION

The Bologna Declaration was preceded by the Sorbonne Declaration (May 1998) signed by the Ministers for HE of France, Germany, Italy and the UK. This called for the 'harmonisation of the architecture of the European higher education system' and referred to 'a system in which two main cycles, undergraduate and graduate, should be recognised for international comparison and equivalence'. This made a significant impact in universities and the use of the word 'harmonisation' was felt to be surprising and even startling as education was regarded as an area where the principle of subsiduarity held sway in the EU. Nevertheless, it was clear that the four Ministers had caught the spirit of the time and it was felt that experience with ERASMUS student exchanges had shown the need for some type of convergence of structure or at least linkages between systems in different countries. CESAER invited the four Ministers to their Annual General Assembly that year. None went but Baroness Blackstone sent a letter in which she referred to the fact that the rest of Europe seemed to be moving towards a system not unlike that in the UK.

THE BOLOGNA DECLARATION

By early 1999, many other countries had expressed support for the general ideas set down in the Sorbonne Declaration and it was clear that the process already started needed to be better defined and enlarged both in scope and in geographical coverage of Europe. In June 1999, the HE Ministers from 29 European countries met in Bologna and put the final form to a declaration which had been drafted in the previous few months. On the day before, the so-called academic day, representatives of European universities had discussed the main topics and their views were summarised and presented to the Ministers by the President of the CRE. However, at that stage the declaration had almost certainly been almost finalised. In the discussions in the academic day, CESAER members had stressed the need to preserve integrated courses in engineering.

THE OBJECTIVES STATED IN THE BOLOGNA DECLARATION

The Bologna Declaration has a clear goal of creating a European Area for Higher Education, together with a set of clear objectives to be achieved within 10 years. There is a clear commitment to achieve these objectives and an action plan to go with it. It is not a mere political statement of intention. The key objectives are:

(a) Adoption of a system of easily readable and comparable degrees to promote employability and competitiveness.

(b) Adoption of a system essentially based on two main cycles, undergraduate and graduate. Access to the second cycle shall require successful completion of first cycle studies, lasting a minimum of three years. The first cycle degree should be relevant to the labour market and the second cycle should lead to the master and/or doctorate degree.

(c) Establishment of a system of credits - such as ECTS - to promote student mobility.

(d) Promotion of European co-operation in quality assurance with a view to developing comparable criteria and methodologies.

After Bologna, much discussion ensued in various bodies, formally and informally, and a mechanism was set up to carry forward the process. Its implications became clearer and the need for adjustments became sharper. Already, changes to the law were underway in Germany and Italy to set up shorter 1st cycle degrees and a two cycle structure.

CONFUSION IN USE OF WORDS

The use of the pairs of terms (1st cycle, 2nd cycle), (undergraduate studies, graduate studies), (Bachelors, Masters) as if they are interchangeable has caused great confusion and certainly brings problems in defining the meaning of these terms. This confusion can be traced to interpretations from different points of view of the Sorbonne, Bologna and Prague declarations of the Ministers which refer to a system composed of two main cycles, undergraduate and postgraduate. Although this is not made explicit, it can be seen that the Ministers are stating their intention to move towards a pattern based on the 'Anglo-Saxon' (i.e. US, UK, Ireland, Australia, SE Asia etc.) model in which graduate (or postgraduate) studies follows on from a first degree of fairly short duration. The Bologna declaration

explicitly states that 1st cycle studies should be of at least three years in duration and should be relevant to the labour market. It also refers to a Masters and/or doctorate degree as 2nd cycle degree. Thus 2nd cycle includes what is commonly referred to as a 'graduate school' in the US and UK in which both MSc and PhD degrees may be awarded either as alternatives or in sequence. In the UK and US, regulations for admission to a doctoral programme requires students to possess a degree whose status and level is equivalent to at least a Bachelors degree. (A complication is that most UK universities first require students to register for an MPhil degree (a less demanding research degree) and only transfer them after about one year to PhD registration after they have demonstrated sufficient aptitude and ability for original research.) In recent years, UK universities have moved increasingly to 'integrated masters level' degrees in engineering and science, e.g. MEng, which are 4 years long in England & Wales and this degree fits uneasily with the above categorisation. These degrees are thus referred to as undergraduate Masters or as integrated Masters. What has happened in most subsequent discussions is that three cycles are articulated, Bachelors, Masters and Doctorates, to be taken in sequence since in most European counties entry to a Doctorate requires the possession of a Masters level degree, though not formally in the UK or Ireland.

THE SALAMANCA AND PRAGUE MEETINGS

The Bologna Declaration was followed by a meeting in Prague in May 2001 which was the next Ministerial meeting in the Bologna Process. This was preceded in March 2001 by the Salamanca Convention of European Higher Education Institutions held to enable universities to discuss progress in meeting the Bologna objectives and to enable university views to be presented to the Ministers before they met in Prague.

In preparation for the Salamanca meeting a working group of CESAER prepared a position paper on the main Bologna Declaration issues and this was presented and promoted at Salamanca. In addition a joint letter stating the key points was produced by CLUSTER, CESAER and SEFI. One of the points made in this paper was the desirability of allowing integrated Masters level degree programmes in engineering to be continued.

After Salamanca and Prague it became clear that 1st cycle degrees (usually called Bachelors) could be either three or four years long (180 - 240 ECTS credits) and that 2nd cycle Masters could be either one or two years long (60 - 120 ECTS credits) but with a presumption that about five years are needed to complete the Masters stage. It was also agreed at Salamanca

that universities could decide to structure certain curricula as 5 year integrated Masters courses.

WHY IS THERE A WISH TO PRESERVE INTEGRATED COURSES?

CESAER and CLUSTER emphasise that there are two engineering profiles in Europe:

(a) engineers who are trained to apply current technology and methods in working on engineering projects/tasks

and

(b) engineers who are able to develop technology and methods beyond present practice and who can assume leadership roles in large projects.

Type (b) requires a strong scientific/mathematical foundation so the early part of courses are devoted to science and maths and only a fairly small amount of real engineering is done at that stage. So there is a belief that after 3 years students on type (b) courses have had little real engineering in their training and so are not suitable for employment. Thus to produce the high standard type (b) engineers the first cycle needs to be followed by a second cycle in the same field which is closely linked and integrated with the first cycle. These have to be coherent in order to produce engineers with both theoretical and practical abilities. Underlying this is a wish to assert the importance of scientific knowledge as basis for advanced engineering and to distance themselves from institutions (e.g. Fachhochschulen in Germany) providing type (a) courses. Thus, in Germany the new law states that Masters level courses are either designated MSc (type (b)) or MEng (type (b)). This choice of degree names is somewhat unfortunate from a UK perspective since at many universities MEng degrees have a strong scientific basis. Also, UK engineering degrees (MEng) are more integrated and contain more real engineering in early years. There is a significant difference in style and also different preparation in secondary school before university entry. These differences particularly effect the balance between theory and practice and the staging of these two aspects.

BACHELOR DEGREES AS A PIVOT

However, CESAER also recognises the good features of the introduction of a Bachelors degree and several of its members are introducing such degrees. A particular advantage is

that a Bachelor degree can act as a pivot enabling a student to make choices about future direction and specialisation rather than representing an end-point. It also allows 'vertical' mobility in which a student moves to another university (notably in another country) to take a Masters degree. There is also the realisation that market forces are also encouraging the introduction of Bachelors degrees. Students are often put off by the prospect of a long course, especially when the employment market at the end may not be so good. Many also may wish to leave after three years to get a well-paid job outside the main profession of the degree. Similarly, employers sometimes want to hire very clever young people when they are quite young and to then give them further training.

Other Aspects of the CESAER Paper presented at Salamanca

CESAER points out the importance to the economical competitiveness of Europe of the training of high quality engineers. It asks that the special role and situation of engineering universities and degrees is recognised and that they are represented in the Bologna Process. It gives general support to the aims of Bologna and to the introduction of a two cycle system but calls for flexibility to be shown in its implementation.

CESAER supports the use of an output-based approach to degree programme definition and calls for ECTS to be developed by incorporating information on objectives and outcomes. It also calls for greater autonomy of universities to compete and in particular to decide on their own student selection policies. Accreditation should be developed at a national level but should be based on shared principles.

The UK Situation

MEng degrees are the main route to professional recognition and Chartered Engineer status. In England and Wales MEng degrees are four years long and involve student selection on entry in order to ensure high standards. They are structured more like 2+2 rather than 3+1 so are difficult to divide into a Bachelors and Masters. They have a less strong theoretical basis than many engineering degrees in the rest of Europe but give better training for tackling 'real world' problems.

Can this integrated structure survive given that the trend to Bachelors and Masters is increasing? Another factor is that vertical mobility will become more important and the

advantages of the 'pivot' provided by a Bachelors degree will become significant. The other question is whether the Masters label on the MEng can continue to be accepted in the rest of Europe given that the norm there is five years. A designation of Advanced Bachelor is being promoted for four year UG Masters.

Points in favour of acceptance of the Masters label are

(a) Student selection at input so more rapid progress is possible and the first year is not wasted as a quasi-selection process.

(b) More specialised secondary school preparation.

(c) Effective teaching because of good interactions between students and staff.

(d) Course better related to useful outcomes and less irrelevant detail.

(e) The 3 Year BSc followed by a 1 Year MSc has been the main system for over 50 years.

(f) The 3 Year BSc in England and Wales is accepted as being at roughly similar level to the 4 Year BSc in Scotland and the US.

PROBLEMS IN THE USE OF ECTS AS AN ACCUMULATION SYSTEM

There is a strong and growing tendency to define degree programmes by ECTS credits, e.g. a pilot project of the European Commission called the Tuning Project has this as its main aim. ECTS credits are defined through total student workload and standard amounts of credits (i.e. standard amounts of student work) are being defined for Bachelor and Master degrees. This appears more convenient that using course specifications based on learning outcomes (the QAA approach) and more 'scientific' than just counting years. However, it ignores (or has difficulty incorporating) crucial factors. Some of these are:

(a) No allowance for different starting points.

(b) The problem of 'inappropriate' learning outcomes (e.g. too much detail) being given full credit.

(c) The fact that learning outcomes also depend on curriculum design and teaching methods, resources available, capabilities of students, etc. and not just on the amount of student work. The problem is that these can vary in a systematic way between universities and between countries so an approach based on the 'average student' is not valid.

It is thus important that these factors are allowed for when degree specifications by ECTS credits are promulgated.

SOME CONCLUSIONS

- The 3 + 2 bandwagon is rolling and cannot be ignored.
- The Bachelors degree provides a useful pivot.
- ECTS is likely to be used (and already is being used) as an accumulation tool despite its failings.

There is a need for a more flexible approach based on careful consideration of actual situations in each country and allowing for different educational approaches.

THE 3+2 STRUCTURE AS APPLIED IN ENGINEERING PROGRAMMES IN GERMAN UNIVERSITIES

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ABSTRACT

Following a brief review of the traditional system for higher education in Germany the requirements resulting from the Bologna Declaration are assessed from different standpoints. Some general features of already existing programmes are described and a few critical issues are addressed.

INTRODUCTION

The Bologna Declaration has found a noticeable echo throughout this country. At all levels quite significant efforts were undertaken to implement the new structure. This process has progressed at a significant pace, involving the higher education institutions for both applied (*Fachhochschulen*) and theoretical sciences (*Universitäten/Hochschulen*). In particular, the changes also concern the engineering programmes. Their traditional degrees (*Diplom-Ingenieur*) generally have a good reputation amongst German companies. Still, there is a very pronounced incentive to develop the new structures. The motivations may slightly differ, depending on the group involved. Indeed, the objectives of politicians, professional associations, and higher education institutions are not quite identical. The purpose of this paper is to assess some of the recent developments. To set the frame the traditional German system will be explained first. The goals and requirements as defined by the different groups will be presented next. A tentative review of programmes already implemented in electrical engineering follows by stressing some of their essential features. The focus, here, is on *Technische Universitäten/Hochschulen (TU/TH)* in contrast to *Fachhochschulen (FH)*. To conclude

the paper addresses some critical issues, also raising a few questions that might have to be answered in the future.

THE TRADITIONAL GERMAN SYSTEM

STRUCTURE

The traditional German higher education system summarised in Table 1 provides two distinct engineering programmes having, however, several features in common. One is offered by the technical universities (*Technische Universitäten/Hochschulen*) and has a more theoretical orientation, while the other one, taught at the *Fachhochschulen*, has an applied profile. The former requires long cycle studies of typically five years and enables for research and in-depth development activities; the latter is a short cycle of typically four years and is meant to train production-type engineers. They are both implemented as one cycle programmes. The *Vordiplom* (pre-diploma) after typically four and three semesters, respectively, is not a qualification for professional activities. It rather represents a hurdle intended to replace an entry exam. Both these programmes include an internship in industry of six and twelve months, respectively. During this period the students are not only supposed to get some insight into basic industrial manufacturing and engineering skills but also to appreciate the work of others they will later rely on. The students receive their degree, called *Diplom-Ingenieur (Dipl.-Ing.)*, following a thesis (*Diplomarbeit*) which typically takes six months. At the *FH* the thesis is often part of the internship for a more practical orientation while it should clearly have a scientific character at the *TU/TH*.

ORGANISATION

The lectures are given during the winter and the summer semester. Each term lasts about 14 weeks. The remainder of the time (the "vacation") is essentially reserved for the exams and the internship.

CO-ORDINATION

During the last decades there has been a serious and successful effort among the *TU/TH* to co-ordinate their programmes in order not only to define a standard but also to lower the barriers for improved (national) student mobility. More recently, complementary programmes of reasonably short duration are being developed and implemented to facilitate the acquisition of the *Dipl.-Ing. (TU/TH)* for graduates of the *FH*.

DOCTORATE

The *Dipl.-Ing. (TU/TH)* is the prerequisite for the doctoral degree (*Doktor-Ingenieur*, *Dr.-Ing.*). The scientific work for the doctoral thesis is usually performed at the university within three to five years as part of research projects. In engineering sciences the candidates are mostly paid staff members, then.

TABLE 1

SUMMARY OF THE TRADITIONAL SYSTEM

	TU/TH	FH
Profile	theoretical	applied
Duration (typ.)	5 years (long cycle)	4 years (short cycle)
***Vordiplom* – after typ. ...**	4 semesters	3 semesters
- qualification	none	none
Entry exam	none	none
Internship	6 months	1 year
Thesis	yes	yes (part of internship)
Degree	Diplom-Ingenieur TU/TH	Diplom-Ingenieur FH
Doctoral degree	possible	not possible

GOALS AND REQUIREMENTS

The most important role in defining the new programmes is played by the following three groups: politics, professional associations, and universities. As will be shown, their stand-points are essentially convergent with some gradual differences that seem characteristic, though.

POLITICS

This position is of course dictated by the agreement underlying the Bologna Declaration. It is clearly intended to foster a "Europe of Knowledge" and to develop "European cultural dimensions". To this end a "European area of higher education" has to be created. The new system should allow an enhanced mobility of citizens. In particular, students should spend some time abroad because this is seen as a crucial element for their international qualification. The new structures should also increase the competitiveness of European universities at an international, that is world-wide level.

To reach these goals an important prerequisite is the readability and comparability of the different European degrees. It is thought that a two-cycle system is the best basis – particularly also in view of European labour market needs. Both levels - undergraduate and graduate - should lead to a professional qualification. A system of credits should be established to ensure the mobility. Quality assurance, that is accreditation and evaluation by both internal and peer review are considered important features for the definition of international standards. It is understood that the independence of the universities has to be respected and that the diversity of cultures, languages, and national education systems has to be fully taken into account.

ASSOCIATIONS

The professional associations play a very active role in the definition of the new structures. Their position recently presented in [1] will be briefly summarised in the following. The traditional German system inherently suffers from the very long average duration of the studies. The associations expect this drawback to be overcome by a change to 3+2 structures. Shorter programmes should however not impair the quality which still would have to meet highest standards. In particular, the qualification for the labour market of professional beginners (undergraduates and graduates) should not suffer. International compatibility is required as well. A two-cycle approach is further thought to bring about an increased flexibility in the planning of the studies. Finally, the important role of the bachelor-degree is stressed. It is expected that 80% of graduates will leave the universities (*TU/TH* and *FH*) directly after obtaining this degree. Among those a significant number is likely to further study towards a master degree later in their professional life. As a result,

approximately two third of the engineers would reach a bachelor (or 1st cycle, undergraduate) level and one third a master (or 2nd cycle, graduate) level.

The professional associations generally recognise the high quality level of the traditional engineering degrees. Therefore, they request the new 3+2 structures to complement the traditional system instead of replacing it. In addition to providing sound theoretical foundations, to developing technical skills, to fostering economical, social, and international competence, the new programmes should – just as the existing ones – communicate scientific methodology and encourage independent, flexible, and creative engineering. An important request is the possibility for lifelong continuing education.

In summary, the professional associations propose a two-cycle model leading to a bachelor (1st cycle) and a master degree (2nd cycle), respectively. The former programme would promote applied engineering and last at least three years. A minimum of six months should be spent in industry to guarantee the practical orientation of the studies. Instead of an entry exam demanding tests should be conducted after the 1st year. In contrast to this, the master programme should provide an in-depth theoretical formation and take at least three semesters. The level should compare with the traditional *Diplom-Ingenieur (TU/TH)*.

UNIVERSITIES

The position of the universities that will briefly be summarised in the following is taken from a recently published paper [2] that formulates the stand-point of 20 major German *Technische Universitäten/Hochschulen*. This paper first postulates the quality of the traditional programmes but also stresses the need for international transparency of the systems. Based on these statements which are quite similar to the ones cited above and on the goals and requirements expressed in the Bologna Declaration it formulates a series of recommendations that will be outlined below.

Because of its quality the traditional system of *TU/TH* and *FH* should be kept. The 3+2 structure should essentially be based on it: Two parallel and distinct profiles with an applied character and with a sound theoretical foundation, respectively, should allow to maintain the present quality. In analogy to current efforts the two programme-types should be permeable, adequate tests being eventually required. International mobility and inherent flexibility of the curricula are to be main features. A close relationship to engineering practice has to be maintained. Quality management must be a key-element of the new system. Finally, in

contrast to the current practice doctorate-programmes should be allowed in future. The schematic taken from [2] and shown in Figure 1 illustrates the proposal. It includes possible designations of the various degrees.

In the first step of its implementation the 1st theoretical degree should mainly define an interface to improve the international compatibility and ease student mobility. It should further provide the qualification for the 2nd cycle.

