

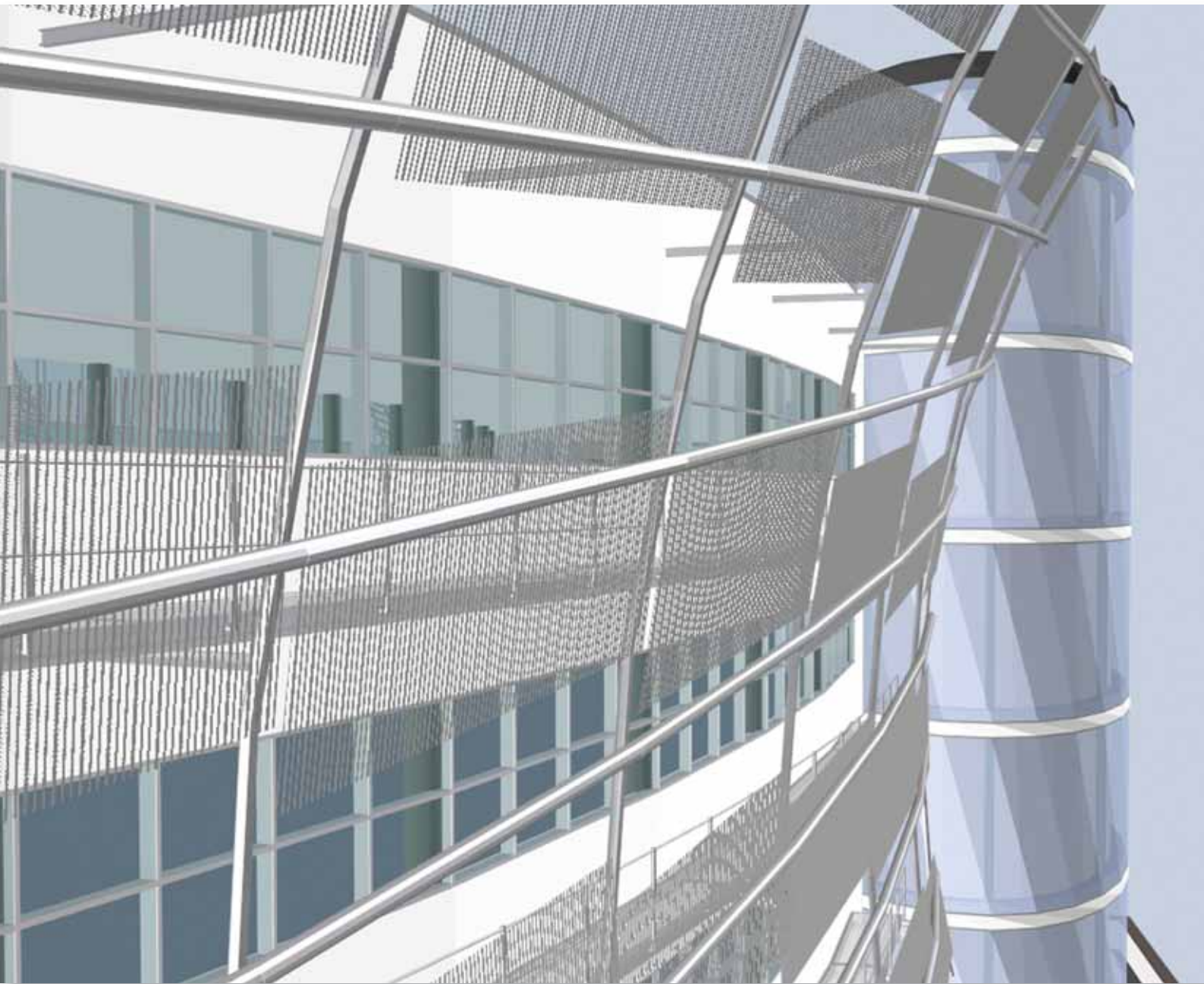
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A Research Study on Hong Kong's Building Services Engineering Profession

*A Review of the Building Services Engineering
Profession in the United Kingdom*

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March 2009

School of the Built Environment □ Northumbria University



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Executive Summary

A review of the building services engineering profession in the United Kingdom is considered in this document. It provides supporting information for a comprehensive study into the profession in Hong Kong which is being conducted by Hong Kong Polytechnic University on behalf of the Hong Kong Institution of Engineers. The overall aim of the work is to investigate mechanisms for raising the profile of building services engineers in Hong Kong.

