Civil/Structural Engineering Education in the Faculty for the Built Environment – looking ahead

1 author:

Alex Torpiano
University of Malta
12 PUBLICATIONS **12** CITATIONS

SEE PROFILE

Civil/Structural Engineering Education in the Faculty for the Built Environment – looking ahead.

Prof. Alex Torpiano
University of Malta, Malta

ABSTRACT: The Faculty for the Built Environment of the University of Malta is currently changing its civil/structural engineering degree programmes. This paper explores the background, in the context of the history of the professions of architects and civil engineers in Malta, and of recent developments in the teaching of civil and structural engineering in the University. The paper explains the rationale behind the proposed changes, and outlines the new course structure which has been launched to replace the current integrated five-year bachelor level degree courses. Professional status of aspiring civil/structural engineers will eventually be achieved after the successful completion of a two-year professional masters course in engineering, (Civil and Structural Engineering), and a subsequent year of professional experience, (required by current national legislation). For admission to this second tier masters programme, candidates will have to successfully complete a three-year bachelor degree programme, and the preceding preparatory "design foundation studies" diploma year.

1 BACKGROUND

1.1 *Introduction*

The Faculty for the Built Environment, at the University of Malta, is at a critical stage of its development, both in terms of its institutional structures, as well of the teaching and research programmes within its remit. This paper is intended to outline the proposals under current discussion, and to explain their rationale. The current proposals are being made in the context of a wide range of issues, from the traditional professional and legislative framework within which the profession has operated in Malta over the last century, to the requirements of the Bologna process to which the University of Malta fully subscribes, to the issues arising from Malta's membership in the European Union, and, not least, to the future developments in the civil engineering industry, that can be discerned for Malta, as well as for Europe.

1.2 *The profession and the legislative framework*

It is reasonable to consider the profession of civil engineering, as distinct from both the profession of architect, and of the military engineer, as born out of the socio-economic necessities of the late 18th, and early 19th, century in Great Britain and France. Before this period, the history of building, in most of the world, makes no distinction between the builder, the architect, and the engineer. The master-builder is the term that is often used, in parallel with the term "architect" – which is itself derived from the Greek term arkhi-tekton, or chief-builder – to explain the combined role of the person responsible for the conceiving, *and* direction and supervision of the construction of buildings and structures. The tradition in Malta is not any different, and, at least

from the 16th century, the terms "mastru" (master), "mghallem" and "perit" (both meaning knowledgeable or expert, the former of semitic, and the latter of latin, origin) were interchangeably used to indicate this particular role in construction.

The governance of the islands of Malta passed to the British Crown, effectively in 1800, and formally in 1814, that is, only a few years before the formal inauguration, in 1818, of the Institution of Civil Engineers of Great Britain. The official, italian, term of "Perito" (loosely translated into English as "architect", but representing more a sort of hybrid architect-engineer), or, alternatively "Perito Agrimensore" (Architect and Land Surveyor), or "Perito Apprezzatore" (Architect and Valuer), was retained by the new colonial administration, although, increasingly, major architectural, and especially engineering, projects were entrusted to, or, at least, overseen by, visiting English architects, and, particularly, engineers, often attached to the military, (Zammit, 2009). In the first decades of the new administration, "periti" (at that time, by statute limited in number!) were gradually appointed to oversee road construction and maintenance, urban and rural property, wharves, land surveying, and, eventually, "Works and Repairs", (or of "Civil Artificers"), (Zammit, 2009). The first Ordinance regulating the profession of, and award of "warrant" for, "Architect and Civil Engineer" was promulgated in 1919, and the self-regulating Chamber of Architects and Civil Engineers, (a form of local chartered institution) was, consequently, set up in 1920.

The introduction of this term suggested, at least to those familiar with the professional organisations in Great Britain, a combination of two distinct professions; however, the local term "perit", whose use was retained, more properly described the integrated remit of this profession. The profession of architect and civil engineer was entrusted not only with the traditional tasks of designing and supervising buildings, with land surveying and with valuing land and built property, but also with the new tasks related to the construction of roads, the construction of water extraction and distribution systems, the design and construction of sewage disposal systems, and even, initially, to the supervision and commissioning of the first electric power installations. This Ordinance, and the profession it regulated, remained in place, practically unchanged, up to 2000, when, with an eye on accession to the European Union, it was replaced by the Periti Act. The main relevant changes in this new legislation were the revision of the academic training requirements that qualified a candidate for the award of the "warrant" – introducing concepts derived from the EU General Professions Directive (89/48/EEC, 1989) – and the recovery of the appellation "perit", in preference of the "hybrid" title used hitherto.