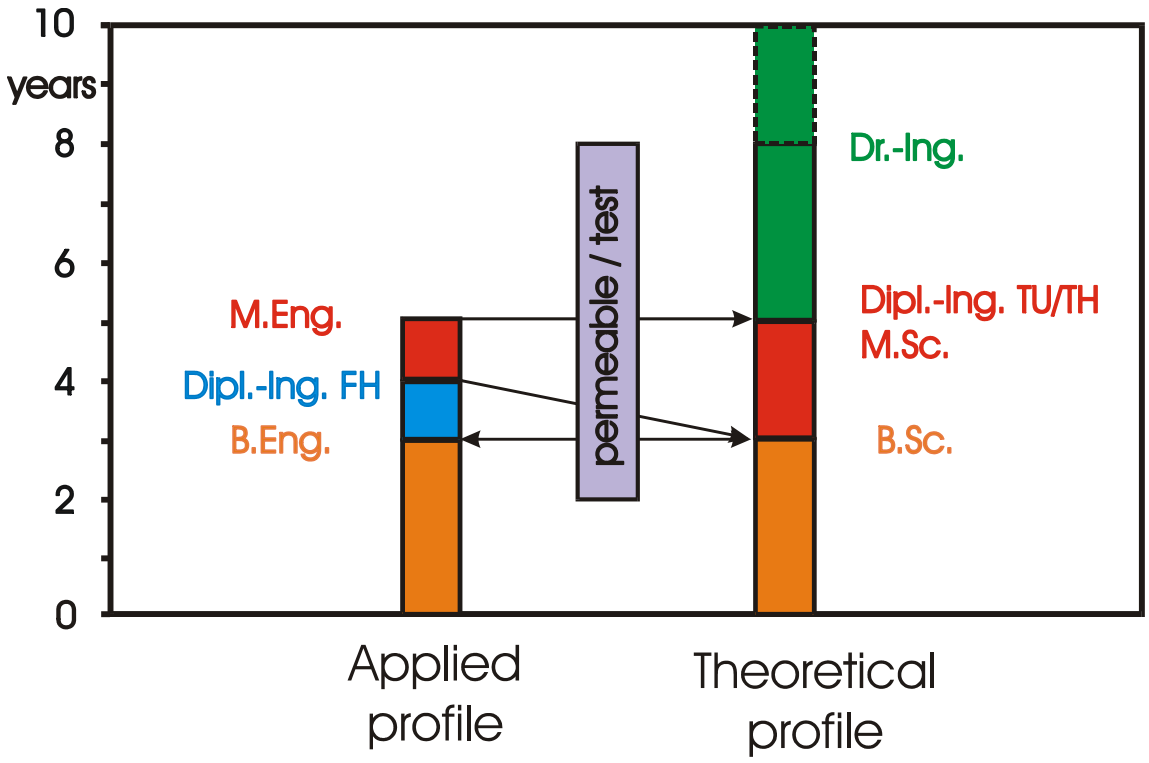


FIGURE 1: SCHEMATIC OF THE PROPOSED 3+2 STRUCTURE (FROM [2])

IMPLEMENTED PROGRAMMES

The following review of programmes that have already been implemented is based on an internet search that was conducted by the author in May 2000. It is by no way complete, not

only because more than a year and a half have passed since then; the survey is also limited to electrical engineering programmes as taught at the *TU/TH*. In particular, civil and mechanical engineering and the *FH* were deliberately excluded, here. Furthermore, the compilation presented below is not the result of a rigorous scientific analysis. It is only a tentative summary and, as such, is simply intended to give an impression of the developments.

General Trends

From about 30 *TU/TH* considered here slightly less than 50% already had implemented new programmes as discussed in this context. The number is increasing. The focus of these programmes is often quite specific, i.e. the subjects treated are restricted to specialised areas of electrical engineering such as information technology. The denomination "Bachelor" and "Master" is commonly used to describe 1st and 2nd cycle degrees.

Motivation

When it is explicitly mentioned, the motivation behind the introduction of these programmes appears mostly to be the wish to increase the attractiveness abroad. This is clearly related to the lasting lack of students in science and engineering. To a lesser extent improved mobility was stated as motivation.

Common Features

The newly implemented programmes usually rely on the existing ones. A Bachelor degree takes typically six to seven semesters, a Master degree three to four. The latter is the prerequisite for the doctorate. Often a credit point system is installed. Entry tests in English and/or German language are often required. Many programmes provide a tutor to coach the students in order to improve their chances of success.

Some Differences

Despite the common features there are also quite some differences. A co-ordination of the efforts is not quite visible, yet.

- The various programmes are for instance designed for different target groups. While some aim at German as well as foreign students, others are explicitly reserved for foreigners.

- This is partly reflected by the language of the courses which are either held in German, English, or a mixture of both.

- The structure of the programmes differs also. Most of the universities offer just 2nd cycle programmes, a few only 1st cycle, and some both.

- The prerequisites to access the 2nd cycle vary in accordance with the target group between Bachelor (foreign or German), *Dipl.-Ing. (FH)*, and *Vordiplom +2 semesters*.

- The duration of the programmes and, correspondingly, the number of credits is not uniform.

- Finally, a stay abroad may or may not be mandatory.

QUALITY MANAGEMENT

To handle the differences as, for instance, the ones noted above an accreditation becomes mandatory. The German Accreditation Council (*Akkreditierungsrat*) was put in place to organise this. It represents the universities, politics, professional associations, and trade unions. It determines several independent accreditation agencies that conduct the actual accreditation of the *TU/TH* and *FH*. These agencies themselves are constituted of representatives from *TU/TH*, *FH*, and professional associations. They are not necessary German. Their mandate is limited in time but renewable. By this time, the first programmes have already been accredited.

Another important aspect of quality management closely related to the accreditation is a regular evaluation. It concerns both the traditional and the new (3+2) programmes. This

task is organised and conducted by public and private agencies. They rely on internal (teaching personnel and students) and, partly, on peer review.

Open Issues

Despite (or because of) the observed progress a few questions remain open (or arise) in the view of this paper's author. The issues which will be addressed reflect solely the author's opinion. They may not be crucial, but probably will have to be addressed in view of a successful implementation of a "European area of higher education". The following considerations are based on personal observations, daily experience, but also on valuable discussions with others.

Attractiveness

As one of the goals is to increase the attractiveness of the European higher education institutions three questions have to be raised.

- The language spoken at the universities but also in daily life constitutes a serious barrier for many European countries such as Germany.
- Their lead in science makes the US a very attractive place to study.
- The (probably related) reputation of (some) US universities acts in the same way.

Harmonisation

Although this is not an explicit goal behind the Bologna Declaration it might be worth to mention some of the problems associated with it.

- The very different structures of the European systems might constitute a barrier for mobility. For example, there are no *Chartered Engineers* in Germany. Is this difference to others acceptable or can it be overcome in one way or the other?

- The duration of the studies is very long in Germany, the average being above 12 semesters in electrical engineering. Can the quality of the education outweigh this (inherent?) disadvantage?

- While the Europeans struggle to implement 3+2 structures this system seems to be already outdated at some US universities (e.g. MIT).

DEMOGRAPHY

The lack of engineering students is one of the motivations to change the existing structures. But this phenomenon is not restricted to Germany or Europe. Where would all the students then come from?

CONCLUSION

Although there are still some open questions which were partly addressed in this paper the process of implementing the 3+2 structure in engineering programmes in Germany is well under way. Besides the fact that it will be kept in parallel the traditional system serves as the basis for the new one. An important aspect of the changes is to improve the readability and comparability of the various European programmes for instance by defining proper interfaces. This goal, although quite ambitious, is certainly within reach.

REFERENCES

[1] VDE[1)], ZVEI[2)], BITKOM[3)], VDEW[4)]: *Leitlinien für Bachelor und Master – Qualitätsanforderungen an Ingenieure der Elektrotechnik und Informationstechnik mit Bachelor- und Master-Abschlüssen*. Frankfurt am Main, February 2001.

[2] Arbeitsgemeinschaft Technischer Universitäten und Hochschulen (ARGE TU/TH): *Positionspapier zur Ingenieursausbildung an Technischen Universitäten und Hochschulen (TU/TH) in Deutschland*. Contact: A. Mehlhorn, TU Dresden (http://www.tu-dresden.de), March 2001.

[1] Verband der Elektrotechnik Elektronik Informationstechnik e.V.

[2] Zentralverband Elektrotechnik- und Elektronikindustrie e.V.

[3] Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V.

[4] Verband der Elektrizitätswirtschaft e.V.

PROF. JOHN KELLY
PROFESSOR EMERITUS
UNIVERSITY COLLEGE DUBLIN

PREAMBLE:

I'm not quite sure why I'm here today speaking on this topic, or why indeed this, topic is being discussed at all because – the 4 year university engineering degree is fully (100%) in compliance with Bologna and there's no reason to change it. However, if anyone thinks that it should be changed to a 3 or 5 year degree schedule – and I think maybe there are some who do – then it could lead to an interesting debate, which of course I welcome.

I would first like to compliment the IEI for its excellent efforts in promoting discussion on the Bologna Declaration. The Submission of the Institution is a model, I believe of how a responsible national representative's body should assist and advise our government ministers and their civil servants on relevant issues of European or international importance. And whilst I will differ on a few points in my opinion from those of the IEI as set out on this Submission publication, I wish to acknowledge that it is an excellent discussion document, and I would urge that it should be actively debated in the faculties and schools of Engineering in Ireland.

I wish to emphasise too, now at the beginning of my talk, that I am speaking in a personal capacity and that the views which I express, which I suspect (and hope) may be controversial are entirely my own. These are based on my observations of the trends and dynamics of both the national and international higher education scenes, and I acknowledge with emphasis, that these are empirical observations and not scientific conclusions based on comprehensive research and study. Since I retired, some years ago as Registrar of UCD, I have become heavily involved in international higher education, particularly in Europe and in North America and, in recent months I have solicited the views of many international colleagues on this whole Bologna process as well as participating in numerous conferences and discussions on this subject. I believe with a passion in the whole European process and I spent many hours over many years in the 1980's and 1990's as Chairman of the Academic Advisory Committee in DG22, the Directorate General for Education, on the development of the Erasmus/Socrates programme for student mobility – it is my great regret that whilst the

engineering students of the very diverse Engineering Schools in mainland Europe are participating very actively in the Erasmus programme – at 10% of the total student mobility – the Irish engineering students are not moving, or being encouraged to move, at all on this great programme.

(sin sceal eile – b'feidir go tiocfaidh me ar ais go dit an sceal sin in san dispoireacht inniu)

I am therefore somewhat surprised, and very delighted, that this rather general two page Bologna Declaration of commendable aspirations for the European HE scene should have caused such a flurry and at times, a seemingly seamless schedule of meetings, conferences, publications as well as a clatter of new agencies established apparently to implement one or other of the objectives contained in the Declaration. It has provoked a major debate on what HE in Europe is all about, and that must be a good thing. This debate, however, has been concentrated at GO and NGO agency levels, such as the, IEI, the EUA, CESEAR, ENQA, SEFI, FEANI and so on. And not so much – hardly at all – at the coal face inside the European universities. There is nothing surprising with this situation – that is what those agencies are there for, but it is of interest that since 1999, the discussion within the universities has been negligible – certainly here in Ireland, but it's picking up now, aided by the IEI and the HEA.

THE 4 YEAR DEGREE

I come to praise the 4-year degree – not to defend it and certainly not to bury it. It has been with us in the Irish universities for close to 100 years – 160 if you are to believe my TCD colleagues, though I suspect their Civil Eng degree was 3 year one, as indeed was the NUI BE (Civil) degree, until some decades ago. It is, I suppose, entirely correct that the appropriateness of any degree structure should be critically examined from time to time, and the Bologna Declaration is as good excuse as any to do that at this time and I welcome this debate.

I do however remind this distinguished audience of the great engineering maxim: " if it ain't broken, don't fix it" and whilst I am willing to be persuaded otherwise, my belief now is that there's nothing broken or even damaged in our 4 year degree. Let me give you some of my

thoughts of praise for the 4-year degree. Throughout the past 50 years when I have been involved – man and boy, in the UCD Engineering School, I have seen our engineering graduates in all disciplines leaving our shores and getting recognition and employment in all continents and many countries of the world. Over that period of time, as at present, there was a wide range of engineering degree programmes and structures in the European universities – 3 year degrees in the UK, 5 in the Netherlands, up to 7 in Germany, 4 in Portugal, Spain, Greece and so on. In general, the length of the basic university degree varies from 3-5 years across Europe – also in some countries, the actual average length of study varies from the required length by up to 50%, whereas in others such as Ireland – it doesn't vary at all.

This diversity then and now, was never a problem for our graduates seeking first employment – and also long before the CEng and indeed afterwards, I am not aware that the accreditation of our degree, or lack of it, was ever an issue in regards to graduate employment – and the same can be said of chartered engineering status.

The 4 year professional engineering degree is, I believe the predominant engineering degree throughout the world – in Japan, Australia, Portugal, South America and many other countries and of course throughout the 4,000 universities of the USA and Canada. Our graduates are not only accepted for post-graduates study in N. American University engineering schools, but are actively head hunted. This was my particular experience when I was Dean of Engineering in UCD in the 1980's. I personally have been involved in assisting the placement of close to 100 of our engineering graduates from all branches in the US and Canadian universities, and they have all done extremely well, (including Pat Kenny). I am not aware of any failures. Moreover it has been the general experience of our graduates that the Masters course-work which they are obliged to take en route to a PhD in North America, is little more that a re-run of their final year courses in Ireland – in other words, the Irish 4 year BE is equivalent to the USA Master's degree. And by the way, in general, the US universities will not accept a 3-year engineering degree, no matter how brilliant, for entry to postgraduate programmes. And, as I said in my opening remarks, the 4-year degree is fully in conformity with the Bologna Declaration, but apart from that; it is my view that a 3-year engineering degree does not make any sense. There is an enormous difference in the intellectual and professional maturity of engineering students between the 3rd and 4th year of the degree programme, as anyone who lectures over those years will readily verify. I really cannot imagine what use to man or beast a 3-year engineering degree would be.

It has been suggested to me by my Swedish and German colleagues that industry, and hence the professional engineering associations, prefers the 3 year degree so that the industrialists can deliver the final practical engineering skills themselves – rather than those egghead academics – and in addition they could pay a somewhat lower starting salary than for a 4 year graduate. I cannot believe that industry or the professional engineering associations could ever be so stupid, and I'm sure they're not – but it does seem to be a point of view currently prevalent in mainland Europe.

If I can be less than serious for a moment and note that our industrial colleagues are often less than kind to us academics, and they often joke that organising academics is like trying to herd cats. They love to abuse the word 'academic', with the meaning of "useless" or "of no practical appreciation". It is also said that as a race, we academics are the most wildly liberal and leftie radicals when pronouncing on contemporary world problems outside our own academic domain, but dare anyone from outside criticise or suggest change to our academic programmes and you will find us the most conservative and reactionary of all groupings. Maybe that's true, or maybe its my Northern blood which prompts one to say about our 4 year degree – "not an inch – or – what we have we hold" or "Ulster says NO".

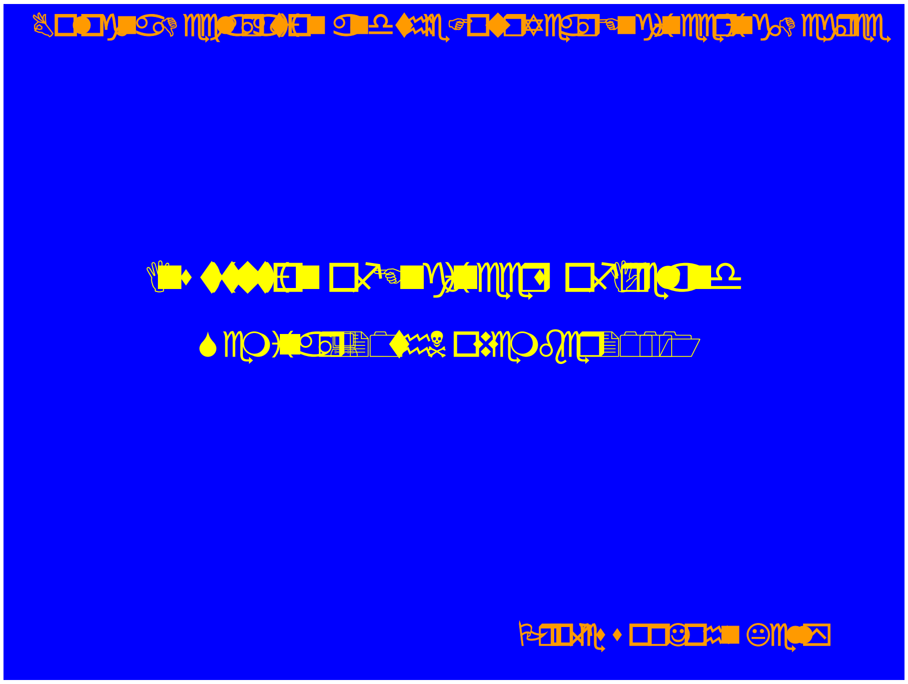
I will now in a Power Point presentation, comment on the various sections of the IEI Submission to our Government of last July in the following order:

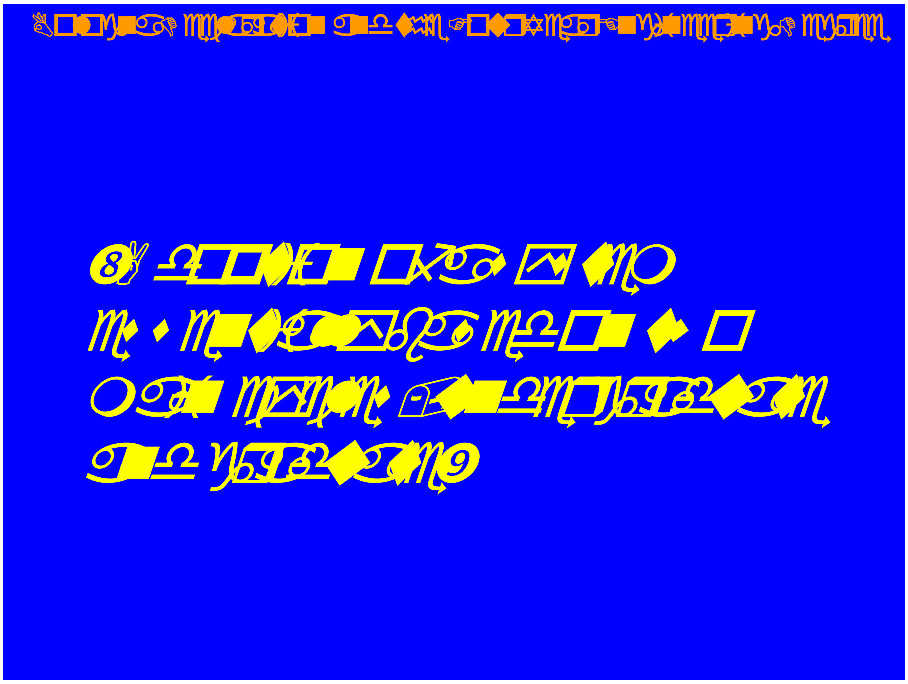
1. Look at what exactly the Bologna Declaration said.