The work presented here explores the standing of building services engineers among the UK engineering professions and their relationships with other built environment professions. It seeks to identify current roles, competences, training needs, challenges and opportunities for the future development of the profession. Particular consideration will be given to the potential for building services engineers' outputs to be licensed under acts of parliament as well as the desirability of re-branding the profession and giving legal protection of title.

Evidence and data have been gathered from numerous sources including industry surveys and reports, a practitioner survey and interviews with leading representatives of professional institutions.

Building services engineers form a young profession and the

most recent of the recognised disciplines to establish itself in the built environment family. Historical intimidation by the large established engineering institutions has largely subsided as they themselves develop fledgling interests in the built environment, energy and sustainability. In spite of these interests, the dominant voice for UK building services engineers continues to be the Chartered Institution of Building Services Engineers (CIBSE). Numbers of registered building services engineers are increasing at a time when total registrations of engineers in the UK and throughout the developed world have been in decline. UK practice is characterised by just two specialist streams: mechanical and electrical. Mechanical specialists outnumber electrical by 2:1. There is no evidence to suggest that other specialisms will emerge in the foreseeable future.

There is unanimity among engineers and other built environment professions that the key focus for building services specialists lies in energy and sustainability. Building services engineers regard the professional relationship they have with architects as the most important one of all and architects place greatest value on engineers who can develop concepts; communicate ideas; and have confidence in their solutions. However the fragmentation arising from the mechanical and electrical specialisms together with the small but growing involvements of other professional institutions – in particular the Institute of Mechanical Engineers (IMechE) and Institution of Engineering and Technology (IET), are viewed as a challenge to the profession by other built environment disciplines. An early involvement in projects with contributions on energy and

sustainability is seen by other disciplines as opportunities for the profession to 'raise its game'.

Recent growth in multidisciplinary consulting practices along with an increasing number of projects delivered through integrated teams and partnering amplify the potential for early project involvement and influence by building services engineers. However traditional services such as the production of drawings and feasibility studies are viewed as most important tasks by consulting engineers; whereas planning and site management remain most important among contractors. It is therefore clear that building services engineers must focus on the key skills and attributes of innovation, communication of ideas and robustness of solutions in order to gain influence within the increasingly integrated built environment team.

Recruitment and retention of building services engineers continues to be a problem among most employers and many of the larger multidisciplinary practices are now seeking graduate employees from disciplines other than building services and, in some cases, other than in any branch of engineering. Indeed, this practice is endorsed by the architecture profession who see it as a way of increasing the scope and influence of building services. There is also considerable scope for female recruitment with just 3% of registered UK engineering appointments occupied by women.

In the wider context of society, energy and environment have come firmly into the public gaze in the UK giving building services engineers the best opportunity for decades to clearly define their crucial role in this important sector. This is essential,

because it is clear that the public understanding of the function of a role, as well as their understanding of its importance, is crucial in profile-raising. A more defined and respected role within the built environment team as well as clearer public understanding of the function of the profession will have considerable impacts in status-raising.

None of the evidence gathered in this study points to a desire for building services engineers to be licensed as approved agents under specific acts of parliament or related statutory measures. There is also no evidence of a desire by the profession to re-brand 'building services' although the architecture profession is in favour of it. The legal protection of the generic title 'engineer' is unlikely to happen in the UK in the foreseeable future.

Introduction

The status and esteem enjoyed by any profession is influenced by at least four factors:

- **Salary**
- **Source and level of qualifications**
- **Public understanding of the role**
- **Public perception of the importance of the role**

Professional institutions are a necessity as they offer codes of conduct as well as recognition of each discipline. The high level institutions advance their respective professions by demonstrating benefit to society and promoting excellence in the profession. As the organisation of projects has become more complex, and the identity of the client more difficult to define, the public seems to have greater appreciation for professionals who can view situations more broadly than just immediate commercial requirements.