The new legislation had a liberating effect on academic programmes in the University of Malta, not least because it was now possible for the University to start to offer alternative study programmes, which would still lead to professional status – something that had not been possible before, and which had stymied a number of previous attempts at change. The legislation also allowed a better alignment with developments in Europe, namely the separate professional recognition structures for "architects" and for "engineers", whilst respecting local needs and traditions. Further developments in the legislation are expected to continue the process in the near future, with the creation of "specialist" registers within the general registration of "periti".

1.3 *The University, and training for the profession*

The formal training of candidates for the profession mirrored, to a certain extent, the legislative developments described above. Formal training in the subjects considered important for the practice of architecture and land surveying, such as drawing, geometry, mensuration, surveying and valuations, (in contrast to apprentice schemes), was probably organized as early as the 1800s, (Zammit, 2009). In 1905, a School of Architecture was established under the science branch of the Faculty of Literature and Science, in the Royal University of Malta. By 1915, the course of studies in Engineering and Architecture was established as an independent Faculty. In 1934, the Faculty was divided into three Departments, that of Architecture, of Civil Engineering, and of Municipal Engineering.

In the late 1950's, a new academic institution, the Malta College of Arts, Science and Technology, was set up, and this set the trend for the separation of civil engineering studies from architecture studies, following the anglo-saxon model. The first courses, leading to distinct Bachelor of Science degrees in Civil Engineering, were offered by the new College in the mid 1960's. This academic development did not find favour with the government of the day, and ran into problems because of the 1919 Ordinance referred to above. In 1972, there was a political decision to revert to an integrated degree course, of five-year duration, leading to the degree of Bachelor in Engineering and Architecture. Other events occurred at institutional level, until the Faculty of Architecture and Civil Engineering was re-established as an independent Faculty in the late 1980's, with two Departments, the Department of Architecture and Urban Design, and the Department of Building and Civil Engineering.

As part of the current institutional re-structuring, in February 2009, the Faculty changed its name to that of the Faculty for the Built Environment, now comprising three Departments, that of Architecture and Urban Design, of Civil and Structural Engineering, and of the Built Heritage – but with four additional units set up with a view to becoming full Departments in the near future, namely Spatial Planning and Infrastructure, Construction and Management, Environmental Design, and Visual Arts. At least three of these departments/units are of relevance within the context of the teaching of civil engineering disciplines.

1.4 *The course programmes*

As has been highlighted above, in the 1960's, formal bachelor degree courses, in civil engineering, were offered for the first time, whilst, at the same time, the training programme for architects was organized into a two-tier (3+2) five year course leading to a Bachelors degree in Architecture. This followed, more or less, the anglo-saxon model for the separate training of architects and civil engineers. However, the change in academic programmes was not accompanied by parallel changes in the legislation regulating the profession/professions; nor was industry really convinced that the complete separation, of the two main "branches" of the construction professions, was necessarily a good thing.

In 1972, the University reverted to an integrated, five-year, course structure leading to the award of Bachelor of Engineering and Architecture. This was deemed to be more appropriate to the local needs of the industry; indeed, if one looked closely at the course curricula offered, one would find a very close similarity to the course curricula found in many Central European Universities, offered for the training of architects. In 1988, when the Faculty was re-established, the five-year course structure was extensively reviewed. In order to respond to the ever-widening range of disciplines that could be considered as relevant to the profession, the Faculty introduced the concept of streamed courses of study. The five-year course was divided into two parts, with the three-year Part 1 retained as practically mandatory for all students, whilst the two-year Part 2 was organized into Streams of Study, leading, however, to the common degree of Bachelor of Engineering and Architecture. At the outset, four different Streams of Study were offered, in Architectural Design, in Urban Design, in Infrastructural Engineering, and in Structural Engineering. Eventually, the Infrastructural and Structural Engineering Streams of study were merged into one.