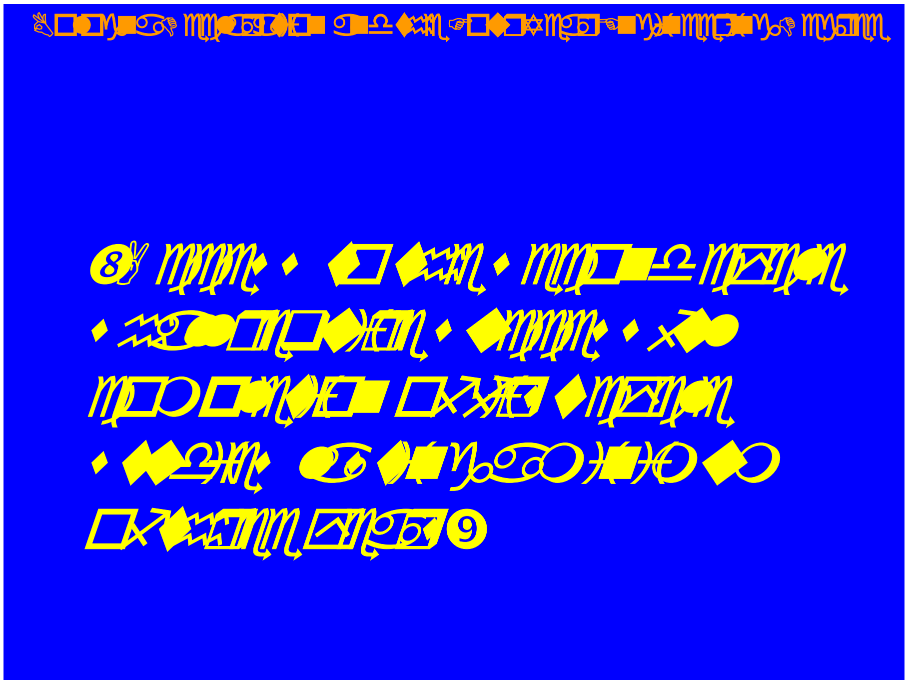
2. Refer to some random comments on this topic by some senior academics/colleagues of mine in Europe.

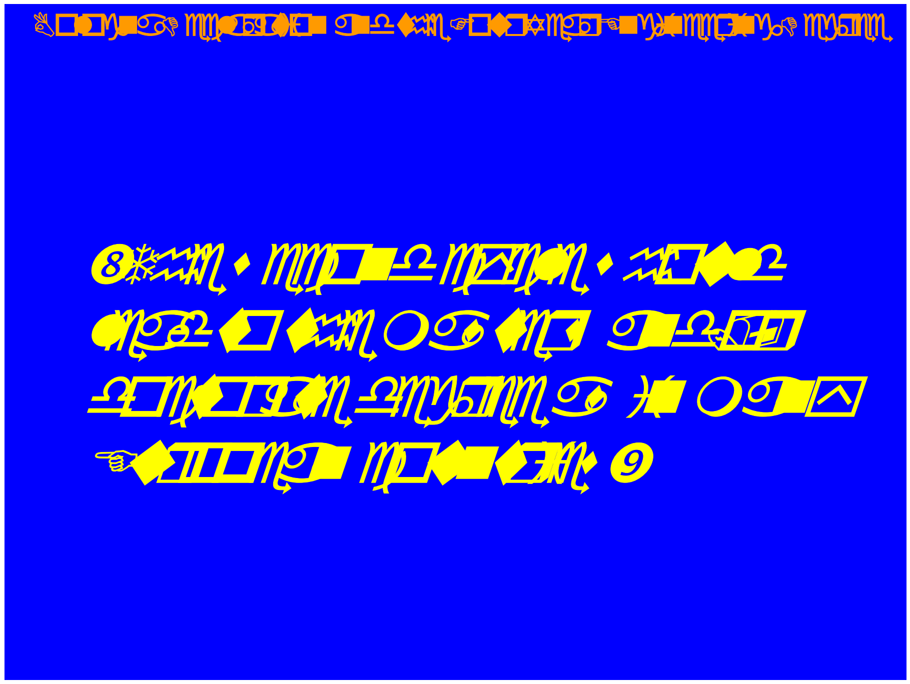
3. Finally look at what the IEI has to say.

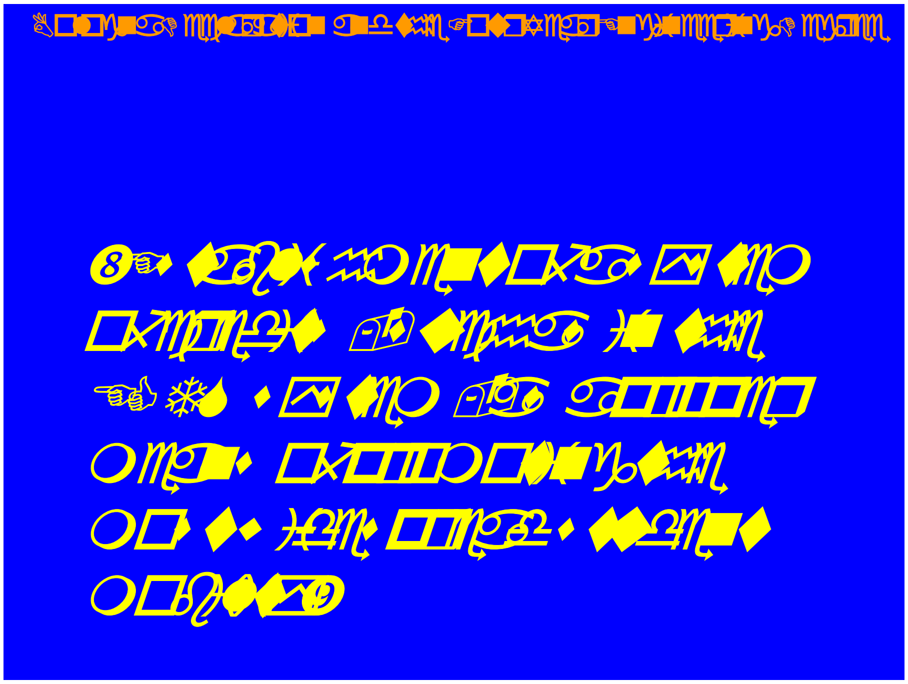
POWERPOINT SLIDES TO FOLLOW:

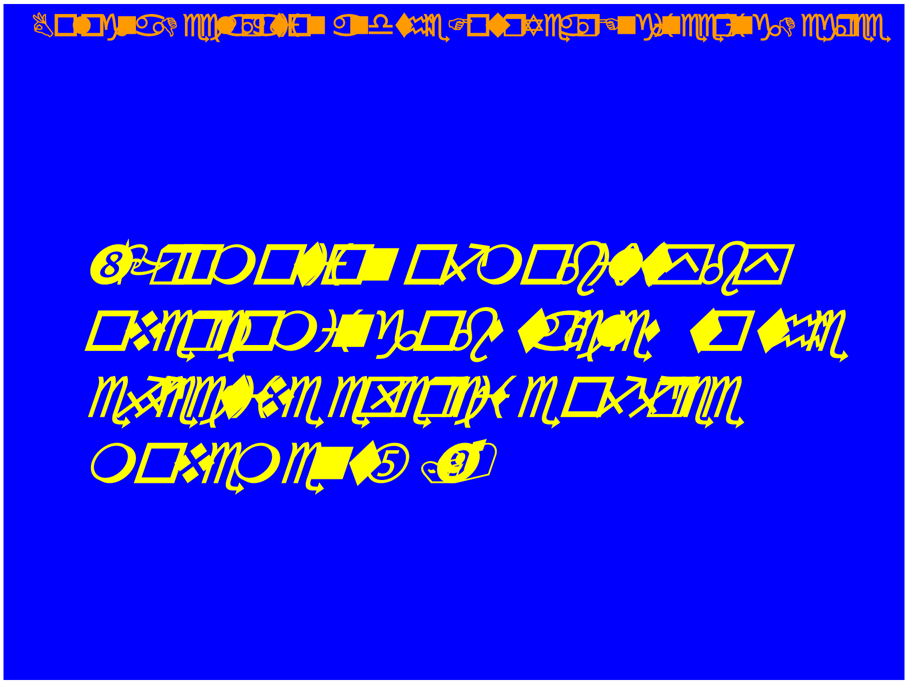


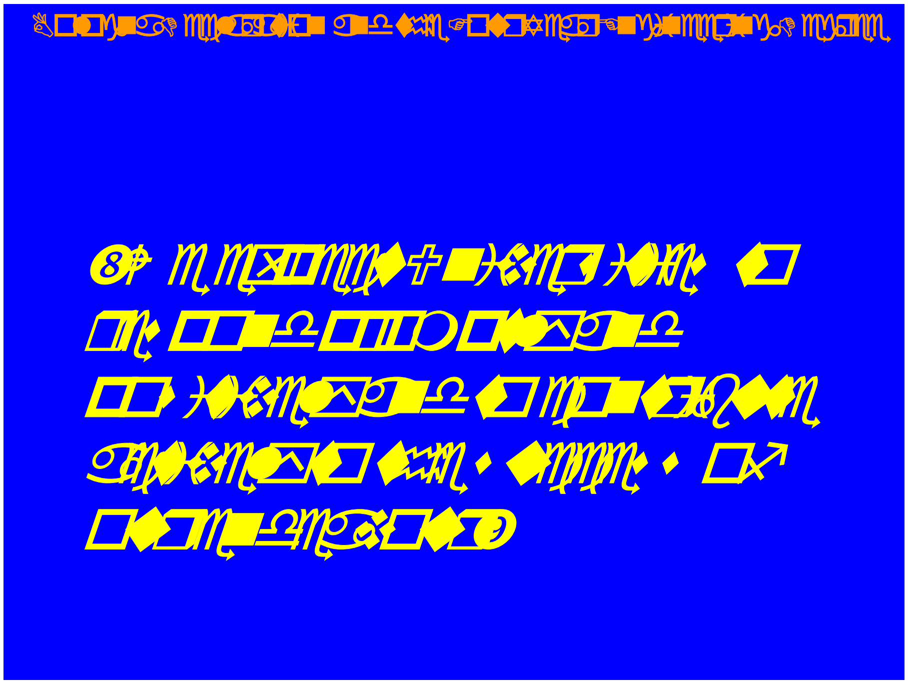


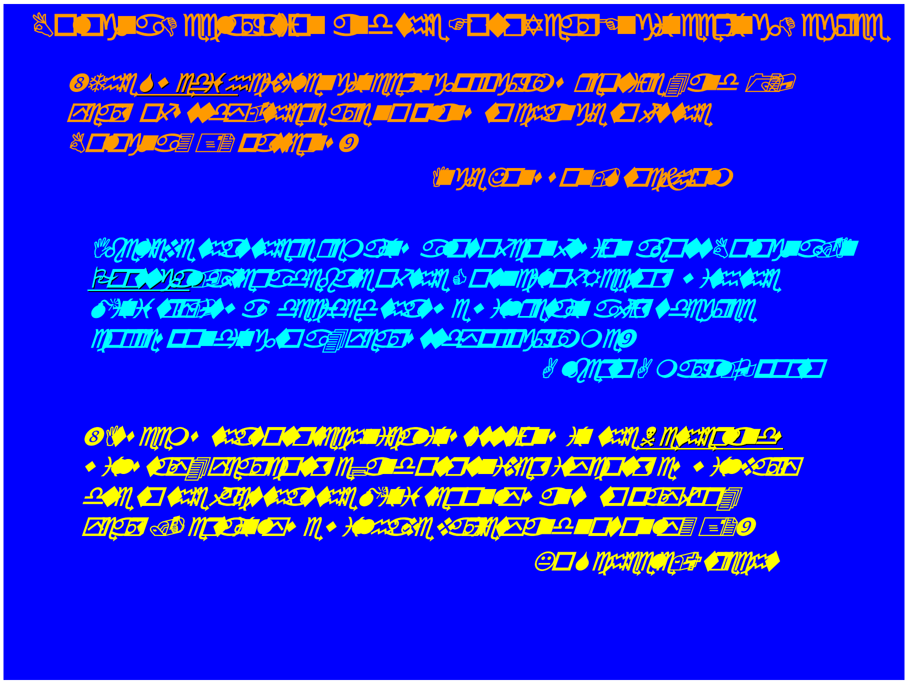


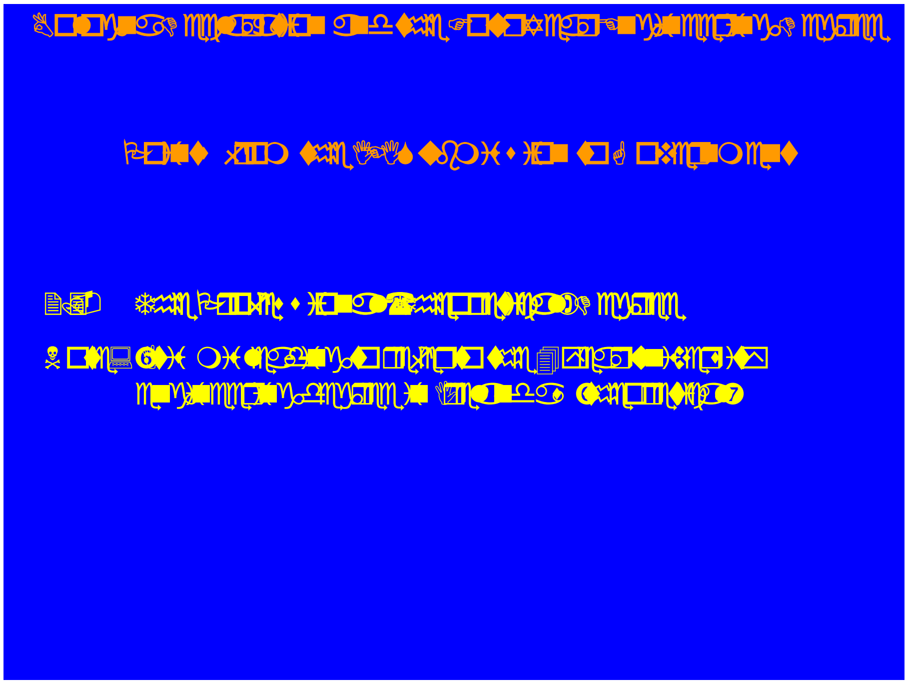


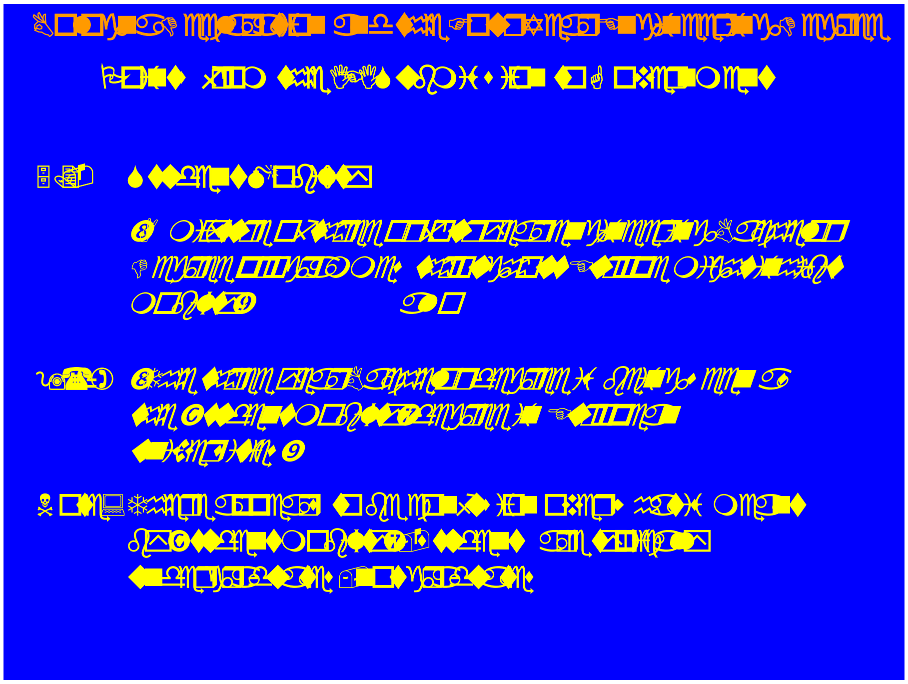


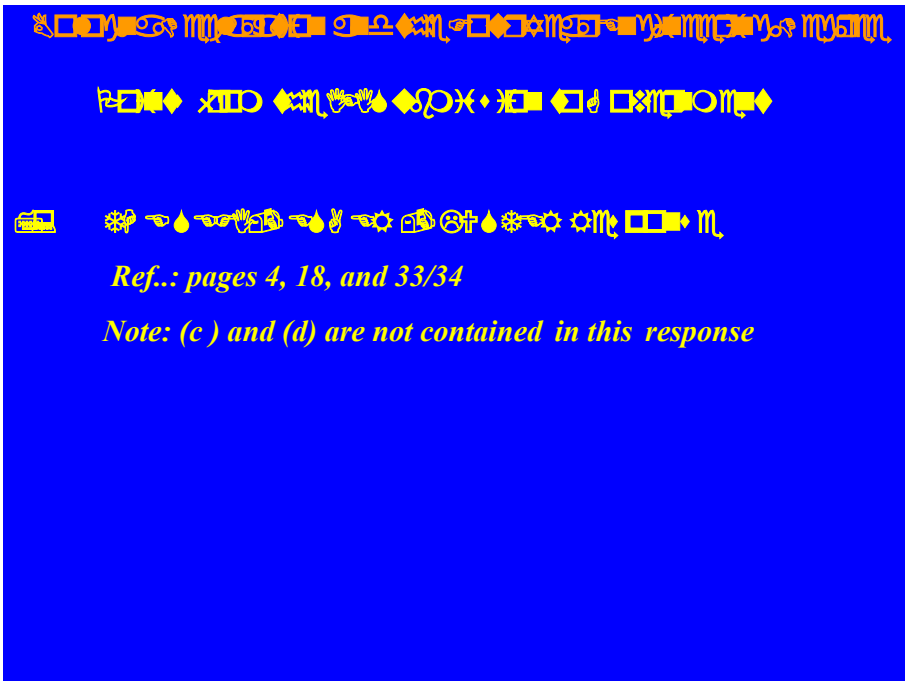












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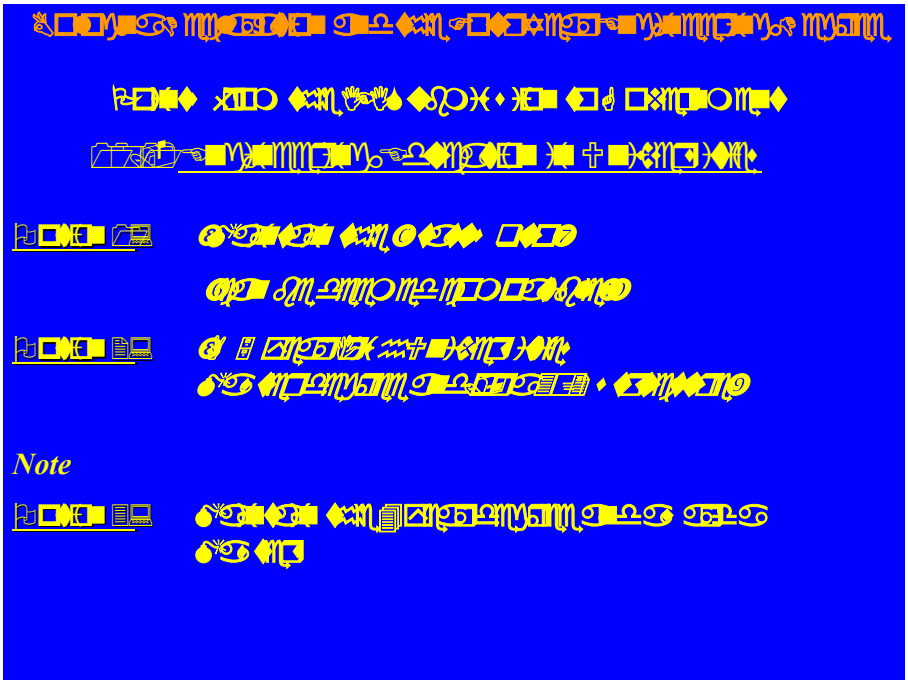
9 (e) “ [illegible] ”



Note

Note: Not true!