This study addresses the role of building services engineers in the United Kingdom in support of a much larger study into strategies for raising the status of the profession in Hong Kong. It was commissioned by the Department of Building Services Engineering at the Hong Kong Polytechnic University who have been, in turn, commissioned by the Hong Kong Institution of Engineers (HKIE). The historical ties between Hong Kong and the United Kingdom, and the influence that these ties have had in evolving the profession in Hong Kong, forms the foundation

behind the work presented here. It is stressed that this study makes no pretence at resolving the issue of status-raising for building services engineers in the UK, but is instead focused on examining features of the profession's current standing and its expected trajectory over the coming years as a means of informing the parent Hong Kong study.

Accordingly, six objectives have been set:

- a) **To review the standing of building services engineers in the wider context of the UK's engineering professions**
- b) **To establish current and evolving professional relationships between building services engineers and other built environment disciplines**
- c) **To review current roles, competences and training needs for the profession**
- d) **To explore future opportunities and challenges for building services engineers including new methods of professional engagement**
- e) **To establish whether there is a case for the licensing of building services output**
- f) **To establish whether there is a case for the rebranding and protection of the professional title**



Evidence to address these objectives has been gathered using a combination of four sources:

- **Previously published work (i.e. review of the literature)**
- **Practitioner survey**
- **Professional institution survey**
- **Selected, previously unpublished data, supplied by the UK Engineering Council (ECUK)**

Most of the previously published work of relevance to the study objectives has been obtained from the professional institutions' websites, particularly Chartered Institution of Building Services Engineers (CIBSE), Engineering Council UK (ECUK) and the Royal Institute of British Architects (RIBA), government websites and industrial associations such as the Construction Industry Council and the Building Services Research and Information Association.

A focused practitioner survey was conducted among a small number of leading building services firms. The following question themes were adopted:

- **Methods of engagement (procurement and fee terms)**
- **Competences**
- **Qualifications and training needs**
- **Staff recruitment and retention**
- **Rebranding 'building services' and protection of title 'engineer'**
- **Relationships with other disciplines**
- **Licensing**

A questionnaire was directed at a relatively small group (25) of leading consulting engineering and contracting firms (with a bias towards the former) with a target of achieving a response of around 50%. A total of 11 responses were obtained representing a return of 44%. The results were segregated into single-discipline consulting engineers specialising in building services only (Group 1); multiple-discipline consulting engineers offering building services plus at least one other mainstream consulting service (Group 2) and contractors specialising in building services only (Group 3).

Evidence gathering



The professional institution survey was directed at leaders of the main professional institutions with an interest in, or relationship with, building services. A semi-structured interview method was used with either face-to-face contact or telephone interviews. Six professional institutions participated in the survey:

- **Engineering Council UK (ECUK), forming the umbrella group for all UK engineering professions**
- **Chartered Institution of Building Services Engineers (CIBSE), the main building services professional institution in the UK**
- **The Institution of Mechanical Engineers (IMechE), having a significant building services division**
- **The Institution of Structural Engineers (IStructE), representing the only other significant engineering discipline within built environment**
- **Royal Institute of British Architects (RIBA), a key stakeholder institution**
- **Chartered Institute of Building (CIOB), an important stakeholder institution**

The following main question themes were explored:

- **Institution statistics**
- **Perceived impact, profile and opportunities for building services engineers**
- **Skills and training deficiencies**
- **Licensing**
- **Identity, title, and protection of title**

In the following sections, the study objectives are dealt with by drawing on information from the various sources.