Since the University of Malta is, to-date, the only university on the islands, it has traditionally sought validation of its degree courses by an extensive system of external examiners, generally coming from UK universities. The courses outlined above are not any different, and every engineering stream graduating course has been validated by such an external examiner. This has enabled the better of the graduates to continue post-graduate engineering studies, normally in the UK. It is worth noting that the five-year course of studies, which included the Engineering Streams, was evaluated by FEANI, soon after the streaming system was launched, and included in the FEANI Index as a validated engineering course.

In addition to the mainstream Bachelors degree courses, the Faculty has, in the past, also offered masters degree courses in, say, road design and construction, in direct response to particular needs identified by industry.

2 WHY CHANGE?

2.1 *The Bologna Process*

The University of Malta is a signatory to the Bologna Declaration, which envisages the adoption of a system of degree courses, which is common to all European Universities (or at least to the signatory Universities). It envisages the adoption of course structures based on three cycles, one building on the previous one. The objective of each level is to better prepare the student for the labour market – a market which is increasingly trans-European - in as flexible a way as possible, and also to build further professional competence in a systematic way. The three tiers envisaged are the Bachelors, the Masters and the Doctoral levels – 180/240 ECTS credits are envisaged for the Bachelors degree (generally three to four years duration), and 90/120 for the Masters degree, (one and a half to two years duration). The first tier degree is not envisaged to be shorter than three years; it is envisaged to be based on credits, so as to be more flexible, more multi-disciplinary, more international, and more relevant to the labour market. First degree courses are required to be meaningful.

In the author's view, the Bologna process has been adopted by the University for two very important reasons. The first reason is the facilitation of mobility – in other words, the possibility exists that a candidate can follow part of his studies in one University, and part in another University – something that might be normal and straightforward for many countries with more than one University, but which, for a place like Malta, is a beneficial target. The advantages of this mobility are innumerable; suffice it to mention the enhanced experiences of our students, the reduction of insularity, the dilution of nationalism, the opening of a wider range of opportunities.

The second reason has to do with the fact that five years is a long period of study, and it is not inconceivable for a student to wish to change direction, after, say, three years, without losing all credit for the time spent at University up to then.

The five-year Bachelors degree hitherto offered by the Faculty is, therefore, unfair to students in that it offers only a first tier qualification to what is effectively a 300 ECTS course. It also does not offer any exit routes, before successful completion of the whole five years. It has to be pointed out that this situation was also the case for the other professional degree courses, particularly those for the profession of lawyer and of medical doctor – with the difference that, traditionally, in the University of Malta, successful students in these five-year degree courses would end with the titles doctor of laws and doctor of medicine, respectively. This made the situation even more unfair for our students.

2.2 *The Architect-Engineer Dilemma*

It is neither possible nor desirable to ignore tradition, especially one that has been at the centre of the local construction industry, and profession, for centuries. The "tension" between training for architects and that for engineers has been difficult to understand, and to address, in Malta; and yet, presumably influenced by trends in the UK, and in Europe, there are many who feel that the local profession has to move in the direction of a greater degree of separation. It remains, however, difficult to understand why the separation between architects, and their training, and engineers and their training, is, in some countries (especially those influenced by the anglo-saxon model), even more distinct than the separation between completely disparate disciplines of engineering. Institutional structures in the UK seem to find it easier to group civil

engineers with naval architects and computer engineers, than with architects – this must certainly be seen as "strange", considering that, up to the 19th century, this distinction did not exist.

The situation on continental Europe is perhaps not so deeply polarized – look at the tradition of prominent architect-engineers in Spain, Italy, France and Germany. Nevertheless, in most of Europe, training processes for architects and for engineers are often very different. This is partially the result of the influence of the anglo-saxon models, and partially the result of the particular history of the EU Directives aimed at harmonizing professional qualifications. In fact, the profession of "architect" was one of the few, initial, "sectoral" professions that was harmonized via a specific Directive (85/384/EEC, 1985) in 1985. The recognition of *all* the engineering disciplines, without distinction, was harmonized by a more general Directive (89/48/EEC, 1989). This distinction remains even today, when the two systems of recognition of professional qualifications have been combined into one Directive, (2005/36/EC, 2005).