I conclude with a final point on costs and facilities. It has been the general experience that students will not leave after getting a Bachelors degree after 3 years on a five year professional degree programme. It is this experience we have in UCD in Architecture and Medicine, and thus I have no doubt that if we switched to a 3+2 degree programme in the University engineering courses, we would incur a full 25% increase in the student population and thus a similar increase in running costs (4 ⟶5 years), and the facilities (lecture theatres, computer rooms, laboratories etc.) would likewise have to be increased by 25%. It has been suggested I have heard, that a pilot study of the change to a 3+2 structure should be undertaken and I can see no benefit whatsoever with such a project. Apart from the very substantial expense of such a study, it would take nearly a decade before steady state in its effects would be obtained and conclusions drawn, and in any event, the various outcomes of such a pilot study could be predicted with near total accuracy before it was started. Pilot studies are only undertaken when you don't know what the outcome is likely to be. My view therefore – in case anyone has any doubt – is that the universities should stick with their 4 year engineering degree programmes and let the non-university sector go ahead with the 3+2 structure if they wish.

Anthony Trollope said the "*The best carriage horses are those which can most steadily hold back against the coach as it trundles down the hill*" which in modern parlance means "*if it ain't broke, don't fix it*'

Thank you

IMPLICATIONS OF THE BOLOGNA DECLARATION FOR ENGINEERING PROGRAMMES

AN INSTITUTE OF TECHNOLOGY PERSPECTIVE

P.J. MCLAUGHLIN
HEAD, SCHOOL OF ENGINEERING
IT TALLAGHT

INTRODUCTION (Slide 1)

Good afternoon ladies and gentlemen I am delighted and honoured to have been given this opportunity to present to you some of the initial thoughts of the School of Engineering at Tallaght on the Bologna Declaration.

As some of you already know I sat on the sub-committee within the IEI that helped formulate the IEI's submission to government and in so doing had a lot of opportunity to participate in the debates for and against the various elements of the declaration. These valuable insights in addition to the final IEI and other documents emerging on the Bologna Declaration have helped us to conceptually shape what we might use as a Bologna Framework in the School of Engineering at Tallaght.

So my presentation today essentially highlights a framework that we believe would work in Tallaght and that would with modest localisation be applicable in other Institutes of Technology. Obviously, what I have to say must be viewed within both the institutional and national contexts and policies for validation and accreditation of engineering courses.

But before I begin I would ask for your indulgence on two fronts. The first to allow me shed some light on why our conference is dealing with the Bologna Declaration and not the Berlin, Birmingham or for that matter, the Ballina Declaration.

Historically Bologna has been a hotly contested city. Some of you may immediately infer that this is sufficient reason to associate it with the declaration which itself will no doubt be hotly

contested in institutions the length and breath of Europe. However, from the Middle Ages until the middle of the Nineteenth Century the city of Bologna was sought after by the Church, by the Imperial powers of the day, and by rich and powerful members of the nobility. There were many reasons for this, not least its strategic geographical location and the economic and cultural benefits brought about by the presence of a university. It is believed the university built here in 1088, was the first university in Europe.

In Bologna, all the world's universities find their roots. In Bologna the University was not merely an ivory tower and venerable monument, but an essential socio-economic part of the city itself. The university was a centre for innovation and invention. It is for this reason that the Bologna Declaration is so named with all it's attendant symbolism and historical import. Just as the city of Bologna made a major contribution to the European Renaissance movement the Bologna Declaration provides us with the opportunity to rebirth European Academia to once again become a world leader in modern education.

SI Prefixes (Slide 2)

But enough of the history lesson and on to my second indulgence with which I hope to introduce a little levity to the proceedings. As we all know engineering students often struggle in the early stages of their formation to understand SI prefixes. So I have taken the liberty to include in my presentation some pointers as to how we might overcome this problem by relating the prefixes to items in common use.

I have also included this slide to try and make the point that **here I am joking deliberately** as for what follows this - make up your own mind!

Bologna in a Nutshell (Slide 3)

So, let's get down to this Bologna business. I view Bologna as just one of a number of external non-congruent forces putting pressure on our education system at present. However, Bologna differs from the others in that it provides a real impetus that can be harnessed to help change our system of education whilst concentrating on our specific and unique strengths.

In essence the Bologna Declaration can be read as an INVITATION to institutions in Higher Education TO SHAPE AND STRUCTURE THEIR OWN STRENGTHS in the light of the Bologna process towards EUROPEAN CONVERGENCE WHILST RETAINING DIVERSITY.

Note the word **process** in the above description. Bologna is not simply a paper exercise. It is a real process that many countries and institutions have already embarked upon and the very fact that we are here today discussing it gives weight to the argument that Bologna has also become a process in Ireland. As with all processes it will require a continuous supply of energy to keep it going. To date the IEI and to a lesser extent the HEA have been the energy providers but the time is fast approaching when institutions must of themselves provide the energy to ensure the success of the process in Ireland.

CHANGE DRIVERS (Slide 4)

As indicated earlier Bologna is only one of a number of forces or change drivers we must presently consider but it is arguably the most important with its implications for education in Europe.

In addition to Bologna we have national policy issues to consider. For example, the creation of the National Qualifications Authority of Ireland and its manifestation in the institute sector as HETAC requires us to put in place more clearly defined systems for academic quality assurance and to pursue a significant measure of institutional autonomy for our courses and qualifications.

Demographically we are under pressure with diminishing numbers of traditional students available to both the universities and the institutes for the foreseeable future. This situation is further compounded by the fact that fewer students within this reducing gross second-level cohort wish to enter engineering courses and therefore the engineering profession. In relative terms we could even be viewed as being in decline as engineering schools and as a profession.

Society meanwhile, requires us to provide life-long learning opportunities that are in keeping, in terms of ease of access and duration, with modern societal thinking on the work-life balance. Additionally, and quite rightly, society requires us to be more open, transparent and accountable as public organisations.

The increasing rate of technological change makes it difficult to keep our courses relevant to the labour market and we are constantly striving to find new ways of ensuring our graduates are effectively prepared for the modern workplace.

Against these drivers for change we have opposing forces. For example, we have the inertia of tradition that opposes any move toward change. This tradition is often represented by the well-known phrase - "if it ain't broke don't fix it". However, as engineers we know that this phrase is patently at odds with the philosophies of continuous improvement and innovation.

We have a more individually rational resistance to change that is rooted in uncertainty that suggests that we should wait to see how others prosper before we change anything ourselves. However, this conservative approach to change is guaranteed to produce followers and rarely produce leaders. I doubt that we want to be forever seen as institutions as followers either in national or international contexts

Then there is that most objectionable of forces against change that of vested interest. This is a force based on individual or group self-interest. It is a force that often acts against the greater good and should whenever possible be highlighted and rejected.

Finally, there is that immediately recognisable and very powerful force against change, cost. If we are to change, we are required to do it in a cost-effective way. As institutes we have a record of being extremely cost effective and very good value for tax payer's money.

So these are some of the current forces pressing on our institutes and they are shown here just to indicate that the Bologna process cannot be viewed in isolation and we must balance any enthusiasm for Bologna with a good measure of pragmatism resulting from the other pressures.

OUR EXISTING MODEL (Slide 5)

The IT sector has for the past 25-30 years made a very significant contribution to Irish economic development. Indeed, it is not assaulting reason to suggest that had it not been for the availability of its graduates, particularly its technician graduates, the economy would not have developed as impressively as it has in the last 8-10 years. As a sector we have a very clear view of, and take pride in, how we contribute to the labour market. We have a track record in developing courses with a strong industrial focus and this record will stand us in good stead when we come to design and deliver Bologna compatible courses.

Our sector has always valued the creation of flexible educational opportunities for its students where we allow the more able students to progress their studies in our sector or the university sector at home or abroad. We have additionally led the way in providing structured workforce development programmes at certificate, diploma and degree level.

However, the fact that we have used our core educational model for 25 years is probably reason enough to review it. In this regard the Bologna process has begun at the ideal time for us as a sector. We should view it as an opportunity to further develop our engineering programmes and institutes.

The model we use at Tallaght is readily recognisable nationally with its 2-year certificate, 1-year diploma and additional 2-year degree. Other institutes in the sector will generally operate scaled versions of this model with variants allowing for *ab initio* diplomas and degrees.

This model has been in existence since we opened our doors to students in 1992. Students progress through the programmes in the normal manner having to achieve the minimum of merit level performance at the end of each course to be eligible to progress to the next one. The exception is progression to the BEng programme where using the latest IEI criteria the student must have a merit with mathematics at distinction level.

However, the model does have a dark side. That dark side is the current student attrition rates associated with the model. We lose 40 to 45% of students by the end of first year, a further 15 to 20% of the remainder in second year meaning that we have a nominal completion rate of 44 to 51%. At diploma, after the strong filtration at certificate, we still manage to lose an additional 5 to 20% of students in a nominal cohort of 25. At degree, after certificate and diploma filtration, we lose 5 to 10% of students in fourth year in a nominal cohort of 10. So by the time we get to the final year of the BEng we will be left with approximately 9 students who will graduate.

It is interesting however to note that almost without fail the students who graduate from the BEng in Manufacturing Engineering for example, are those who entered the certificate with pass maths results of 'B2' of better, have studied a science subject and have average points of about 300.

So the model as represented on the current slide is how we currently conduct our business. I believe it is not a sustainable model given Bologna and the other forces for change our sector is experiencing as outlined earlier.

WHAT DOES BOLOGNA OFFER US? (Slide 6)

I am not going to bore you further by reciting the Bologna Declaration chapter and verse rather in the next few slides I hope to present what it might mean on the ground in an institute of technology. As outlined in the IEI submission to government the institutes of technology have probably got three realistic options when it comes to considering what Bologna offers us.

Option 1 is to maintain the status quo. Continue with the two-year National Certificate followed by the one-year National Diploma and the further two-year Bachelor degree in addition to continuing with the 4 year *ab initio* Bachelor degree.

Advantages

No direct additional cost

No change driven stress

Retention of proven 2 + 1 structure

Disadvantages

Potential devaluation of existing certificate and diploma qualifications

Post-Bologna mutual recognition agreements might not include the diploma

Option 2 is to replace the three-year National Diploma with a three-year Bachelor degree and an articulation arrangement enabling students to transfer to the penultimate year of a Master degree. The two-year add-on post diploma degree is discontinued and the two-year certificate is retained with articulation possibilities to the Bachelor degree.

Advantages

Structure is Bologna compatible

Mobility would be enhanced as a Bachelor degree in more widely understood outside Ireland

The Bachelor degree would be a FEANI Index first cycle degree

A three-year degree would meet a definite industrial need

It retains our valued ladder system

Modest additional funding required

Graduates of Bachelor degrees would be eligible for Associate Membership of the IEI

Graduates of accredited Master degree programmes would be eligible for Ordinary Membership of the IEI

Students might find the structure more attractive as it provides increased flexibility and mobility

Disadvantages:

Disruption during transition phase

New course development required

The Master degrees by research may need to be re-evaluated

Option 3 is to maintain the status quo but, in addition, offer a three-year Bachelor degree.

Advantages

No direct additional cost

No change driven stress

Retention of proven 2 + 1 structure

Structure is partially Bologna compatible

Disadvantages

Potential confusion with objectives of existing diploma qualification

Potential confusion with 2-year post diploma degree qualification

Having considered these options I believe that our best course of action at Tallaght is to select Option 2 but to look at it in a much more holistic way than Bologna requires. Notice that in Option 2 a disadvantage is that it requires new course development that is to say that it **is not, repeat is not,** a repackaging of existing diploma programmes. Any institution that adopts a repackaging approach to Bologna is doing a huge disservice to their students, to their institute, to employers and to Ireland's international standing as a quality educator. The precepts of the declaration demand that we embark upon a process of new course design.

I would at this juncture ask the IEI who have a responsibility to accredit our programmes, not only for their own membership purposes, but also for international recognition purposes to exclude from their register of accredited courses any repackaged diploma. Additionally, I would ask HETAC not to validate any course of this ilk submitted to them. We must be clear about what Bologna offers - it offers institutes a context for course review, redesign and realignment. It should not be sold as the modern educational equivalent to snake oil!

A Basic Framework for Bologna (Slide 7)

As indicated earlier we have at Tallaght quite a strong filtration process as students try to progress through our programmes of study. One of the problems with our current model is that we take a wide spectrum of student ability and try filter out the weaker students. Most of the weaker students are filtered out in first year. But what categorises a student as weak?

We generally identify a weak student based on a combination of factors as follows:

Having a D grade Leaving Certificate maths result

Having a course preference of 4 or lower

A student not passing maths diagnostic test in first 3 weeks of course

We profile students each year to quickly identify students at risk and try to ensure that they avail of the academic supports such as additional tutorials we provide them with. To date we have had modest success in retaining the weaker students on our full time courses. We still to all intents and purposes lecture to the average capability of a first year cohort and in so doing under-develop the strong student and over-tax the weaker student.

We need to look at a new model and try to develop a system that recognises the weak, average and strong student and helps each reach their full educational potential. We can now look at this new model in the context of option 2 described earlier. I am using the word new here but in reality some elements of the model are not new but have been around for years in our sector. What is new here is that the elements are now being redefined in a holistic manner using the Bologna declaration as an integral part of the design specification.

For the purposes of this presentation let us suppose we use the Leaving Certificate Mathematics result as the major measure of student strength and select a grade of 'B2' at LC Ordinary level as an input filter to the new course system. Using this metric of student

strength we can start to get a picture of what the introduction of a Bologna Bachelor course might do to our student input, throughput and progression.

So to gain entry to a Bologna Bachelor course I am suggesting that a student will need as a minimum entry requirement, Ordinary level pass maths at 'B2' and 2 Leaving Certificate higher subjects. Any student with results below this profile will be entered in the first instance to a certificate course.

Looking at the input figures this year we can see that that we would have had 33 students eligible for a Bologna Bachelors within our first year electronics certificate cohort and 19 eligible from our first year mechanical engineering certificate cohort. This leaves 90 and 69 students in these certificate courses respectively.

Using historical data for the past five years we would have averaged 42 Bologna Bachelor students and 59 certificate students within our first year electronics cohort. The figures for the mechanical certificate over a six-year period are 33 Bachelor and 58 certificate respectively.

(Slide 8)

On the face of it these numbers are sufficient to sustain both certificate and Bologna Bachelor streams.

THE BOLOGNA FIRST CYCLE FRAMEWORK (Slide 9)

So we might now describe our new Bologna course framework as having a certificate entry point and a Bachelor entry point with articulation possibilities from the certificate to the Bachelor stream and a pivot point at the end of the Bachelor course.

This pivot point allows the students three possible performance based options. One option available to the student would be to progress to a Bologna 'second cycle' Master course in Tallaght. This is similar to our existing model of performance-based transfer from the diploma programmes to our B Eng programmes.

The second option the student may select is to transfer to a Bologna 'second cycle' Master course in another institution in Europe. This may not be as linguistically difficult for Irish students as it has been in the past, because if the 'European Educational Zone' is to become globally competitive, as Bologna envisages, in the way the American system is, it must almost by default offer courses taught predominantly in English.

This is both an opportunity and a threat to us in Ireland as some of our students may opt to move to other centres in Europe to complete their professional education but we may also be able to attract overseas students to help redress the balance. However, current problems with general infrastructure and accommodation in particular may deter some overseas students from attending college in Ireland. If this were the case we might become net exporters of students seeking to complete their professional education.

The final option available to the student at the end of his or her 'first cycle' is to enter the world of work. However, by entering the world of work the students should not have to detach themselves from formal learning and we should provide flexible alternatives to full time study to allow them access higher qualifications and continued professional development.

If we look at the progression scenario alone then our Bologna Framework would look like that shown on the slide. Included also are suggested IEI membership grades for graduates of each course stream that are in keeping with current grading practice.

(Slide 10)

But at its crudest all this model has managed to do thus far is take the better students out of the existing certificate programme and produced a collectively weaker certificate cohort. Yes we have a Bologna compatible framework but we do not have an educational model optimised to meet the needs of all our students.

To allow realistic and seamless transfer to the Bachelor programme from the certificate stream we must have equipped students with the same analytical capabilities in two years that a Bachelor student gets in one year. I believe this may be possible with some very careful course design. However, this suggests that our certificate programme must retain a significant element of analytical subjects yet it is these very subjects that eject the weaker students from our courses. So how might we resolve this tension?

THE EXTENDED BOLOGNA FRAMEWORK (Slide 11)

One way that we might resolve this tension is to develop an 'Extended Bologna Framework' by introducing an additional technology stream that would facilitate criteria based transfer of the weaker students from the relatively analytically difficult engineering certificate. This technology stream would have relevance to the labour market and our sectoral experiences

with the Manufacturing Technology programme and our institutional experiences with the Maintenance Technology programme lead us to believe that such a programme could be devised if we take time and pay careful attention to module content.