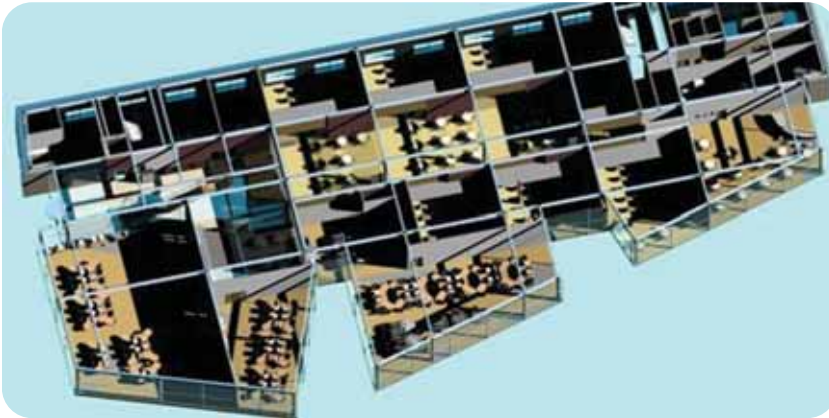
A historical perspective

In the UK, the 19th Century was the great period when most professional activity became established. The Institute of Civil Engineers was founded in 1818, the Royal Institute of British Architects in 1834, the Society of Builders also in 1834 (Institute in 1884), the Institution of Mechanical Engineers in 1847, the Institute of Surveyors in 1868 and, somewhat later, the Institution of Heating and Ventilating Engineers in 1898. Some fledgling professionals were trying to emancipate themselves from noble patronage, others were attempting to distinguish themselves as artists; but most were aiming to make a distinction between profession and trade. By the end of the century, all the major associations had been established and professionalism as it is understood today became an accepted principle (Carr-Saunders and Wilson, 1933). The professional had achieved the status of expert and the relationship with the client was dominated by it. Throughout most of the 19th and 20th centuries, clients were laypeople who did not understand the design and construction of buildings. It was therefore in the long-term interest of every professional to ensure that the public received only efficient services from his colleagues. The associations tried to protect the buyer by guaranteeing the competence and integrity of their members (Kaye, 1960). A profession

was defined as an occupation possessing skilled intellectual techniques, a voluntary association and a code of conduct. Non-professional occupations may have associations, training schemes and tests of competence; but they do not have, for they do not need to have, codes of conduct.

The mission, vision, aims and objectives of the Royal Institute of British Architects (RIBA) are interesting in that there is no mention of a client. The mission is to advance architecture by demonstrating benefit to society and promoting excellence in the profession. The vision is to be a champion for architecture and for a better environment. The Royal Charter Supplemental (1971) states that the objects of the Royal Institute are the advancement of Architecture and 'the promotion of the acquirement of knowledge of the Arts and Sciences connected therewith' (RIBA, 2007a). This stance of benefit to the public, built environment and the profession has caused some friction with clients as defined by the person or organisation that funds a building project. However, as it became less clear as to who exactly is funding the work; the architects' position of supporting the public good, began to find favour with society. It also opened up some far-reaching debates on a range of people who

might be considered to be the client. Together with their central role from inception to completion of a project support for the public interest has enabled architects to be appreciated as high quality professionals by the public and the construction industry. Media attention on the Royal Institute's portfolio of prizes enhances this position. There are more than twelve categories of awards. The final stages of the Stirling Prize for the Institute's Building of the Year are broadcast on national television. The programme includes an exposition of the shortlisted buildings, together with the judges' decision and award to the winners. The Royal Gold Medal is advertised as one of the world's most prestigious architectural prizes to a practice or individual. The Honorary Fellowship awards spread interest even wider. They recognise the diversity of influence on architecture. All fellows are leaders in their own fields, and each has a track record of achievement that provides inspiration for architects and all other built environment professionals. These are presented at a prestigious event (<http://www.architecture.com/WhatsOn/AwardsCeremonies/Events/>). Media and society are attracted by style and a visible product that, in most cases, is understandable and usable by the public.



It is argued that the public and the construction industry recognise architects by the letters RIBA, i.e. members of the Royal Institute of British Architects, but this is not the definition of an architect. In 1938, the Architects Registration Act ensured that nobody can describe themselves as an architect unless they appear on the register. It should be noted that Parliament only grants registration to professions whose services are urgent and indispensable. It became known as protection of title. Anybody may design and supervise the construction of buildings, provided they avoid using the term architect. This has led to a long-running debate about protection of title and the extent of its worth without protection of function. In the European Union, the function of the Architect is protected to a greater or lesser extent in all countries, with the exception of the British Isles, the Netherlands and Scandinavia. In countries where it is a legal requirement that an architect is appointed for a building project, it is noticeable that state control of construction is weaker. It appears to be the case that in those countries (such as France, Spain and Germany) the State effectively privatises the responsibility to ensure that the design and implementation of the project will be technically adequate, relying on

competent professionals to perform their tasks rather than for the State to meticulously recheck and recalculate submissions that have been made to a public body. The process of submitting Building Regulation applications to UK local councils, irrespective of whether a competent professional has been employed or not, inclines to the approach that the State should always take responsibility and check that work is done properly rather than rely on a professional person paid from private rather than from public funds. In addition, it is perhaps worth observing that in those parts of continental Europe where the Architect's function is protected, the Architect appears to be even more respected by society (Shrimplin 2007).