Indeed, the author would argue that, were it not for a number of historical quirks, this distinct separation should, today, appear incongruous. In the 15th century, Leon Battista Alberti defined the architect as the person who could devise and execute works, using the available technology (pulleys and levers), which could be "adapted to the uses of mankind" ("with the greatest beauty"!). This is not a million miles away from the 1828 definition of the profession of the civil engineer, as published in the first charter of the Institution of Civil Engineers – "the art of directing the great sources of power in nature, for the use and convenience of man". Closer to our times, in 1971, Jean Prouve' has argued: "Architect? Engineer? Why raise the question, why debate it? The important thing is to build. Why cannot the builders of aeroplanes, or dams etc., be called architects? It immediately makes one realise that the architect has to be an engineer, otherwise there is no defensible idea. My opinion is precisely this; that the question should not arise in the first place." The late Prof.E. Happold has strongly argued against the perception that architectural training, as contrasted to engineering training, requires the development of creativity skills – as if engineering did not. In fact, he has written: "these days, only people with an arts training are said to be creative. But if truth be told, it is technology that is creative, because it gives us these new opportunities. Historic ideas of art and culture can entrap. It is technology that frees the scene". (E.Happold, A Personal Perception of Engineering, 1987) Finally, the renowned Italian architect, Paolo Portoghesi, has recently written that for the "architect" to survive, he probably had to change into a technologist ("tecnico") of environmental quality – and only later into a poet, and only if and when he had the necessary qualities.

The author would finally argue, making reference to the theme of this conference, and to the words of the ECCE President, Gorazd Humar, that as issues of sustainability, of environmental quality, of energy efficiency, and of life cycle processes, become more and more important for the quality of life of humanity, and hence for the construction and infrastructural support industries, the closeness between architecture and civil engineering, and the degree of overlap, is bound to increase, and not decrease.

On the other hand, the range of disciplines that are nowadays important, or relevant, to the construction/building/infrastructure industry is much wider than it has ever been, and goes beyond the architect – engineer divide. This is probably a much more difficult problem to resolve. In a recent paper, a proposal was outlined to add the following subjects to courses in civil engineering, in order to "green" the engineering curriculum, namely "ethics in civil engineering, human resources in civil engineering, biological indicators of water quality, land reclamation and ecology, nature conservation and river engineering, biological indicators of air quality, waste disposal and management, habitat creation, landscaping of roads landscaping of industrial developments, three-dimensional design in urban building, social planning and community architecture, justification and accountability in construction activity, public enquiries, noise and visual intrusion from traffic, environmental impact assessment". Which subjects should be part of the engineering curriculum, and which, consequently, have to be taken out? How does one reconcile the need for greater knowledge in depth, in a greater number of sub-disciplines, with

the increased need for a better overall, holistic, understanding of the complexities of today's industry?

2.3 *SWOT Analysis*

In view of the particular professional and educational traditions in Malta, and mindful of the issues raised above, the author carried out a SWOT analysis of the current course structures, at the beginning of the Faculty review process. It was concluded that the potential benefits of the traditional "closeness" of "architects" and "civil engineers" could, paradoxically, only be fulfilled if greater flexibility, variety and choice were allowed to students. The rigidity of the current system made it very difficult for new disciplines, or new approaches to traditional disciplines, to be taken on board, in response to obvious contemporary needs. This could already be read from the skills gaps, in some disciplines, that the industry was reporting, and which gaps could only increase, in the future, unless properly addressed.

On the other hand, the possibility of developing a common grammar, or a common language, between the different branches of the profession, was deemed an important characteristic, on the basis of which students would not only make more informed career decisions, and choices, but could also carry with them the ability to discourse with the wide range of "specialists" that are necessary today. It was certainly deemed necessary to move away from an integrated five-year course structure to a multi-tiered one – and not only to satisfy the Bologna process – as well as to align the title of the degrees awarded, more properly to current European standards. The opportunity was perceived to further develop the system of Streams of Study, so as to create a "tree-like" study route structure – with the main branches of training for architecture, civil engineering, and spatial planning emerging from a common "trunk", with, in addition, the possibility of cross-linking across disciplines to create variety and choice, within reasonable resources.

Is this model possible? Is there any precedent?

In 1981, the Committee of Ministers of the Council of Europe prepared outline recommendations on the specialized training of architects, town planners, civil engineers and landscape designers (Council of Europe, 1980). The Committee proposed that a common core should be established for university studies in the four disciplines directly concerned by integrated conservation, without prejudice to the specific character of studies in each discipline, so as:

- to make clear that any action involving one of those disciplines is but partial and belongs to a general pattern;
- to foster the adoption of a common language for the various participants, in order to create an atmosphere of inter-disciplinarity and clarity, which is often lacking at present.