Again, with careful design this course could also cater for non-standard entrants by providing an entry-level foundation programme of two semesters. Students entering via this route could opt to progress on the technology certificate or exit with a two-semester foundation certificate in technology.

If we now superimpose a complete articulation map onto this extended Bologna framework we can get a better idea of its intent. Lets look at the individual articulation paths in turn.

(Slide 12)

1. Students on the engineering certificate course who pass at Merit level or who, having passed and additionally pass qualifying examinations, would be eligible to transfer to the second year of the three-year Bachelor course
2. For those students who struggle with the Engineering Certificate programme there would exist a possibility to transfer to the Technology Certificate provided their GPA was between 1 and 2. By logical extension students struggling with the Bachelor course would be given a similar opportunity to transfer to the Certificate programme
3. Those students who gain a pass in their Engineering Certificate course would have an opportunity to pass straight to a nominated Technology Diploma
4. Those students passing their Technology Certificate at Merit 2 level would, in addition to being eligible for entry onto a Technology Diploma, be eligible to transfer to the second year of an Engineering Certificate
5. Those students completing a Technology Diploma would, in addition to being eligible to progress onto a Technology Degree, be eligible to transfer onto the second year of the Bachelors course

The technology stream may with careful design be capable of being offered as a general type of programme such as an Electromechanical Technology course or a denominated programme in Mechanical or Manufacturing Technology.

STUDENT NUMBERS & THE EXTENDED BOLOGNA FRAMEWORK (Slide 13)

If we look at the impact that the introduction of the Technology Stream would have made at Tallaght in the last four-years we see that our Engineering Certificate retention numbers increase significantly. We would have saved on average 34 souls per year at the end of our first year certificate courses and offered immediate progression possibilities to an average of 24 students with pass certificates in engineering.

(Slide 14)

Additionally, analysis of the number of students who last year entered the existing Certificate courses with a Leaving Certificate 'Pass Mathematics' result less than a 'B2', but who gained a Merit award at certificate or better we can see the potential transfer rates to the Bachelor courses.

So using the Extended Bologna Framework we can greatly facilitate students to reach their full educational potential. This framework is Bologna compatible and responds to the needs of our students, our economy and our institutes.

The extended framework may be used as a backdrop against which we can design new course programmes that will be more attractive to students. If we benchmark the potential content of these programmes prior to their being designed with their European and indeed American equivalents we can further refine the design specification for each stream.

(Slide 15)

Before I finish might I leave you with two additional thoughts about this framework. The framework might also benefit from some picture of what the outputs from the various streams might mean in the workplace. I have taken the liberty to include on this next slide my current mental model of what each stream might produce. However, you should not view the diagram as formally defining the role of each graduate type rather it is an additional guide, which requires further validation, for subsequent course and module design purposes.

The second thought is probably more provocative in that it is about efficient course design and resource utilisation. Consider if we were to have as part of our design specification a truly modular approach similar to that used in the United States. We might consider a scenario similar to the one represented on my penultimate slide.

(Slide 16)

If we use Maths as the example module we could conceivably construct our course streams such that they each contain an 'analytical time-lag' of one year. That is to say that students in the Technology Certificate would attain in two-years the maths capability that the Engineering Certificate students acquired in one year. Similarly, the Engineering Certificate students attain in two-years the same level of maths capability that the Bachelor students acquire in one year. This arrangement would help make transfer from one course to another almost seamless. It would additionally facilitate the combination of student groups for lectures pedagogic good sense permitting. So it might be feasible to combine a small group of second-year engineering certificate students with a small group of first-year Bachelor students for maths tuition.

Obviously this could be extended to other modules that lend themselves to this approach. Logical extension of this train of thought might lead to core modules being developed and deployed on a sector-wide basis at least at certificate level.

So to close I believe that the Bologna process could play a role in our sectors educational renaissance just as the city of Bologna and its university contributed to the renaissance movement in Europe in the fifteenth century.

(Slide 17)

Bologna in essence is about **B**uilding **O**ptimised **L**earning **O**pportunities or **G**enerating the **N**ew **A**cademy.

Thank you for listening.

Before we begin...

Engineering & Science Conversion

$2x10^{3}$	mockingbirds	=	2 kilomockingbirds
$1x10^{18}$	picolos	=	1 gigolo
$1x10^{12}$	pins	=	1 terrapin
$1x10^{12}$	Microphones	=	1 Megaphone
$1x10^{6}$	bicycles	=	2 megacycles
$1x10^{-6}$	fish	=	1 microfiche

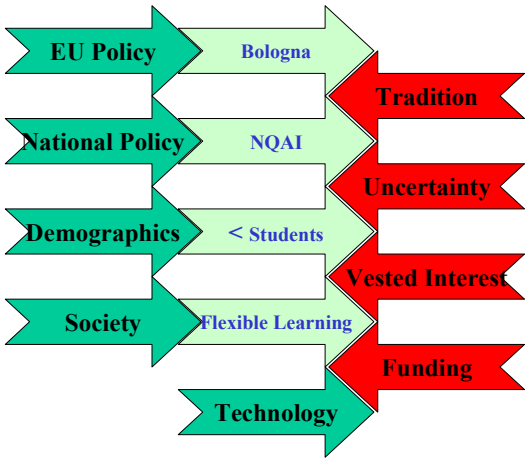
Slide 2

Bologna in a Nutshell

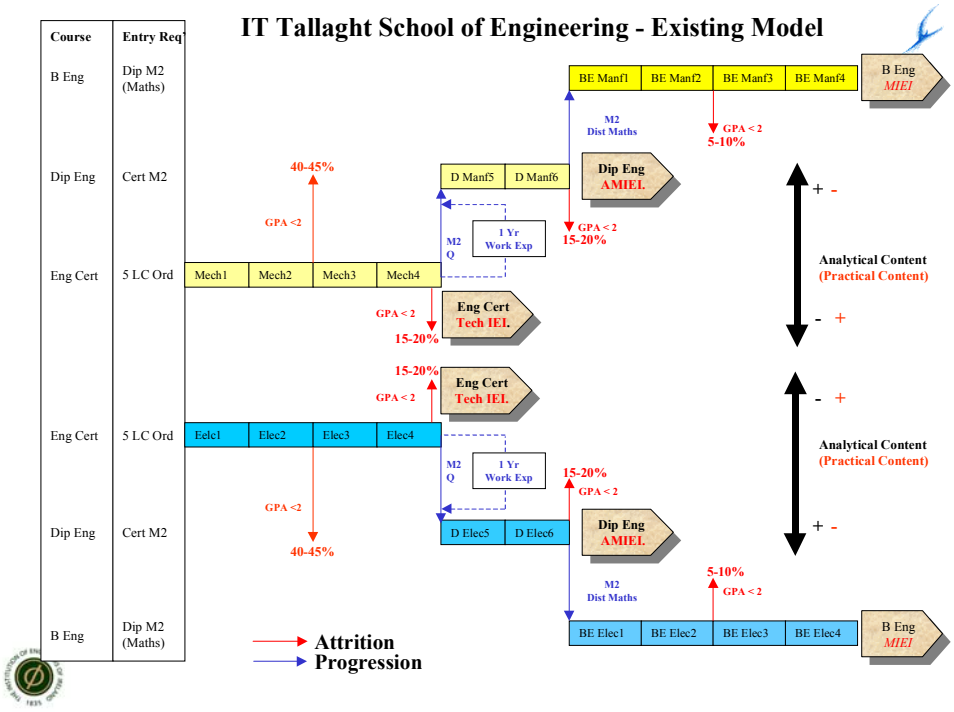
The Bologna Declaration can be read as an INVITATION to institutions in Higher Education TO SHAPE AND STRUCTURE THEIR OWN STRENGTHS in the light of the Bologna PROCESS towards EUROPEAN CONVERGENCE WHILST RETAINING DIVERSITY.

Slide 3

Some Change Drivers in IT Engineering Education



Slide 4


IT Tallaght School of Engineering - Existing Model
Course
Entry Req
B Eng
Dip M2 (Maths)
Dip Eng
Cert M2
Eng Cert
5 LC Ord
Eng Cert
5 LC Ord
Dip Eng
Cert M2
B Eng
Dip M2 (Maths)
Mech1
Mech2
Mech3
Mech4
Eelc1
Elec2
Elec3
Elec4
D Manf5
D Manf6
D Elec5
D Elec6
BE Manf1
BE Manf2
BE Manf3
BE Manf4
BE Elec1
BE Elec2
BE Elec3
BE Elec4
B Eng MIEI
B Eng MIEI
Dip Eng AMIEI
Dip Eng AMIEI
Eng Cert Tech IEI.
Eng Cert Tech IEI.
1 Yr Work Exp
1 Yr Work Exp
M2 Q
M2 Q
M2 Dist Maths
M2 Dist Maths
GPA < 2
GPA < 2
GPA < 2
GPA < 2
GPA < 2
GPA < 2
40-45%
40-45%
15-20%
15-20%
15-20%
15-20%
5-10%
5-10%
Analytical Content (Practical Content)
Analytical Content (Practical Content)
Attrition
Progression

Slide 5

The Options for the Institutes

Option 1 is to maintain the status quo. Continue with the two-year National Certificate followed by the one-year National Diploma and the further two-year Bachelor degree in addition to continuing with the 4 year ab initio Bachelor degree.

Option 2 is to replace the three-year National Diploma with a three-year Bachelor degree and an articulation arrangement enabling students to transfer to the penultimate year of a Master degree. The two-year add-on post diploma degree is discontinued and the two-year certificate is retained with articulation possibilities to the Bachelor degree

Option 3 is to maintain the status quo but, in addition, offer a three-year Bachelor degree

Slide 6

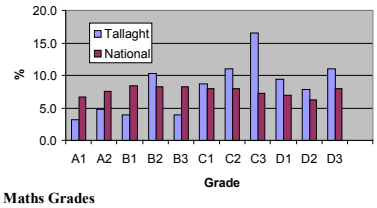
TA004 Electronics - LC Maths Grades

	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E
Higher	0	0	0	0	0	1	0	1	3	1.0	1.0	3.0
Ordinary	4	6	5	13	5	11	14	21	12	10	14	

Total Elec B Eng = 33

Total Elec Eng Cert = 90

LC Maths as an entry filter

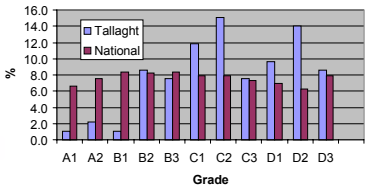


TA005 Mechanical - LC Maths Grades

	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E
Higher	0	0	0	0	1	0	1	3	1	0	1	0
Ordinary	1	2	1	8	7	11	14	7	9	13	8	

Total Mech B Eng = 19

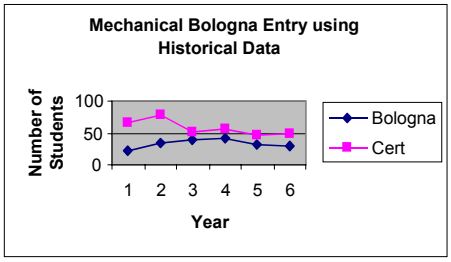
Total Mech Eng Cert = 69



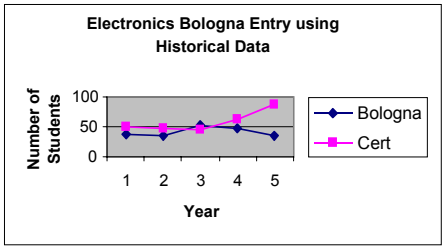
Slide 7

Bologna entry requirements - impact on historical student data

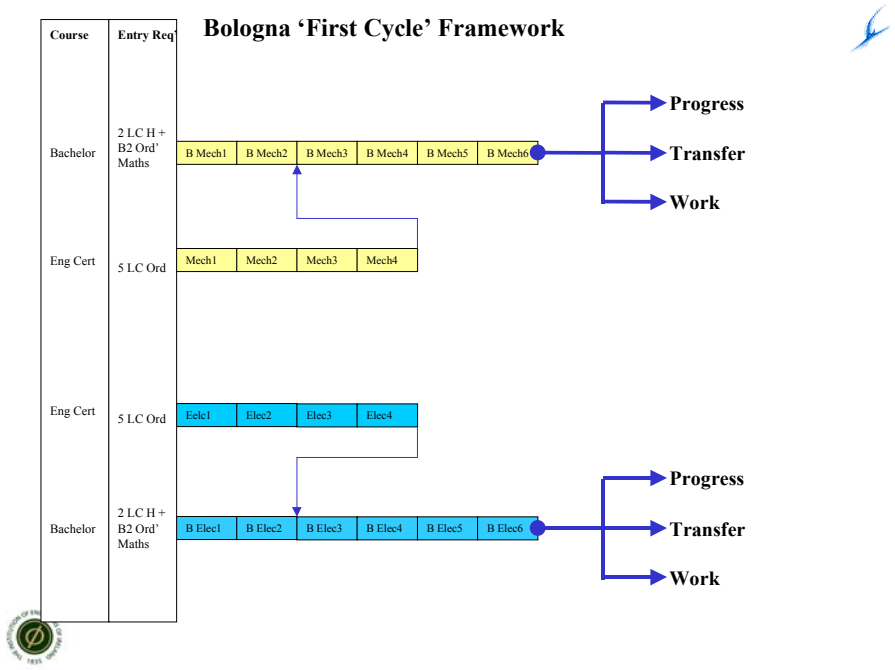
			Total		Ave
Bologna B Eng			198		33
Cert			349		58



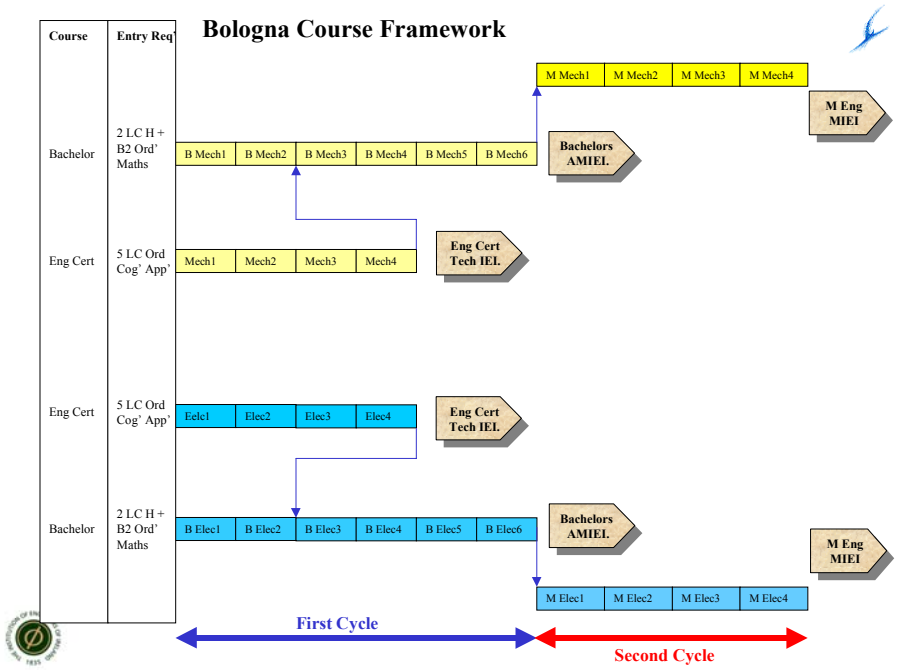
			Total		Ave
Bologna B Eng			208		42
Cert			293		59



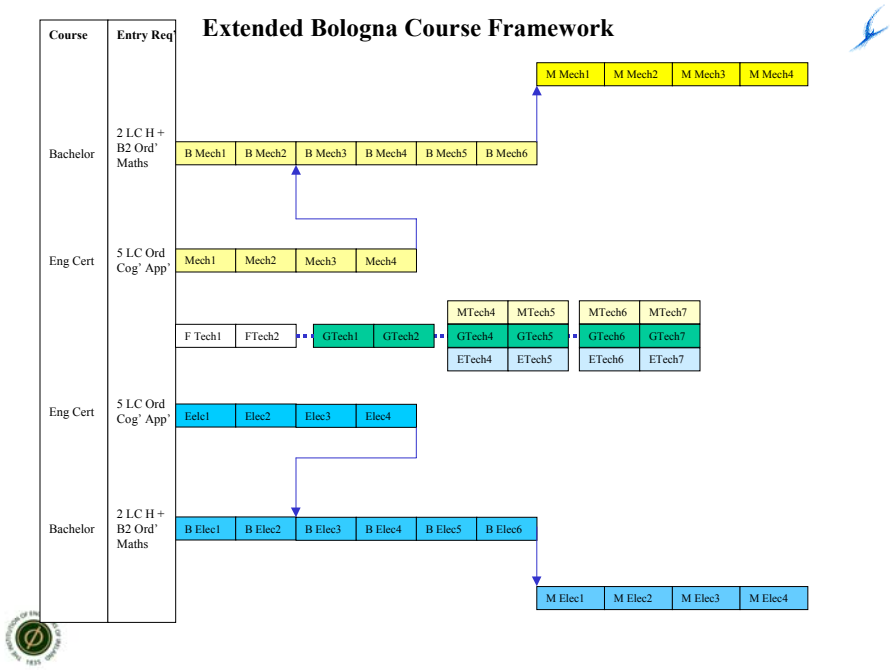
Slide 8


Bologna 'First Cycle' Framework
Course
Entry Req
Bachelor
2 LC H + B2 Ord' Maths
B Mech1
B Mech2
B Mech3
B Mech4
B Mech5
B Mech6
Progress
Transfer
Work
Eng Cert
5 LC Ord
Mech1
Mech2
Mech3
Mech4
Eng Cert
5 LC Ord
Eelc1
Elec2
Elec3
Elec4
Bachelor
2 LC H + B2 Ord' Maths
B Elec1
B Elec2
B Elec3
B Elec4
B Elec5
B Elec6
Progress
Transfer
Work