The Architects Registration Council for the United Kingdom (ARCUK) became established following the 1938 Act. It comprised approximately 50 architects, of which about 30 were members of the RIBA and 20 were non-members, known as the unattached. The entire Council was elected by the profession. The Conservative government of the 1980s introduced a substantial amount of deregulation in the professions, industry and public services. There were attacks on the

traditional procurement system and professional fee scales. It signalled an opportunity for other built environment professionals to lobby government to remove protection of title. The Architects Act 1997 followed, but it did not favour the deregulators. ARCUK was disbanded but replaced by the Architects Registration Board (ARB), which is a much smaller group. However, the most significant change is that only seven members of the Board are elected architects, whereas eight are non-architects appointed by the Privy Council. The purpose of the Board is an extended function to protect the consumer as well as safeguarding the reputation of architects (<http://www.arb.org.uk>). This is not cosmetic and has generated some conflict between ARB and the RIBA, which has still not been resolved.



The Society of Builders had also been established in 1834; becoming an incorporated Institute only fifty years later. Since the beginning of the 20th Century, this institute has faced a number of challenges in maintaining a separation between its members and the trade. At various times, groups of members have attempted to move towards the Institution of Civil Engineers, one of the oldest professional institutes. Yet, this has not been popular with most members. The reasons are not totally clear but loss of identity and the decline of civil engineering in the UK, have been cited. The Institute gained strength from a Royal Charter in 1980 coinciding with an attempt to present itself as an umbrella organisation for professionals in the built environment. However, the changes were too subtle. The title change from 'builders' to 'building' has been overlooked by most people, and the Chartered Institute has never been able to impact upon the public in the way that the RIBA has achieved. By the end of the 20th Century, the Chartered Institute of Building (CIOB) was either unknown publicly or associated with national and international building contractors. This is a misrepresentation – albeit unintentional. By 2007, the CIOB had formal reciprocal agreements with the RIBA and the Chartered Institute of Architectural Technologists (CIAT); and had absorbed the Architects and Surveyors Institute (ASI) into its Faculty of Architecture and Surveying. Of the current membership, only 50% have reported



that they actually work in building contracting. Yet, arguably, more significant has been the Institute's response to the Royal Charter and the Charity Commissioners. The objectives, as stated in the Royal Charter are:

- **The promotion for the public benefit of the science and practice of building**
- **The advancement of public education in the said science and practice including all necessary research and publication of the results of such research**

(<http://www.ciob.org.uk/about/royalcharter>)

As the deputy chief executive put it: 'As you can see, we do not exist for

the benefit of our members'. While the Royal Charter leads the way, the Charity Commissioners are becoming more active in determining the effective performance of charities. Thus the CIOB is redefining its governance and offering more demonstrable evidence of its actions for the public benefit. In recent years the CIOB has served the construction industry well. It is now involved in more public campaigns. It is developing a series of policy statements for the public benefit. It has also introduced a number of international ambassadors and spokespersons on specific topics. In addition, the innovation and research awards are growing in size and stature. These are truly international with a high proportion of winners from overseas. A difference in emphasis is observed in a non-charity chartered institution such as the Royal Institute of Chartered Surveyors (RICS), which promotes the profession of the surveyor for the public advantage.