It was further proposed that the following educational objectives should be defined:

- stimulating thought, and hence inculcating a new philosophy of the environment, with particular reference to the architectural and natural heritages, including social aspects;
- creating understanding of, and respect for, the various scientific disciplines relating to the environment, and to their importance as a framework for living conditions;
- preparing for co-operation, notably by means of joint exercises throughout the training period.

The recommendations clearly reflect the concern with the quality of the environment, and the preservation of heritage as well as natural resources, a concern that emerged in the 1980s, but which is today widely acknowledged as of over-riding importance. It is not clear whether any such courses were, in fact, developed anywhere. However, the recommendations read as very close to the objectives that the Faculty has set itself.

3 THE PROPOSED STRUCTURE

3.1 *General Overview*

The system, that is being developed to address the issues raised in the previous section, is a 1+3+2 multi-tier system, which culminates in professional masters degrees. A six-year academic programme to achieve professional status may be perceived as an inordinately long time, particularly when compared to typical UK engineering degree programmes (although probably not to systems in Central European schools). However, this has to be considered in the context of the current five-year programme leading to a bachelors degree, which would normally be followed, for the better students, by at least a further year of studies, abroad, to achieve masters status. In addition, achieving professional status currently envisages a one-year practical experience after academic qualification – in other countries, shorter academic programmes normally need two or three years practical experience, before admittance to professional status.

The first year of this multi-tier system, which leads to a Diploma in Design Foundation Studies, is an innovative feature, certainly for anybody aspiring to follow a conventional engineering career. This first year is a mandatory requirement for anybody wishing to follow professional degrees in architecture, civil/structural engineering, and even planning. It is also offered as a preparatory year to other "design-centred" degree programmes, including printed and digital media, computer graphics, and, eventually, industrial design. The objective of this year is to allow students to develop visual literacy and visual communication skills, (as well as communication skills in general), including drawing, colour appreciation, photography, relevant IT skills, and creativity/thinking skills.

It is probably more difficult to explain the relevance of this type of preparation to engineers than it is to architects. The length of this paper limits full consideration of this point. However, this approach to engineering design is not without precedent, albeit not universal acceptance. The underlying philosophy is that the professions operating in the built environment can generally be defined as "design-oriented", in the sense that, para-phrasing Prof.E Happold's words, in all of them, there is the desire to decide "what you are going to make before you make it", and that this requires the engineer (professional) to have a "knowledge of science and scientific method…, knowledge of construction materials and methods … and *imagination*. (E.Happold, Design and the Profession, 1983). Happold takes this concept further, by sub-dividing design, (after Vicenti), into normal design and radical design – radical design requiring the same knowledge as normal design, (or technician technology), but with, in addition, *originality and invention*, (E.Happold, The nature of structural engineering, 1992). The theme is taken up by other prominent engineers. In the introduction to his Gold Medal Address, I. Liddell decries how, when young children are asked to take decisions about their future careers, they are offered the choices of either science or arts subjects – often to mutual exclusion of the two (W.I.Liddell, 2000) – he goes on " Engineering is the creative end of science. To take it up, one has to do maths and physics, but the art side is usually ignored or played down". Similar comments have been made by others, (T.M.Crisp, 2003). The author finds this arts-vs-science attitude even in staff members of our Faculty, in spite of the theoretically favourable pre-disposition which the local traditions should engender.

3.2 *First Tier Degree Programmes*

The first-tier degre, which launches the programme of academic preparation proper, is the three-year Bachelors degree, conceived as a series of six semesters, based not only on formal lecture courses, offering knowledge of materials, construction processes, building technologies and the relevant sciences, as well as of laboratory methods and numerical processes, but also a sequence of "design" exercises to develop the ability to synthesize this knowledge, and workshops to foster creativity and presentation skills. The emphasis of the B.Sc. course is, first of all, to offer as much choice to students as resources allow, and, secondly, to require the least number of man-

datory study-units possible – in stark contrast to the situation in the current first three years; this will allow as late as possible a decision about which particular discipline a candidate wishes to eventually follow – addressing the reality that it is generally very difficult for these aspiring professionals to make such decisions before they have found out a bit more of what the respective directions entail. This will also allow for the possibility that candidates stop after three years, and possibly take completely different routes, such as Law, or Business, combinations that are becoming increasingly relevant to a more complex building/construction industry.