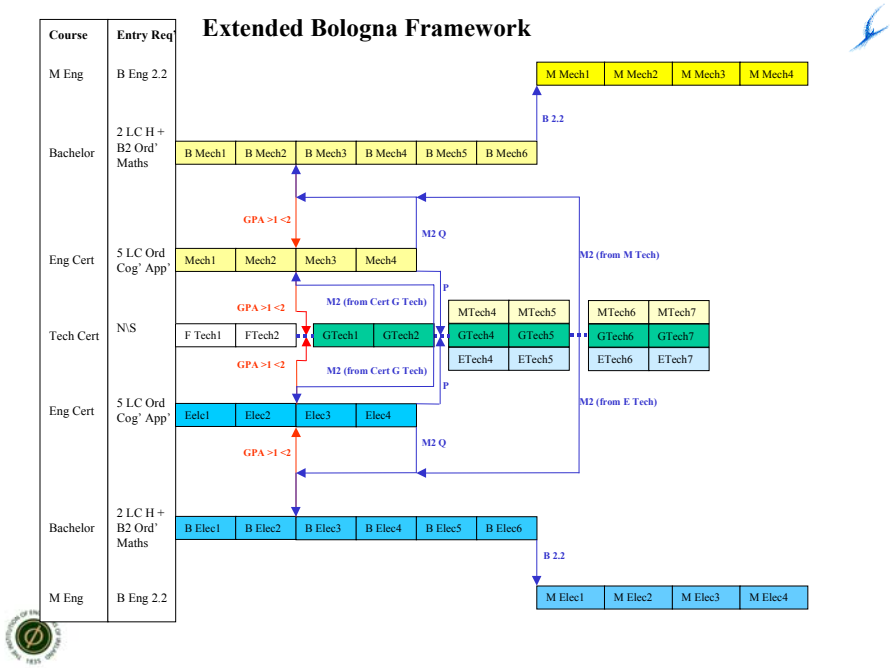
Slide 9


Bologna Course Framework
Course
Entry Req
Bachelor
2 LC H + B2 Ord' Maths
Eng Cert
5 LC Ord Cog' App'
Eng Cert
5 LC Ord Cog' App'
Bachelor
2 LC H + B2 Ord' Maths
B Mech1
B Mech2
B Mech3
B Mech4
B Mech5
B Mech6
Mech1
Mech2
Mech3
Mech4
Eelc1
Elec2
Elec3
Elec4
B Elec1
B Elec2
B Elec3
B Elec4
B Elec5
B Elec6
M Mech1
M Mech2
M Mech3
M Mech4
M Elec1
M Elec2
M Elec3
M Elec4
Bachelors AMIEI.
Eng Cert Tech IEI.
Eng Cert Tech IEI.
Bachelors AMIEI.
M Eng MIEI
M Eng MIEI
First Cycle
Second Cycle

Slide 10

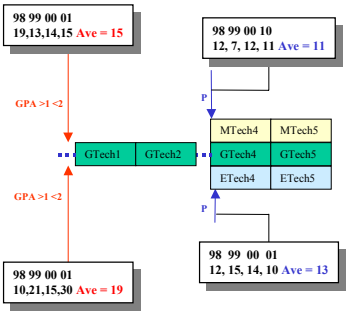

Extended Bologna Course Framework
Course
Entry Req'
Bachelor
2 LC H + B2 Ord' Maths
Eng Cert
5 LC Ord Cog' App'
Eng Cert
5 LC Ord Cog' App'
Bachelor
2 LC H + B2 Ord' Maths
M Mech1
M Mech2
M Mech3
M Mech4
B Mech1
B Mech2
B Mech3
B Mech4
B Mech5
B Mech6
Mech1
Mech2
Mech3
Mech4
F Tech1
FTech2
GTech1
GTech2
MTech4
MTech5
MTech6
MTech7
GTech4
GTech5
GTech6
GTech7
ETech4
ETech5
ETech6
ETech7
Eelc1
Elec2
Elec3
Elec4
B Elec1
B Elec2
B Elec3
B Elec4
B Elec5
B Elec6
M Elec1
M Elec2
M Elec3
M Elec4

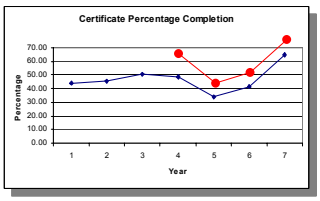
Slide 11

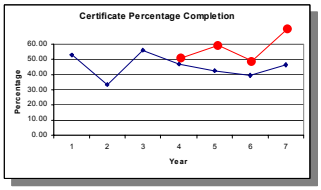

Extended Bologna Framework
Course
Entry Req'
M Eng
B Eng 2.2
Bachelor
2 LC H + B2 Ord' Maths
Eng Cert
5 LC Ord Cog' App'
Tech Cert
N\S
Eng Cert
5 LC Ord Cog' App'
Bachelor
2 LC H + B2 Ord' Maths
M Eng
B Eng 2.2
M Mech1
M Mech2
M Mech3
M Mech4
B 2.2
B Mech1
B Mech2
B Mech3
B Mech4
B Mech5
B Mech6
GPA >1 <2
M2 Q
M2 (from M Tech)
Mech1
Mech2
Mech3
Mech4
P
GPA >1 <2
M2 (from Cert G Tech)
MTech4
MTech5
MTech6
MTech7
F Tech1
FTech2
GTech1
GTech2
GTech4
GTech5
GTech6
GTech7
ETech4
ETech5
ETech6
ETech7
GPA >1 <2
M2 (from Cert G Tech)
P
M2 (from E Tech)
Eelc1
Elec2
Elec3
Elec4
M2 Q
GPA >1 <2
B Elec1
B Elec2
B Elec3
B Elec4
B Elec5
B Elec6
B 2.2
M Elec1
M Elec2
M Elec3
M Elec4

Slide 12

Extended Bologna Framework & Certificate Student Numbers

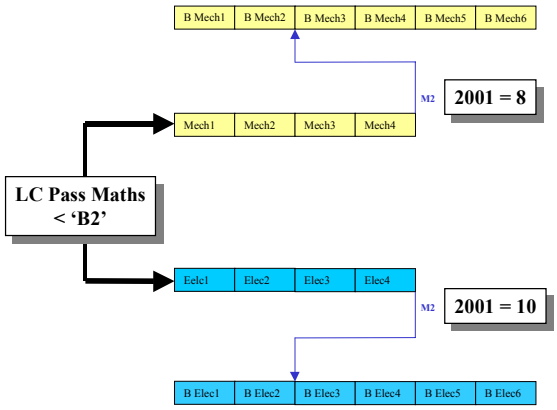






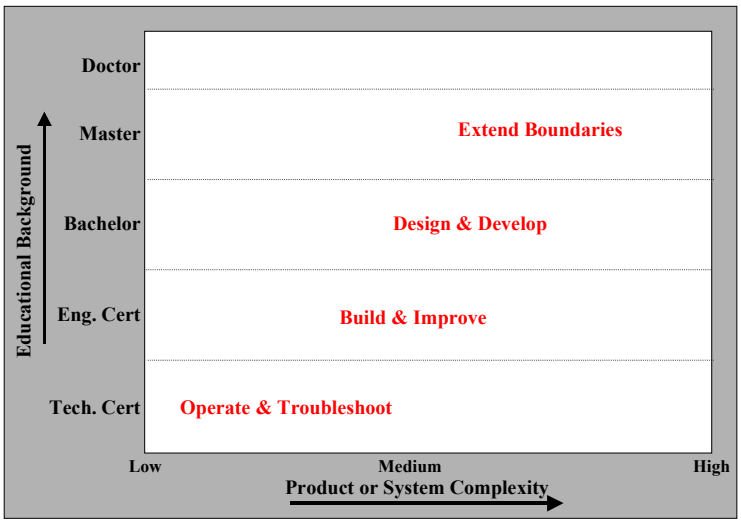
Slide 13

Extended Bologna Framework & Certificate Student Numbers



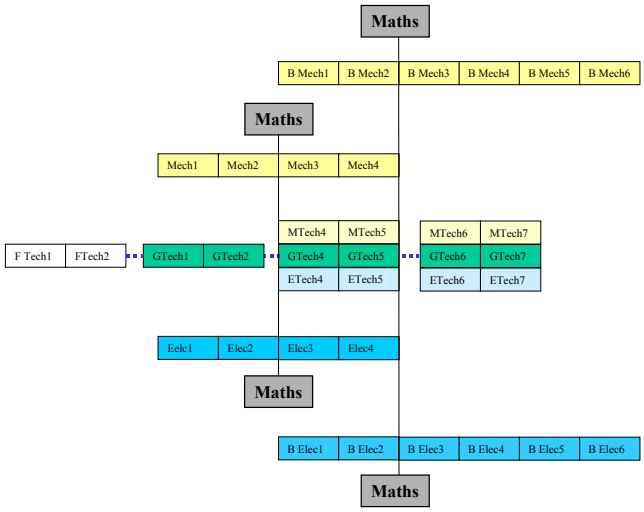
Slide 14

Extended Bologna Framework Output Model



Slide 15

Extended Bologna Framework & Modularity



Slide 16

Finally!!

Building

Optimised

Learning

Opportunities and

Generating the

New

Academy

Slide 17

PLENARY DISCUSSION

THE BOLOGNA DECLARATION AND ENGINEERING EDUCATION IN IRELAND

Chairman, Denis McGrath, Registrar, IEI

We are now going to have a plenary discussion which will centre on the discussion document the IEI produced together with anything that was said this morning.

We have 2 hours and we will not break. I will start off by just letting the discussion flow a bit. Depending on the degree of importance that you place on particular issues it would be my intention to try and ensure that all the topics listed in the options that are at the back of the discussion document are covered.

So first question.

John Fitzpatrick, Trinity College Dublin (TCD)

I would not agree totally with what John Kelly said this morning. I think we will have 4 year degree courses for a while. I think there will be a lot of questions facing the university sector, and I think the university sector has to get out and discuss them openly. I think we should look at the approach taken by the Institutes of Technology who have shown that it is possible to look for new routes and new sub-structures for our systems. The things that universities have to face, if we go for a 5 year structure are, do we have a 3 year structure, will it be 3 plus 2, or 5. What do we do if we go for 3; some of us have common entry, some have designated entry, some have 1 year common, some of us have 3 years common. So there will be many questions for the universities to answer. I think perhaps part of the reluctance to go for a 5 year structure, which I believe from a professional prospective is really what we should be looking for, is that there are a lot of questions to be answered and a lot of structures to be sorted out between now and then.

John Kelly, University College Dublin (UCD)

Yes, it is a big debate. I would hope that the universities will start debating it. But I think Trinity is perhaps ahead of the rest of the posse; I understand that you have set up some sort of an all-faculty committee that is looking at Bologna, is that correct?

John Fitzpatrick (TCD)

As far as I know John Scattergood who is Dean of Arts, Professor of English is looking at the implications across the university of the Bologna agreement at the minute. He is to meet with the engineering faculty in a couple of weeks to discuss the issue with us.

John Kelly (UCD)

Perhaps we are all at the same stage. I am out of the system now in UCD so I am not absolutely sure what is going on. I know that very little was going on until indeed this particular conference was announced. I know in the non-engineering area very little is happening. But again perhaps at the risk of repeating myself, you seem to indicate that we have to go to a 5 year structure. I can't see this at all. The 4 year structure is by far the one that is most recognised throughout the world as a credible professional degree structure. Why do we need the extra year? The cost is quite enormous. 25% or, if not 25%, certainly over 20% increase in costs due to the 25% increase in students; and if we have the 3 plus 2 do you really think that students enrolling in engineering will leave after 3 years? I don't think so, it will be just like what we have in architecture, like we have in medicine, they will go for the 5 year degree and pick up the bachelor degree after 3 years and keep going.

John Fitzpatrick (TCD)

I am not advocating 5 years. I am saying that we should be in a position that if we need to make our degrees 5 years we should have the structures in place. That is all I am saying.

Maria Kyne, Limerick Institute of Technology (LIT)

Could I ask Pat McLaughlin, under option 2, could he clarify the position of the 2 year add-on degrees? Will they become non-functional?

Pat McLaughlin, Institute of Technology, Tallaght (ITT)

I will try and give it to you as best as I can, in terms of my own thinking on it. There will be a period of transition if we are to go down the route I described this morning. I think effectively what we will be doing is replacing the existing 2 plus 1 plus 2 with the 3 plus 2 as described in the Bologna Declaration. The 3 year first cycle, the 2 year second cycle. The transition is going to be difficult, there is going to be a lot of ambiguity both from the student perspective and from an employer perspective, but I think if we are prepared to suffer the pain during that transition phase we can come out in the end much stronger and much more focused, in terms of what it is we are actually doing for students.

Bryan Maguire, National Qualifications Authority of Ireland (NQAI)

Listening to the discussion, one would be forgiven for thinking that it was a discussion about mathematics rather than of pedagogy. The entire discussion is about 3 plus 2, or 3 plus 1 plus 2, or 4 plus 1 whatever, rather than in terms of what would be different about the competences of a second cycle graduate as opposed to a first cycle graduate. It seems to me that if, as the German example seems to indicate, one of the characteristics that differentiate between a second cycle graduate and a first cycle graduate is that the second cycle graduate is prepared to go on to research and do a doctorate, for example. That is a clear distinction, it is about being in a position to push back the frontiers of knowledge. That may not be the requirement for the basic entry into the profession. You should be talking about differentiating between what the outcomes are specifically and only secondarily then say, with respect to students of a given entry standard or given mode of education, how many years of a course it will take to get them to that level. So if I have a question it is to what extent do we have to begin with definitions of what these graduates, at whatever level, are going to be able to do. Do we want engineers in the future to do something different than the standard graduate has done up to now?

Gareth Jones, Imperial College, London (IC)

I think you are quite right to raise this as the approach that we should take. I believe that a clear specification of what the graduate should be capable of doing when they graduate and leave the university, is required, before you start designing the course. I think one of the things which does distinguish the masters level graduate is the

ability to go on and do research and I think that should be foremost in your mind when you are generating masters level programmes. That is probably the main one, but there is an additional one. That is, that there should be special and alternative paths rather than an additional one. They could be specialised in some fairly narrow field but at a very high level. So they might be experts in new optical technology or something like that, contributing to technological development in that area. But not perhaps needing to go on and do a Ph.D. So I think there are different types of outcomes that you should be aiming for, both at masters level. If I could refer also to the question from the gentleman from Trinity College, Prof. Fitzpatrick. I think it would be a shame if you have to mess about too much with your very successful 4 year bachelor degree that you have now. I think if it's satisfying the needs of the market and if the graduates are pleased with it and they feel it's a very valuable programme, it would be a shame to chop that down to a 3 year programme plus something which is rather experimental. Perhaps a better way might be to add on optional MSc courses at the end, which are in specialised areas and then allow the market to decide. So if students feel yes, I would like to do one of those MSc courses, make it a 4 plus 1 is what I am saying. Then allow students to decide, yes, that looks like a very attractive course and I would like to do that and maybe industry might even sponsor students to do such a course if they feel that it's going to be valuable for their personal needs in the future.

John Kelly (UCD)

In response to Bryan Maguire, you are absolutely right; why are we considering these changes? It seems to me that two reasons have come forward this morning. One is that we need to; our degree is not competitive. As the Bologna Declaration says, they are concerned about the international competitiveness of higher education. So we have to look at our degree and find is it up to what is needed in the market place, is it up to what is needed by the profession, and does it prepare graduates for post-graduate degrees. You know my view on that, it certainly is. It's been up to that for a long time. Our graduates do 4 years as do all our universities here, in the United States and in most other countries of the world. The other reason is the political one, or the one that if everyone else is doing it we have to do it or our graduates are going to suffer, and this is perhaps a real argument. If our 4 year degree is considered to be first cycle, equivalent to a 3 year degree in most other countries, then that perhaps is a concern, and that is a reason why it should be considered. At the moment I don't think it is, because that is the way it's always been for the last 30, 40 or 50 years. We have had graduates coming out and competing with graduates from 3, 4, 5, 6 years

and it hasn't made a bit of difference to the employment situation of our graduates and I don't think its going to make one in the future. But I do realise that it is a concern that a lot of people feel, that if everyone else is doing it across Europe we have got to do it.

Chairman

Could I just make a comment on the FEANI, position. I am on the European Monitoring Committee of FEANI that deals with the index. FEANI in response to the Bologna Declaration has introduced new classifications for all degrees. They are, applied, theoretical, first cycle, second cycle, and you have to tick the appropriate boxes.

Pat McLaughlin (ITT)

Could I just pick up on Bryan Maguire's point. One of the things that we have been doing in the sector for years, is actually looking at the competencies required at the output end of any particular programme. So in effect, what we do is we identify the competency required from the role in the work place and reverse engineer the curriculum to ensure that we actually deliver on those learning outcomes. We overlay that then with the various pedagogical approaches that we might be using through various lectures, tutorials, laboratories, problem based learning, whatever else; and increasingly so, in terms of the actual adult learner who has no known standard, as our traditional type of student market is drying up fairly rapidly. We are looking at the implications of designing these programmes not only for students coming through the traditional second level system and through our doors, but also for the adult student. So there is a huge, if you like, element of the iceberg in terms of curriculum design, that hasn't been touched on I think in any of the presentations today. But it is there and it does address some of the issues that you are actually raising. Maths was used as an example, simply because it has been a bugbear in this building and unfortunately every other building around the country in terms of engineering education.

John Fitzpatrick (TCD)

Just to respond to Gareth Jones, I think most of the universities do operate these 4 plus 1 specialist courses for which students go and we do get industrial sponsorship and participation and I think this is true right across the sector in Ireland.

Chairman

I think it's also true to say that the number of engineering graduates doing Master and Ph.D. degrees is relatively low here, as a proportion of the BE graduates?

John Kelly (UCD)

My understanding is, I don't have the figures, but certainly up to a while ago, this was an increasing curve. We used to be very low, 30 years ago, but we are heading close to 25% of our total students are post-graduate. And going up. We would like it to be higher but with the Celtic Tiger over the last 4 or 5 years students are more attracted to the market place than to post-graduate research and that has hit us all.

Chairman

Arne you wanted to say something.

Arne Jacob, University of Braunschweig, Germany (UB)

It's more of a remark. In Germany, one reason to go for bachelor and master system is of course the wish of politicians to have it, to offer an entry level for foreign students. And the bachelor seems to be appropriate for that. My question now is what would you plan or where do you see the interface or how would you interface with foreign programmes? At what level? So it's not only the question does your final degree compete with the final degrees of other countries, but also the question can you attract foreign students.

John Kelly (UCD)

I am not quite sure if I have the answer to this one, but for the most part our engineering students, and I think its true of the other colleges, if they want to do post-graduate work either do it in their own college or indeed in another Irish college or a large proportion have gone to the United States. A large proportion of ours go to the United States not because the universities are very good, (they are no better than the European ones) but because they give us money. You can get a teaching position, teaching assistant, or research assistant which pays you $25,000 a year if you have a good first class honours degree from our universities and this is very attractive. So we have a large number of our graduates going to masters and PhD's in American and Canadian universities. It's always been a concern of mine over many years that we have very little traffic with European universities, very, very little traffic. That is why we all welcome the Socrates programme where we have a lot of traffic at under-

graduate level and very little still at post-graduate level. But the situation Arne is still the same, we have very little traffic with the mainland European universities at post-graduate level in engineering. We have some with the British universities but not very much. But the answer to your question is that our degree is acceptable to certainly American and British and mainland European universities as an entry to post-graduate PhD. It's just the opportunities are not there, and in Europe it's largely a question of finance.