Much of the day-to-day work of the Privy Council is concerned with the affairs of chartered bodies – the 400 or so institutions, charities and companies who are incorporated by Royal Charter. It also has an important part to play in the ten UK statutory regulatory bodies, mostly in health care, but including the Architects Registration Board (<http://www.privy-zouncil.org.uk/output/>). In countries without a monarchy, such as Ireland, chartered status and regulation have to be achieved by specific acts of parliament. For example, The Institution of Civil Engineers of Ireland (Charter Amendment) Act, 1969 (<http://www.irishstatutebook.ie/>) states that chartered members shall have the right to describe themselves as chartered engineers. Effectively, this becomes a mirror of the situation in the UK. However, a completely new venture has been the Irish Building Control Bill 2007 (<http://www.environ.ie/en/DevelopmentandHousing/BuildingStandards/News/MainBody,15984,en.htm>) part of which provides for titles of Architect, Quantity Surveyor and Building Surveyor to be protected. The relevant registers are being administered by the Royal Institute of Architects of Ireland (RIAI) founded 1839 (<http://www.riai.ie>), and the Society of Chartered

Surveyors (SCS) (<http://www.scs.ie/>) which became a separate entity from the Royal Institution of Chartered Surveyors (RICS) in 1993. Both the Construction Industry Council, who lobbied for the Bill, and the Irish government were keen to keep the number of protected titles to a minimum – just for reasons of management and enforcement. Whether or not they decided on the three most applicable titles can be debated but it is noticeable that no engineers are included. As well as advantages, there are disadvantages in the engineers operating as a single group. Only a proportion of them are built environment professionals. There was also some scepticism as to whether the Bill would ever be enacted and these two factors meant that the engineers distanced themselves from the process until the latter stages. By this time, the government was not particularly responsive to adding further professionals to the protected titles. It would not accept the generic title of Engineer for protection, as there are too many interpretations; and to separate the built environment engineers was seen as too complicated and too late in the development of the Act. The government therefore declined belated attempts by the engineers to become involved.



The Chartered Institution of Building Services Engineers' (CIBSE) roots can be traced back to the Institution of Heating and Ventilating Engineers (IHVE) which formed in 1898. The title Building Services Engineer was established with the granting of the profession's Royal Charter in 1976. In a recent interview (Building Services Journal, 2007a, p. 48), Andrew Ramsay, the chief executive of ECUK, described building services engineers as having been 'downtrodden historically' due to the dominance of the 'big 3' institutions (the then Institution of Electrical Engineers (now the Institution of Engineering and Technology (IET)), the Institution of Civil Engineers (ICE) and the Institution of Mechanical Engineers (IMechE)). In 1947, the IHVE's application to the Privy Council for a Royal Charter was

blocked by these 3 institutions. This went on until 1976 when the then Department of Environment intervened and a Royal Charter was granted. Even then, as a compromise to the 'big 3', the title 'Engineer' was omitted (CIBS), but was included when CIBSE joined the newly established Engineering Council in 1982, among the first tranche of professional institutions. Thus, just as engineers struggle to achieve the status in society that they feel they deserve today, building services engineers have historically struggled to achieve the status and recognition they felt they deserved among their kindred professions. It took the formation of the Engineering Council at the recommendation of the 1979 Finniston report, and CIBSE's membership of it, to change that for the better.

Key points...

- Key built environment professions, including the then Heating and Ventilating Engineers, established themselves in the 19th Century
- Of these professions, only architects enjoy protection of title through an act of parliament, but this does not extend to protection of function
- Building services is one of the youngest of the various built environment professions, becoming properly established in the UK with the granting of a Royal Charter in 1976
- Initially, building services engineers were seen as a 'poor relation' by several dominant engineering professions and this resulted in a compromise in the choice of title for the profession

Europe's engineering professions

The single voice for all engineering professions in Europe is Fédération Européenne d'Associations Nationales d'Ingénieurs; European Federation of National Engineering Associations (FEANI) (<http://www.feani.org/>). FEANI represents the interests of 29 European countries (mainly, but not restricted to, EU) registered or 'declared' engineers – some 3.5m professional engineers. Its aim is to 'affirm and develop the professional identity of engineers' in Europe and, through the professional title, 'European Engineer' (EUR ING), to facilitate mutual recognition of engineering qualifications in Europe. Membership of FEANI comprises a national FEANI committee in each member country. In the UK the national committee is established through ECUK whose 280,000 declared engineers and technicians are themselves members of one or more of the 36 professional institutions licensed by ECUK (see Appendix for further details). Other examples are: Germany – FEANI national committee represented through Deutscher Verband Technisch-Wissenschaftlicher (DVT) who in turn represent 54 professional associations with 250,000 registered engineers.