The development of the study-unit programmes is informed by the need to emphasize the "commonality of interest, knowledge and method" (E.Happold, Design and the Profession, 1983), whilst also making it easier to diversify, to increase the range of possible permutations, and to introduce new disciplines, in response to the changing needs of the industry, (for example, the increased relevance of energy-efficiency, resource-efficiency, and sustainability issues, (E.Happold, Directions and opportunities, 1990). For the prospective engineers, it will offer the possibility of relevant liberal studies, such as history, or ancillary subjects such as material chemistry or management. Most of all, the "commonality" of the programmes will allow the aspiring professionals to learn each other's language and concerns, thus preparing the ground to higher degree of true multi-disciplinary practice – in professional life. Whereas there are an increasing number of masters level courses offering multi-disciplinary training at post-graduate level, even in the UK, acknowledging the need for a greater flexibility in the organization of the built environment professionals, and for better communication across the divide, the proposed course offers the possibility of "multi-disciplinarity" at the beginning of the formation process, leaving the necessary professional "specialization" to the latter stages – a process that should be acknowledged to be, according to the author, a more rational approach, once conventional constructs of rival professions are put aside.

The choice of study-units followed, organized as they are into the broad respective disciplines, will not be completely random and arbitrary, but will be increasingly guided towards the requirements of the second tier professional degree that the students will eventually choose to read - at about the mid-point of the three-year process, it is envisaged.

One of the criticisms often leveled at the Bologna Process by professional associations is that, by prescribing a multi-tier academic process, instead of integrated courses (i.e. five-year courses, as currently in Malta, and, up to some time ago, in many European countries), problems will arise with the aspirations of those students who only complete the first tier level of studies. The proposed course structure will offer a degree at the end of the first tier process that will *not* in itself qualify the graduand to professional status. It will allow, however, access to a wider range of possible professional careers within the building/construction industry, but also to other careers outside the industry. The first tier degree will also impart skills which, for the candidate who declines to continue down the full professional route, would be useful for employment at technician level.

3.3 *Second Tier Degree Programmes*

At this stage, it is envisaged that the Faculty will offer one main "engineering" masters degree programme, in Civil and Structural Engineering, addressing structural analysis and design, in the conventional materials, (concrete, steel and masonry, as relevant locally), and geo-technical issues. The programme will include lectures, laboratory sessions, (including an introduction to the world of research), and practical, studio-based, design workshops, where design is understood in the widest possible meaning, and not only calculation and detailing, but encompassing other issues relevant today, such as energy-efficiency, sustainable construction, interaction with services, and, why not, visual appearance.

In addition, however, it is nowadays clear that, in order to address those disciplines which, although conventionally grouped under the overall umbrella of "civil engineering", relate particularly to infrastructural systems, it is appropriate to offer these subjects in conjunction with subjects which relate to spatial planning, acknowledging, in this way, the inter-relationship, often ignored – at least locally – between, say urban road systems, solid and water waste treatment, and water and mineral resources on one side, and urban and regional planning development. This is particularly relevant for Malta, but also, it is felt, for other countries. It is intended, therefore, to offer masters level degree courses which bridge over the traditional academic subdivisions. The first priority would be a masters degree in Spatial Planning and Infrastructure, focusing on sustainable planning and development, and infrastructural issues of relevance to Malta, including urban and spatial planning, landscape planning, transport planning, water and mineral resources, solid and liquid waste management, geographic information systems applied to spatial planning, related public policies and EU legislation, and environmental impact assessments.

A 2001 South African Government paper on land-use management was prefaced by the words: Land is an Asset; Land is Scarce; Land is Fragile (Ministry of Agriculture and Land Affairs, 2001). The words are more than appropriate for an island-state, such as Malta, with one of the highest densities of population in the world. The land-use management situation in Malta has not been helped by the fact that formal planning in Malta is still a relatively young discipline, and that Malta has, particularly in recent history, lurched from one planning system to another, without much success. Spatial planning provides an interdisciplinary platform for mapping land-use management policies, for devising infrastructural systems, and for the moulding of the "built" environment in general. The nationally critical issues of accessibility, (both road and harbour infrastructures), of waste management, of water resources, (including sewage), and of resource husbanding, have to be addressed within this programme, within an overall land-use management system. The programme will also address the ever-growing range of EU policies and legislation, relevant to the environment industry, so as to be able to advise the legislator on the best approaches to adopt for Malta and Gozo.