John Fitzpatrick (TCD)

We have at the minute, in our department about 40 graduate students of whom 20 have come from Europe including German, French, and Dutch universities. So we have no difficulty, they work easily with the graduate students who have graduated from our department. We have only had one or two who have gone to Europe.

Michael Creed, University College Cork (UCC)

I think in my department of civil and environmental engineering in Cork the majority of our post-graduates at this point in time are not Irish, and of our non-Irish post-graduates the majority of them are from mainland Europe. We have got German, Italian, Polish, Romanian, Hungarian students, so there is quite a lot of interaction, primarily under the auspices of the new HEA funding for research in the universities. To go back to my main point, I think we are talking very much in a sort of internal, introverted way about what goes on in the universities, but it seems to me that all this business is coming from the outside. There are certain political points. The question is, why would we want to change anything. The only reason we would want to change anything is if there were certain regulatory forces coming to bear on us. I think we are all satisfied that at an academic level, we can interact with other academic institutions. If we have partner institutions we have a good idea of comparability and so on. But the question arises as to who the profession of engineering is to be regulated by. And that is the fundamental question. In Germany it would appear that when you graduate with your diploma in engineering you are a fully-fledged professional engineer. In Britain and Ireland we operate the Chartered Engineer system where you are not regarded as a fully qualified professional engineer when you graduate, so you go through a period of further formation in the work place. So the fundamental issue will be how the engineering profession will be regulated. Will there be a Europe-wide regulatory system? If so, we will need to look at that. We would need perhaps to try and anticipate what that might be. We should influence what that might be. So for me that is the question. FEANI keeps

getting mentioned. I have a question. Is FEANI of any significance in this debate? Is FEANI going to have a big influence on how the engineering profession is regulated. I would just like perhaps to focus a bit on the regulation of the engineering profession. Perhaps IEI might have something to say about it. Professor Jones from the UK, Professor Jacob, you might have things to say and I would like to hear people perhaps discuss how the engineering profession is likely to be regulated in 10 years time.

Chairman

Could I just clarify the IEI position on this. We are simply at the moment facilitating discussion on these issues. We do not have a position other than that. In relation to FEANI I could just comment Michael, I think the thing that is most important about FEANI at the moment is their index of approved courses which is used widely. It lists all degrees in Europe which are acceptable for the EurIng title and the classification I mentioned earlier is going in now. I think that could be important from the point of view of Irish institutions when that index is being used perhaps by US universities, or by other countries, in order to determine the standard of a particular degree programme. Maybe some of the panel would wish to comment on what Michael said.

Gareth Jones (IC)

I can comment on the earlier part of your question. I am not sufficiently involved with discussions on accreditation, but I think you obviously put your finger on a very important question, which is why does the Bologna Declaration have significance, why was it introduced? And I think my own view is that the Bologna Declaration was needed much more in the rest of Europe than it was needed in Great Britain or in Ireland, in the sense that there were clear problems in several European countries of very long studies, where students would be studying for say 6 years before they would leave with any kind of qualification from university. So they were the overrun problems. There was also the failure rate problem that the number of students who finally graduated compared with those who entered was less than 50% in some cases, so these were major problems that I think the politicians legitimately had an interest in and felt they really should do something about. One of the things that they suggested was that if you introduce a shorter course it will, as long as it has value in the labour market, contribute to solving some of these very significant problems. I think that is one of the reasons why the Bologna Declaration was important. Another reason is because there is a view that the future in Europe is going to involve much more mobility both of students and of graduates. Companies are going to

operate on a Europe wide, if not a globally wide basis. They will want to see a qualification system which is more suited to an operation in which national boundaries are not important and so a system which is more easily understood where students can get recognition more easily in other countries. I think that is of benefit to major industrial employers. I think they would want to see that. A third reason is this question of the interface to the outside world and in particular attracting more students from outside Europe to come and study in Europe, particularly at masters level. In Germany, Sweden and the Netherlands, they are putting on quite a large number of masters courses taught in English where the main target audience for these courses is students from all over the world, but principally from outside Europe. There are various reasons for that. One I think is to make sure that Europe remains attractive as a potential supplier of good quality engineers for the future for the whole world, not just for Europe. And that people coming here from South America, for example, will value the experience they get in Europe and take it back with them and go back able to give a good account of the capabilities of European higher education and industry. I think the question of whether there will be a growing interest from students in Great Britain and Ireland in wanting to take masters courses and PhD's in the rest of Europe, is an interesting question. My own view is that once bachelor/masters programmes get established in most European countries this will become more attractive to our students. They will actually want to do that. It's interesting in the last few months even, that some of our students have picked this up and are now asking me specifically, "can I go and do a masters degree in Germany or in Italy", or something like that. So they are asking these questions. In the reverse direction we certainly have strong demand from students in Germany, Italy and Spain who want to do masters degree courses with us. At the moment there is a problem because our master degree courses, the MSc courses, the specialised courses are obviously defined as post-graduate courses and the regulations say you must have a first degree before you can register on one of these courses. At the moment students from Germany cannot register on these courses until they have got their diploma/degree, and that sounds a bit ridiculous because they are pretty advanced by the time they get their diploma/degree. If there is a system where they can get a bachelor degree before that, then they would be much more interested. And we would welcome them. And they would be much more able to come and do a MSc degree with us. So I think there is going to be an increase in flow in both directions which will be made more easy by an introduction of a bachelors degree.

John Kelly (UCD)

Michael, if I may have a thought on your question, how is the engineering profession to be regulated in the next 5 or 10 years? I am sorry if I sound a bit negative but the question that should be asked is do we need to be regulated. Have we ever been regulated? Is the engineering profession regulated in Germany, we hear it's not, you just graduate and you are straight into the work place. I think you will agree that our engineers will get their first job on the basis of the accreditation or standard of the university that they come from as well as their own academic record and from then on they are on their own. The CEng, I was involved with the Institution on the Council for many years and when we brought in CEng, I am a great believer in it. But it doesn't count that much in the market place. Perhaps it counts a wee bit more for civil engineers than it does for chemical engineers. I don't know. But certainly it doesn't matter in the market place whether you have a CEng or not after you have got your first job, or whether you get another job. So why do we need regulation? Do we really need regulation? If you say the main reason we should change to conform to Bologna is not academic or standard but because of political pressure to be regulated, I am lost a bit, I can't see those arguments.

Michael Creed (UCC)

Perhaps I might ask the question, why is the medical profession regulated? Is there something greater about the medical profession, or the legal profession that those professions should be regulated and that the engineering profession perhaps is a lesser profession and should not be regulated?

John Kelly (UCD)

The answer is yes. Unfortunately people are concerned when they are working on your health that the person who is looking after you is fully qualified from an accredited institution. When you are in trouble, as you are in medicine, or in trouble as you are in law, you are anxious that if you are being defended or maybe going to jail you want to know you are being defended by someone who is well qualified. Unfortunately Michael, we don't have the same pressure in society that those two professions have. We just don't.

Michael Creed (UCC)

You have indicated that market forces will dictate. If somebody was carrying out operations and had a high casualty rate I think the market forces would dictate that

that person would get no more work. Similarly if a lawyer was losing all his cases, then the market forces would mitigate against that person. I think we should be, if we are a proud profession, thinking in terms of regulation. And if we regulate ourselves and expect our members to have a certain education, certain formation to enable them to enter the profession, that they would continue to develop themselves and that they would behave in a certain ethical manner, I think we should be working towards regulation of the profession right across Europe. That should be our main motivation so that we would be capable of recognising what is being done in each other's countries to bring about a situation where we have a well-educated and responsible profession.

Kevin O'Kelly (TCD)

Just in response to that first question, I think it is easy to establish a more regulated system and, in fact, it is so in the United States with PE qualification which is a very rigorous certification and it has to be repeated. The fact that we chose not to have perhaps a slightly loser arrangement with the CEng is our own choosing. I would completely agree that we can implement a stronger more rigorous regulatory environment. Going back to the value of a 4 year programme, and holding on to it, I would like to challenge that, long before Bologna, I know I was having conversations with colleagues about certain frustrations in a 4 year programme. The inability to have larger more developed projects, the inability to have industrial placements longer than simply summer work. So I think from an academic point of view there is merit in a 5 year programme. Touching also on the reference to the United States and their 4 year programmes. The truth of the matter is, that because of their modular system most students take 4 ½ to 5 years. Not repeating but simply stretching out the course. It's a very intense programme to do in 4 years. So I think there is evidence that students would benefit from a 5 year programme. Whether you call it a bachelor or masters that is another issue. And I think this touches on the question, the earlier question, what is the entry level for professional engineering. What are we going to say is the entry level for professional engineering? I would make an argument that it is 5 years, not necessarily all academic, but a combination of enhanced project work and industrial placements.

Arne Jacob (UB)

Maybe just one word about the German system. A Diploma Engineer from a German university is able to do research right away. And often the diploma thesis itself is part of research work that leads to publication, partly in refereed journals. So this is

just to tell you where we consider the level to be. And as a professor I can tell you I find this system very, very useful for my own work. Because it helps us in our progress, so this is one thing I wouldn't like to miss. Maybe another thing about mobility, you were talking about globalisation and companies being all over Europe and all over the world. I think that this appeals for mobility. I think that mobility also, especially at a student level, has a very important cultural meaning. Because it's only if you have spent some time in another country that you have the chance to learn something about this country, about the people who live there and to understand their way of thinking. I am not sure, of course about that, but I could imagine that this is one of the incentives of the politicians to foster mobility by means of these programmes. From my personal experience, you heard that I grew up in France and Switzerland and I spent some years in the United States. I can only encourage this type of exchange as being very, very important to get the sensitivity for people from other cultural backgrounds.

Chairman

I have heard of a model of a 5 year master degree that might be taken up here as being one which includes a placement perhaps of one semester in duration and an expanded final year project, but not changing the curriculum material that much but spreading it out a little bit more. I know that this is being discussed in one or two universities in Ireland. There does seem to be a strong feeling in the CESAER/SEFI/CLUSTER view that there should be a 5 year master degree and that industry also needs 3 year bachelor degrees, and the link between the two presents a problem.

Robert Simpson, Dublin Institute of Technology (DIT)

Could I ask a question before I make a statement? Are there any former 4 year programmes that have gone to a 3 year plus 2 programme, in Europe? It seems that there is a problem reducing the 4 year programme down to a 3 year. I think we are all agreed on that. Pat McLaughlin was talking about bringing the diploma technicians up to a 3 year degree programme. I see a benefit in that okay, but I don't see a benefit in reducing the 4 year programme down to 3 years, with the exception of being able to allow students to transfer to other colleges. I can't see any other benefit in it professionally. That is my first comment.

Gareth Jones (IC)

I don't know of any. If there had been any good examples I probably would know. However there have been examples in Spain of what was a 5 year degree in Physics

and some other subjects like Chemistry, which was reduced to a 4 year programme, essentially for political reasons. This was a disaster. What happened is that the people in charge of delivering this programme were not convinced that it was the right thing to do and so they tried to include in their new 4 year programme everything that was in the 5 year programme. And of course students couldn't do it. And so the number of students who completed on time was just a few percent. So they had to go back to a 5 year programme. It was quite an upheaval for the Spanish university system when this happened, and a big problem for the students. I think it was a bit unfair on the students, asking them to try and do that. But there were special factors in Spain which I could talk about for ages. If I could go back to what the gentleman from Trinity College just said, I quite agree with you. My comment was that if your 4 year degree is working well and there are no problems then maybe you shouldn't change it. But I think you are quite right to look at it carefully and see if there are problems. Are there things that could be improved in it, can we do it better? And if your conclusion is that it needs to be extended then yes, you should do that. One question you have to ask yourself is will the students want to spend an extra year? Even though it might be in their best interests, there are financial pressures on them. There are other pressures on them which might result in them saying they don't want to spend an extra year. Have you thought about that? Will students want to do an extra year?

Robert Simpson (DIT)

I will answer that with another question. It depends on the nature of that extra year. If the extra year is made up largely of project work, and also industrial placement, the argument is that the graduates will be far more likely to enter the work place at a higher level and be more useful. If it's just simply another year of course work I would agree with you, perhaps the student will say I want to enter the work of pay cheques please. So it's the nature of the extra year that's important, and I think we would have to be careful not to simply see it as an opportunity to pack more and more into them.

Martin Mannion, Cork Institute of Technology (CIT)

First of all I would like to support Michael Creed about regulation.

We are very concerned about losing Maths students. I wonder if the Maths pool is decreasing as much as we think it is? I think what is happening is that many of the Maths people are being attracted away to other professions like law, medicine and

accountancy and it's possible they are not seeing engineering as very attractive any more. And maybe it's because we are not prepared to be answerable to the public. I am a civil/ structural engineer and I believe civil/structural engineers have to be answerable. Even though we are effectively not regulated, if a bridge collapses it will do a lot more damage than one or two patients dying. And yet we are losing out because of this. I think in Germany, Italy and France it's somewhat better for civil engineers. They seem to have a higher standing in society. Here the word engineer is just seen as a kind of a "catch all" for just about everything. In fact my postman about a year ago said to me, "Oh, you are a Chartered Engineer, I thought you were only an engineer". I was quite taken aback at that. He obviously has a totally different perception of a Chartered Engineer than a "normal" engineer. But Professor Kelly's points are hard to disagree with. I wouldn't agree with this idea of "if it's not broken don't fix it". I think it's very important to realise that we can always improve. I do believe that the universities should actually at least debate this Declaration and see if it can be improved. But we have to think about public perception and parental perception. And we in Ireland I think are in a rather unique position. Most of the investment in this country is American investment. We don't get as much from Europe. We also have the language barrier. I think it's not just the money that is attracting people to the United States. It is the fact that they speak English there. We don't have a great record of speaking a second language here in this country. In fact many of us can't even speak our own language, which is very regrettable, and we conduct all business effectively through English. Cork has its own language of course! But the point is, I have experience of exchanging quite a few students with universities in France, Spain, Germany, wherever. But most of them are incoming and the numbers that are going out tend to only want to go to Germany, because most of the professors speak English. They don't want to go to France. The few who went there had bad experience because they were told they had to do everything including their reports through French. But coming back to the whole 3 plus 2 debate, how can someone impose this. We are not going to change the university system which has been there for 100+ years. And the university people are not going to. They might modify it and I suggest they should. We can also look at a situation where we are converting diplomas into degrees because we must look at the input standard. And I still think the Maths, even though some people will knock us for it, but I personally believe that a B2 in Pass Leaving Certificate Maths is generally too weak. And even now to look at a C3 in Honours Maths, I think the standard at Leaving Certificate is actually falling. I think it's easier to get a C3 than it was 5 or 10

years ago. I wonder if Professor Kelly would like to comment on one thing, does he feel that you need Honours Maths to study engineering or can you do it at Pass level?

John Kelly (UCD)

The answer is yes, you do need Honours Maths to do engineering if you want to do engineering to a professional level, as we do at the moment. And you are quite right and I confess I am not totally up to speed on the change in Maths over the last 3 or 4 years. But I am aware from the comments of my colleagues, who agree with what you just said, that the standard has certainly changed quite considerably downwards from what it was. Yes, I agree.

Martin Mannion (CIT)

I was probably just saying how low do you feel you could go as regards Maths. What is the least, would you think C3 in Honours or an A1 in Pass? Or should people with Pass Maths be given a kind of a bridging course. I am sure there are a lot of good people out there who have done Pass Maths and who didn't get the opportunity to do Honours.

John Kelly (UCD)

Certainly I have accepted an A1 in Pass Maths. Maybe this is our next conference we are talking about now as there is a lot that could be said about Maths.

Could I just make a comment, that if we do go to 5 years its not more cramming. We do I think, in our 4 years, over-lecture our students. They are heavily crammed from 9 to 5, 5 days a week, with 4 afternoons of laboratory classes over 4 years. I have always thought this and everyone always agrees with me, but it's like the weather in Ireland, we talk about it all the time but do nothing about it. I know, Chairman, that there are ideas that we should go to 5 years and one source of that idea would want to put more stuff into the programme and more lecturing into the 5th year. That would be wrong. I think the standards that we have set in our 4 year courses now are the right standards for a professional engineering degree. If we could extend it to 5 years with industrial contact, with a more relaxed 5 years rather than the pressure they are under at the moment, that would be more appropriate. And again just a quick word, on Michael Creed's point. Of course I am all for the things you said, but I call those standards. The standards in our engineering profession are enormously important and this is what our Institution has a responsibility in. Regulation is different from acceptable standards. I would just like to make that point.

Paul Sliney (CIT)

I found myself this morning disagreeing with Professor Kelly but now I think I may have arrived at closer agreement. We have a 4 year Bachelor of Engineering in electronic engineering and we suffer from a constant pressure on reviews every 5 years to put in new material. The technology changes very rapidly and we must respond to those changes. We also have 6 months co-op. Our students are very pressured. A 5 year version of the same degree, a 3 plus 2 effectively, if we could have a longer co-op between years 3 and 4, that would be very good for the students. I think if we devoted year 5 to project and maybe some electives, we could arrive at some of the German standards of project work which is published, at 5th year level. And I am beginning to favour a 3 plus 2 Bachelor of Engineering followed by Master of Engineering. It would seem to me it would make life more comfortable for the students and maybe deliver a better engineer. I am sorry that is not a question.

Bryan Maguire (NQAI)

Following on this theme of what goes into the 5 years, if we accept John Kelly's hypothesis that the actual standard of engineering is such that it is at the current level of the internationally accepted professional engineering degree, we still have to look at what else goes into an engineering degree. We mentioned work experience and research, but there are other things that we have been at pains to squeeze in. Things to do with business awareness. Things to do with transferable skills. Languages, and so on. That could in fact make the basic engineering degree to master level a much more comprehensive and transferable qualification.

Kevin O'Kelly (TCD)

In comparing 4 year programmes on the American model, keep in mind that they use 2 x 15 weeks teaching terms. Which means that after 4 years they have had 120 weeks of teaching. After 4 years we have had 96 so if you are comparing like with like in terms of duration they are already operating an equivalent 5 year programme covering the same material. And it goes back to the point of the previous speaker about the pace and essentially we cram our students and then hold it up as a 4 year degree. In effect we are doing what the Americans take 5 years to do. It may be worth looking at the pace and intensity of our teaching. Not just whether we have 4 or 5 year programmes.

Pat Frawley, (UL)

Professor Jones made a comment earlier, that in all this, diversity should be maintained as much as possible. Many people here have argued very well for a 4 plus 1 and I think maybe the Irish position might be along those lines. However, in continental Europe, say in Germany, 3 plus 2 is definitely coming out. How can we have diversity with different degrees and mobility and all of that? We have two totally different models.