France – FEANI national committee represented by Conseil National des Ingénieurs et Scientifiques de France (CNISF) who in turn represent 140 professional associations with 160,000 registered engineers. Italy – Consiglio Nazionale Ingegneri (CNI)

with 190,000 declared engineers operating under the Italian Ministry of Justice.

Engineering professions across the world are managed and regulated in a variety of different ways (Hamilton, 2000) ranging from those having a single powerful central body created by an act of parliament (e.g. Greece, Italy, Portugal) to those having a number of professional bodies with no central governing body (e.g. Verein Deutscher Ingenieure (VDI) in Germany). The UK, with its non-governmental coordinating body ECUK acting as an umbrella body for 36 professional institutions, lies somewhere in between.

The Washington accord was signed in 1989 by the UK, Ireland, USA, Canada, New Zealand, Australia, South Africa and Hong Kong forging an agreement to recognise each others engineers. Since 1989, Japan and Singapore have joined, Germany and Malaysia are intending to take part, and China and India have indicated a desire to join. This does not mean recognition – merely that the qualifications held by a registered engineer from a signatory to the Accord will be considered by other signatories.

In 1999, the Bologna accord, signed by European Union ministers of education, aimed at making Europe the 'most competitive and dynamic knowledge-based economy in the world'. A key objective is the

formation of a single European higher education 'area' by 2010 aimed at making Europe an attractive target for non-Europeans to engage in higher education as well as to create mobility among member states. A key sub-objective is the harmonisation of Europe's degrees in 2 uniform 'cycles' (i.e. Bachelor and Masters degrees). Already we are seeing the impact of Bologna evidenced by the growing number of non-UK universities offering degrees in English and, in Germany, the growing introduction of Bachelor degree awards alongside the more usual Diploma awards in the recently formed universities of applied sciences (formerly hochshules and fachhochshules). The spirit and intent of Bologna has been unreservedly supported by FEANI (FEANI, 2003) from the viewpoint of harmonising engineering education across Europe.

Besides the generic role of FEANI, the European umbrella group Federation of European Heating and Air Conditioning Associations (REHVA) formed in 1963 and currently represents the interests of approx 110,000 'building engineers' in 30 European countries through a membership structure composed of European institutions representing the interests of specialist engineers (including the UK for which CIBSE is a REHVA member). Its mission is to develop and disseminate economical, energy efficient and healthy technology for mechanical services of buildings'. Thus it is mainly a learned society whose purpose is to support research, technical know-how and knowledge-sharing and dissemination among member states. It organises the Clima-2000 series of international conferences.

Key points...

- The regulation of engineering professions across Europe is piecemeal — ranging from specific acts of parliament in some countries to the establishment of non-governmental umbrella bodies such as the Engineering Council in the UK
- Increasingly, the European umbrella body for engineering professions, *Fédération Européenne d'Associations Nationales d'Ingénieurs (FEANI)*, is becoming influential as a single voice for Europe's engineers
- The late 20th Century Bologna and Washington accords have established the first tentative steps for the recognition of qualifications and, thus, professional mobility between countries



The UK's engineering professions

The Engineering Council, ECUK, is the umbrella institution for most of the UK professional institutions representing the engineering professions (ECUK, 2003). It is governed by a board whose membership includes representation from each of the member institutions. Currently, there are 36 member institutions.

ECUK maintains the register of all chartered engineers, incorporated engineers and engineering technicians in the UK. 'UK-SPEC' (UK-SPEC, 2005) governs the standard of professional engineers in the UK by maintaining a register of professional engineers and technicians. Chartered Engineers (designated 'CEng') are characterised by their ability to develop appropriate solutions to engineering problems, using new or existing technologies, through innovation, creativity and change'. Incorporated Engineers (designated 'IEng') are 'characterised by their ability to act as exponents of today's technology through creativity and innovation'. There is also a registration grade for engineering technicians (designated 'EngTech'). ECUK is governed by a board made up of a membership of the current 36 UK engineering institutions represented. Details of these professional institutions, including the most recently available registered membership numbers can be found in Table A.1, in the Appendix.