Additional "hybrid" approaches will be developed, to widen the horizons of our future engineers towards environmental design, towards construction management, towards architecture, and towards heritage conservation studies (the conservation engineer), for example, by offering specialization masters programmes, with judicious grouping of study-units.

4 CONCLUSIONS

The theme of this Conference is that of the contribution of civil engineering to sustainable development and the built environment. This paper addresses the changes that the Faculty for the Built Environment is making to the degree course structure, which has been offered for many decades. These changes start from a professional reality, in Malta, which is not necessarily the norm in the anglo-saxon world, in spite of the many strong traditional links between the University of Malta and UK universities, but which is not necessarily unique in Europe. The changes have however become necessary in order to respond to different, and evolving, realities in Malta, and in Europe – which is, increasingly, an important market for our graduates – and also to over-riding policy directions, such as the Bologna Process. The Faculty has embraced the Bologna Process as an opportunity to create structures to enhance the relevance of civil engineering disciplines, within academic processes, but, especially, as a modern profession.

In addition to enabling civil engineers to reach out, from within traditional boundaries, to better support sustainable building/infrastructural development, these changes are seen as a way to make the profession itself more sustainable. Reference to the 1828 definition of the profession has already been made; this definition has been widened, in recent years, to include "the care and consideration of the environment". However, the profession itself, with some notable exceptions, has not yet taken a more central role in this debate.

Engineering is a dynamic and creative profession; we are not “just” the structural/civil engineers! We are designers, in the sense that we participate in the formation of our built environment. We bring our skills, and knowledge of science, materials, construction processes, and structure, to help “make what society decides it should make”. We should, however, also be present in the decisions about *what* society should make; and, in order for us to do this, we should ensure that our training/education processes are more flexible, more responsive and more diversified, so that our young engineers are better qualified to take part in the wider debate, and take greater responsibility for their role.

5 REFERENCES

2005/36/EC, D. (2005). On the recognition of professional qualifications. *OJ L255 20.9.2005* , 22-145.

85/384/EEC, D. (1985). On the mutual recognition of diplomas, certificates and other evidence of formal qualifications in architecture, including measures to facilitate the effective exercise of the right of establishment and freedom to provide services. *OJ* .

89/48/EEC, D. (1989). On a general system for the recognition of higher education diplomas awarded on completion of professional education and training of at least three years' duration. *Official Journal L019 24/01/1989* , 0016-0023.

Burnside, J., (2004). Sharing imagination: Educating Designers of the Future, *The Structural Engineer*, 26-28.

Cairns, J, Crisp, T.M. (1996). A Strategy for Teaching Structural Engineering Design, *The Structural Engineer*, 375-379.

Clark, L.A., (1988). The Next Generation of Structural Engineers. *The Structural Engineer* , 125-127.

Council of Europe, Committee of Ministers, (1980, December 15). On the Specialised Training of Architects, Town Planners, Civil Engineers and Landscape Designers. *Recommendation No. R(80) 16* .

Crisp, T.M., Wilson, L., Cairns, J. (2003). Developing architectural awareness in structural engineers. *The Structural Engineer*, 27-32.

Happold, E. (1987). A Personal Perception of Engineering. in D. Walker, *Great Engineers* (pp. 24-39). London: Academy Editions.

Happold, E. (1986). Can you hear me at the back? *The Structural Engineer* , 367-378.

Happold, E. (1983). Design and the Profession. *The Structural Engineers* , 312-313.

Happold, E. (1990). Directions and opportunities. *The Structural Engineer* , 55-56.

Happold, E. (1992). The nature of structural engineering. *The Structural Engineer* , 349-354.

Ibell, T. (2010). Learning Structural Engineering. *The Structural Engineer* , 17-19.

Johnson, D., May, I.M., (2008), The Teaching of Structural Analysis, *The Structural Engineer* , 32-39.

Liddell, W.I. (2000). Creating Engineers. *The Structural Engineer* , 27-32.

Ministry of Agriculture and Land Affairs, (2001). *White Paper on Spatial Planning and Land Use Management.* South Africa.

Owens, G. (2011). Transforming Undergraduate Structural Engineering Education in the 21st Century. *The Structural Engineer* , 18-20

Zammit, A. (2009). *Our Architects.* Malta: P.E.G. Ltd.