Gareth Jones (IC)

I agree. There is a danger that you will end up with something which is just incompatible. If you find that your aim is diversity and you impose a rigid structure then you may end up with a system where diversity is being removed. And that was my danger. I think there is value in diversity. Not so much in diversity of structure but in diversity of content of courses, aims of courses, styles of courses, teaching styles and I think that is valuable. There is a difference in style between what happens in a typical German or Italian university. And what happens in a typical British or I imagine an Irish university where there is much more emphasis in the early years on the relevance of what you are doing and making sure that students appreciate that when they are learning Maths and Physics, there is an engineering context in which that is going to be set. And in which you can see immediately why you are studying particular differential equations for example. I think that is a question of style being different. I think the approach in Germany certainly in Physics and some related areas of engineering which are close to Physics is very much to give a very general treatment of the subjects. A very powerful mathematical technique which you can use in all kinds of different problems but which is rather difficult to get hold of first time round. So that does set up barriers. The best students will survive and they will gain from having these very general, very powerful techniques. Whereas I think many other students will find it just doesn't work for them. So I think differences of style I would like to preserve, because I think they are of some value. I would still however wish to see more transparency and more comparability and to make it easier for students to move from one system to another. That does require some changes. I would hope changes that are not so severe that they cause you to change the style of how you do things, but they might push you to change the structure slightly.

Unknown speaker

The speaker at the back raised the point about America having 2 x 15 week terms. We don't have a semester system generally in this country to the best of my knowledge. What is typically the number of weeks a student will spend per year in a German university?

Arne Jacob (UB)

3 ½ months each semester. So this is the typical time for classes. And then you have 30 weeks in a year. And then the remainder of the time is called the vacation time. We, the professors call it time without lectures. There is a subtle difference of course. This is the time that is needed to prepare the exams and actually write the exams. And this takes a lot of time because during the semester there is not enough time to work thoroughly through all the lectures. So the timing of vacations is needed. And of course also partly for the internship in industry.

Unknown speaker

Maybe this approach would solve our problem and give us a 5 year programme in a 4 year time frame. We do tend to crush things up into about 25 weeks per annum in general and that includes examination time.

John Kelly (UCD)

I am going to query that, if I may Chairman. I thought we are about 26 or 27 weeks with a total of 30 weeks including examination time. We are not that far different from America. In America they don't have a big examination time at the end of year, its continuous examination all through the year.

Gareth Jones (IC)

Could I make a comment about the number of study weeks in the year? In the UK it's probably similar to Ireland, we have 31 weeks, but not all of that is used for teaching. The actual teaching time is more like 27 weeks up to 28. And so it's not so different. I think in most other European countries the teaching weeks in the year are greater than they are in the UK but not by a big factor. Maybe about 10% or something like that. There have recently been various studies of this, certainly there is a Socrates thematic network project in Physics which has made a very careful study of this and in the Tuning Project which is underway now, there have also been investigations made of this. And they do tend to show that the UK, I am not so sure

about Ireland, was almost the lowest in terms of the actual number of teaching weeks or teaching hours in the year. However this comes back to the question of style also.

I think there is a great tendency in many countries to view things very much from the eye of the subject and the eye of the professor, rather than the student. So they do tend to over-lecture, to give too many lectures on a given area, and not allow enough time for private study, for students to really think hard about the question and to devote time to solving problems. One part of the study that I referred to done by this Socrates Network in Physics, looked at how students divide their private study time between different types of activities. How many hours a week do they spend reading books, studying lecture notes, doing problems of different types, a range of different activities. And these investigations were quite revealing and showed that in the UK a lot of this time is spent on problem solving. Whereas in Italy a lot of it is spent on reading books. Now reading books is good for you, I have nothing against that, but it might be even more important to get practice at problem solving. So there are differences in styles which underlay these differences in hours per year. And what worries me at the moment is the people looking naively at how many hours per year students are studying and then saying this is a measure of student work load and a measure of whether they are meeting the right number of ECTS credits to generate a masters double degree. And I am concerned that this is being done in a far too naïve way.

Chairman

Could we just focus for a moment on one of the options in our document, a 3 plus 2 structure. It's probably true to say that it's possible to design a 3 year degree in the general area of engineering/technology, which would mean that the graduate would be employable on the European labour market. There are many of these. There are BTech, 3 year degrees in South Africa, in Australia and in New Zealand. But can that person continue to do another 2 years and get a Masters degree which is a professional engineering qualification or not. Or is there a need for some remedial measures or bridging studies. Has anyone any particular views or comments on that?

Brian Foley (TCD)

I think one of the difficulties I would see with 3 plus 2 is having an incompatibility of goals between the initial 3 year period and the subsequent 2 year period. So if for example your 3 year programme is being primarily directed towards technicians or technician engineers, aimed at a particular segment of the workforce, then you design

your curriculum, your set of courses with that particular objective in mind. If subsequently you are going to tack on to that then a much more academically driven masters degree programme, over the subsequent 2 years, it seems to me that you mightn't really have the appropriate foundations for that subsequent 2 year programme. I think one of the characteristics of the current European model of the 5 year programme, the 5 year reduced to 4 years, is that you always have this particular end goal in mind. What sort of individual do you wish to produce after 4 or 5 years? Your curriculum is developed with that full period in mind and you try to lay the mathematical foundations, the scientific foundations and so on. The fundamental problem about this whole idea of the 3 plus 2 structure with the 3 years leading on to an engineer who is of immediate benefit to a particular segment of the work force and then a masters graduate who is intended to work at a much higher design level, is that there are going to be problems of a very fundamental nature with the whole structure and design of the curriculum. Perhaps the panel might have some views on that.

John Kelly (UCD)

Yes, I was just thinking, if one had to go to this 3 plus 2 arrangement. Again just thinking off the top of my head, and indeed thinking of the example of Trinity College Dublin, and correct me if I am wrong. Would the idea be that the 3 years would be a basic 3 year engineering science degree with Aerodynamics, Material Science, Physics, Chemistry and Maths, at the end of which then the graduates in that could go to Mechanical Engineering, Electrical Engineering or Chemical, for a 2 year engineering type programme on top of that? In Trinity you had something like that, didn't you and it seemed to by all accounts be a very satisfactory programme.

Brian Foley (TCD)

Just to correct you, much of what you say is correct but in fact it's actually a 2 year programme. So the general philosophy of the engineering programme is a 2 plus 2. So there is 2 years common, with the students experiencing foundation material in Electrical, Mechanical, Civil and Computer Engineering and then after 2 years choosing which way to go. I think whatever about having a bachelor degree after 3 years I don't think we will get away with it after 2 years.

John Kelly (UCD)

I wasn't suggesting that you would get it, but that 2 years could be extended to a more in-depth 3 years with more emphasis perhaps on the engineering sciences then you have at the moment. And make it a 3 plus 2. It's just a thought. I am not an advocator of the 3 plus 2.

Brian Foley (TCD)

It would cut across the very foundations of our programme because the idea is that the two years initially is a foundation and you are going to build subsequently on that foundation. And it might well be extremely difficult after 1 year of that particular type of foundation, to achieve a bachelor level degree. It certainly seems to be to be impossible to produce the type of graduate that would be of the more applied nature.

Martin Mannion (CIT)

Looking at the 3 plus 2, I think industry would appear to have a different concept, if I was taking Professor Jacob's slides correctly earlier. They talked about a lot of applied material in the BEng element. And then doing theoretical material. That would seem to be like an inverted pyramid type of thing. It would seem much more logical to do the fundamentals first, if we were going to go for a 3 plus 2. A question, probably to Denis in some ways, who is actually driving the 3 plus 2. Is it industry putting pressure on the politicians or where is it coming from?

Chairman

I can't answer that but I would have views, but I couldn't answer it properly. I think Professor Jacob or Gareth Jones might have a comment to make on it. Who is driving the 3 plus 2?

Gareth Jones (IC)

In the UK nobody is driving it, they have not yet appreciated that it's an issue. The people who I think are driving it are mostly in other European countries and they are politicians and they are people from industry. I think industry does want to get a system which at least has the potential to produce graduates after 3 years who are quite well trained in the theoretical side as well as the practical side. And so I think that would be the driving force. Now whether in the UK there is a driving force because politicians want to go back to a 3 year basic degree, which is cheaper, I am not sure. I think there is a likelihood that politicians in several countries are

concerned to at least restrict the rising costs of education, given that they also have at the same time ambitions to increase the proportion of students going to university. So I think that might be part of the reasons why they want to push a 3 plus 2, so that more students go to university but don't cost so much.

Chairman

Could I just ask Arne when he is answering that question, I understand that the number of students applying to do the new 3 year bachelor degrees in Germany increased over the number who were, prior to that, applying to do the previous Diploma programmes, is that correct?

Arne Jacob (UB)

I don't know the numbers for these 3 plus 2 programmes. But I want just to confirm what Gareth said, that the driving forces behind 3 plus 2 are politicians, European politicians and industry. About the more applied and theoretical orientations, I think industry wants to have applied engineers doing short programmes. But they also need engineers with a stronger theoretical background and that is the different career path, or also a university programme. And it follows a different track. It means that if you want to go towards the more theoretical degree then you have to start differently with a more thorough scientific base. And I think this is a matter of choice actually, and Gareth's diagram showed exactly where the problem is. You can be more or less vertical on this plane, theory versus more applied branch. And what I hear from this discussion is that, well you said it this morning, that the United Kingdom is somewhere in-between these two tracks that we follow in Germany. And this is a matter of choice. For instance if a student in Germany wants to follow a more applied track well that is up to him. And if later on he notices that well actually he would like to have a more in-depth theoretical formation well then he has to pay for it. It's as simple as that. He has to follow a programme that allows him to learn what he didn't learn right from the beginning, which I think is okay. It's good if the university offers this possibility and that is what I showed on one of my graphs, where you had these complementary programmes that are being installed now at some universities. What do they offer, in fact mathematics, theoretical foundations and a lot of this. And I will tell you an experience I had once.

A student came to me in a 5th semester lecture on Transmission Line Theory and he said, I have got a diploma from a Fachhochschule and he had excellent marks. And he said I have already done all this business with Transmission Line Theory, could you just recognise this mark. And I said okay, well come to my office and we will have a discussion and after that I will tell you if I will recognise it or not. And believe me or not, the result was devastating, he barely would have passed the exam. So I told him listen it's better that you take the written exam like every other student as well. The result of this written exam for this student confirmed what I noticed before. So now I am very cautious looking at this transition from one path to the other. Which does not mean that I do not recognise the other one, I think it's a very, very valuable professional formation and these engineers are needed and are highly appreciated. But simply they have a different formation from what we teach at the university and you simply cannot mix things up. That is it really.

John Fitzpatrick (TCD)

I have some experience with what is currently going on in Italy, and I think that there is a university both in Naples, two in Rome and the Polytechnic in Torino which are simply continuing the 5 year courses that they have always taught and the students have an option to graduate after 3 years. I don't know how precisely they are going to deal with that. I think the problem mentioned by Brian Foley has been addressed and Denis can correct me if I am wrong, by the Polytechnic in Milano which streams students after one year. The students come in and after one year they select students to go on a 3 year track or a 5 year track and this seems to be, I think the answer. Again I would agree that the politicians and industry have put pressure on Italian universities and their attitude has been to shrug their shoulders and say if you want people after 3 years then you can have them.

Chairman

I think I can feel the discussion coming to a natural conclusion.

John Kelly (UCD)

Can I comment on this emphasis on meeting the needs of the labour market? And this has been highlighted in many of the presentations by other people. I still have an old fashioned idea that we are in the business of education, not training people for the labour market. We did a study of the engineers in my department some years ago and found out that after 5 years only 40% of our graduates were actually working as engineers. We have them all over the place, in everything you can imagine. So I just raise that issue that maybe it's not a concern of everybody. I think the universities would suffer and indeed engineering education would suffer if we concentrated on meeting the immediate needs of the labour market.

Chairman

Any final questions?

Pat McLaughlin (ITT)

I think there is a danger that we might adopt a sneering sort of approach to the politicians and employers. The last time I checked, most of the universities and the ITs in Ireland were public institutions. We are responsible and we need to respond to the needs of society as often enunciated by politicians. Industry employs our students and again it pays our wages. We are public servants. Don't forget the import of that particular position. We can listen and debate, but I think there are occasions whereby we have got to take on board legitimate concerns and requests from society and indeed employers who ultimately pay the wages. I think if you look at the sort of approach we have had in the past, there is nothing wrong with being close to the labour market. I think there is potential for the IT sector to make an awful lot of hay with the Bologna type of approach particularly when if you look at some of the developing economies whereby they have produced a lot of theoretical engineers but they don't have the middle ground of technicians available to them. I think there is a lot of work that the IT sector in Ireland could do to respond to that global demand for technicians, be that through a Bologna BEng or any other sort of intervention. But I think at the end of the day a question asked by Martin Mannion, do you need Honours Maths to study engineering, the answer is no. You need Honours Maths to get into most engineering courses in universities, that is a different thing.

Chairman

I don't think we will open that up Pat.

Pat McLaughlin (ITT)

I am just making the point because it was left hanging. I think coming back to Brian Foley's point. I fully take the point that you have got to look at the outputs in terms of how you are trying to address the objectives in relation to the outputs of your course. But I think taking John Fitzpatrick's point and the example he gave about Milan, it's down to very astute curriculum design whereby you may be able to give a student who is coming through the 3 year programme electives that would orient them either towards an applied programme immediately relevant to the labour market or for entry on to a more theoretical second cycle programme.

Pat Frawley (UL)

A colleague of mine from Trinity pointed out earlier that they found it very difficult to bring additional material into the 4 years graduate BEng degrees and we would find exactly the same thing. Our course is jam packed to the top, full of subject material that the BEng's need. The politicians are telling us that we should put it into 3 years. They are not in a position to say that. Okay, I take John Fitzpatrick's comment that if industry will accept those people then that is what we will give them. But we as engineers, as educators, should say to them, it's not a good idea.

Arne Jacob (UB)

John, I don't know if I got your point right, you said you are not really concerned by the labour market.

John Kelly (UCD)

No, I didn't say that, we are doing a disservice to society if we are led by the market place. We should lead. That is the role of a university to society. We are talking about philosophy, arts, the social sciences, not only engineering. I am talking about the Bologna process in the wider higher educational scene. It should not be dictated by the labour market.

Arne Jacob (UB)

I consider myself part of the labour market because some of the students are employed by myself when they are really good and so I strive for good education and, of course, also looking at the labour market I think I have to satisfy my customers because this makes my reputation. I think it's something that has to go hand in hand.

John O'Shea (CIT)

I am a bit worried about the use of the terms lead and being led. I think really it's a partnership. Okay, on the one hand we don't want to get involved in the business of trying to produce a toolbox of skills when in fact what we should be teaching them is how to use it and think about it and how to develop and validate. All that sort of stuff. And move up and above and beyond it. But by the same token you obviously do need to recognise the need to share our views on how things go forward. And I think partnership needs to be the focus rather than worrying unduly about who leads and who doesn't.

Chairman

I think we will draw it to a close now. What will happen now is that we will produce proceedings of this conference. We will put them on the IEI web site. The delightful colloquialisms and other little comments that were made during the discussion will be judiciously edited out, so you need fear nothing!

John Kelly (UCD)

I am reminded by the speaker here before John, about an event back in 1967, in University College Galway, when the then Minister for Education, Donagh O'Malley, appeared at the conferring ceremony and in his address suggested to the assembled multitude, that he felt their 4 year degree should be reduced to a 3 year degree structure. And the President of the university at the time, Martin Newell, spoke up and said "That is an extraordinary recommendation Minister considering you took 5 years to do the 4 year degree course!"

Chairman

Just to continue we will do the proceedings and put them up on the web site within a few weeks and there will be a report on this going to our Accreditation Board and on other issues that are emerging. I know that some institutes of technology and some universities are actively pursuing this even though they are not saying that in public. There are things going on and we will have to consider what the next step is in progressing dialogue on this matter. But you will all be hearing from us at that time. On that note, could I finally just ask you to thank our speakers from this morning. Their contributions added greatly to our understanding of the Bologna Declaration, thank you all very much for coming along. This is the conclusion of the conference.

THE BOLOGNA DECLARATION AND ENGINEERING EDUCATION IN IRELAND

TUESDAY 20TH NOVEMBER 2001

DELEGATES

Names:	Institute:
Ambikairajah, E.	Athlone Institute of Technology
Bruce, Christopher J	Dublin Institute of Technology
Burton, Martha	Institute of Technology, Tallaght
Byrne, Don	Dublin Institute of Technology
Charter, Frank	Institute of Technology, Sligo
Coman, Pat	Institute of Technology, Tallaght
Convery, Catherine	University College Dublin
Costelloe, Liam	Institute of Technology, Tallaght
Costello, Colm	Institute of Technology, Tallaght
Cox, Joseph P.	HETAC
Creed, Michael	University College Cork
Devaney, Theo	Arup Consulting Engineers
Doyle, John	Institute of Technology, Carlow
Fanning, Paul	University College Dublin
Farrell, Gerard	Dublin Institute of Technology
Fisher, Jonathan	Dublin Institute of Technology
Fitzpatrick, John	Trinity College Dublin
Foley, Brian	Trinity College Dublin
Frawley, Patrick	University of Limerick
Galbraith, Ross	Dublin Institute of Technology
Garvie, Stuart	Dublin Institute of Technology
Gough, Hugh	University College Dublin
Hanley, Jim	Institute of Technology, Sligo
Higgins, Michael J	University College Cork
Hillery, Michael	University of Limerick
Kyne, Maria	Limerick Institute of Technology
Lynch, Kevin	Tralee Institute of Technology

Name:	Institute:
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Madden, Michael	National University of Ireland, Galway
Maguire, Bryan	National Qualifications Authority of Ireland
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McCorkell, Charles	Dublin City University
McCormack, Brendan	Institute of Technology, Sligo
Monaghan, John	Trinity College Dublin
Moran, P.J.	Athlone Institute of Technology
Murphy, John	Tralee Institute of Technology
Murray, Darina	Trinity College Dublin
Niven, Andrew	University of Limerick
O'Brian, Terence	Institute of Technology, Tallaght
O'Donoghue, Padraic	National University of Ireland, Galway
O'Flynn, Paddy	Irish Federation of University Teachers
O'Kelly, Kevin	Trinity College Dublin
O'Shea, John	Cork Institute of Technology
O'Somachain, Ciaran	Letterkenny Institute of Technology
Rogers, Martin	Dublin Institute of Technology
Russell, Matt	Formerly Dublin Institute of Technology
Ryan, Kevin	University of Limerick
Simpson, Robert	Dublin Institute of Technology
Sliney, Paul	Cork Institute of Technology
Stockil, Gerard	Institute of Technology, Tallaght
Taggart, Gertie	Athlone Institute of Technology
Vickery, John	Institute of Technology, Tallaght
White, Thomas	Galway-Mayo Institute of Technology
Wright, James	Institute of Technology, Tallaght