In 2001, the Engineering Technology Board (ETB) was formed following a review by the then chairman of ECUK, Dr Robert Hawley. The ETB was formed with the vision:

To become an authoritative voice for engineering and technology, integrated seamlessly with science and mathematics, and facilitator of a skilled, innovative workforce"

The formation of the ETB as the UK's 'voice for engineering and technology' enabled the ECUK to focus on its central role of maintaining the Engineers Register.



The UK's building services profession

The Chartered Institution of Building Services Engineers (CIBSE) has significant prominence among European professional institutions of its kind, its 18,417 current membership dwarfing all kindred European institutions. However, there is a tendency in Europe for much larger generic engineering professional institutions. For example, the Association of German Engineers (VDI) is the largest engineering professional association in Western Europe with 132,000 members in that region. It has a core role of promoting the advancement of technology including the educational development and continuing professional development of its members. However, it also represents engineers in society through its Professional Division which addresses 11 specific areas of activity focused on 'the engineer in professional life and society' (VDI, 2007). Evidently, these larger institutions enjoy both the resources and presence to have a real impact on society's awareness of them as well as understanding their collective roles.

When last reported comprehensively in 2003 (CIC, 2003), there were 23,500 professional firms in the UK construction sector employing a total of 225,000 built environment professionals (38% of which are full members of professional institutions) and generating £12.3bn of fee income annually. 77% of these firms operated out of a single office, with 23% of them based in single person practices and 81% employing less than 10 people. Architecture accounted for 22% of this business volume, engineering (including civil engineering) 30% and surveying 16%. Significantly, 45% of fee income is earned by multidisciplinary practices. Of the 30% engineering services

income, 15% is earned by building services engineers with a further 5% on fire engineering.

The value of the building services industry in the UK when last comprehensively reviewed in 2004 (King and Samuelsson-Brown, 2004) was £21.5bn with a total employment of 400,000 people. It comprised 112,500 companies which included a 'very large number' of single person companies. The companies breakdown was: 106,119 (contracting); 2,700 (design and consulting); 4,507 (equipment supply). Based on 2003 figures, building services contracting represented 21% of total construction output in the UK.

CIBSE members holding full CEng registrations amounted to 2.51% of the total UK registrants in 2002. This increased to 2.96% in 2006 representing an increase of 15.1% in CIBSE CEng registrants whilst, over the same period, the total number of ECUK registrants declined by 2.47% more or less in line with the decline experienced in other developed countries. At present, CIBSE ranks as 8th largest engineering professional institution in the UK in terms of CEng registrants behind IET, IMechE, ICE, IStructE, IChemE, BCS and IOM3 (*). In 2006, 900 CIBSE members held dual membership with the IMechE, 648 with the IET, 329 with the EI (*) and 476 with all other professional institutions. These multiple membership numbers have not changed significantly over the past 5 years. There were 314 FEANI registrants among CIBSE members amounting to about 2.5% of overall UK FEANI registrants in 2006. Across all CIBSE registration grades on the ECUK register, 73.4% were at the CEng grade in 2006 (up from 70.5% in 2002) whilst the percentage for all ECUK registrants was about

78%. Significantly among built environment engineers, the growth in CIBSE registered engineers over the past 5 years has taken place whilst the registered membership of the IStructE has remained more or less static over the same period.

* See Table A.1, in the Appendix for the full titles.

Key points...

- There are 36 recognised engineering professions in the UK most of which have members registered as chartered and incorporated engineers
- The Engineering Council maintains the UK register of engineers with some 242,530 full registrants currently of which 78% are chartered
- CIBSE is 8th largest of the UK engineering professional institutions and currently has an average growth rate in chartered engineers of 3.8% per year against a decline of just under 1% per year for all professions
- During this period of growth, registered membership of structural engineers in IStructE has remained more or less static

Current roles, competences and qualifications

According to a survey conducted by the Construction Industry Council (CIC, 2004), 80% of firms experience 'skills problems' within their existing workforces. 65% experienced 'significant difficulties' in recruiting staff with appropriate skills (a higher proportion of these in engineering and a lower proportion in architecture).

Firms appear to have particular problems with technical and practical skills. Technical, problem-solving, literacy and professional IT skills problems were more pronounced among smaller firms whereas management, client handling, communication and general IT skills problems were more pronounced among larger firms (CIC, 2004). The lack of mathematical ability has been identified as the biggest constraint on engineering (Building Services Journal, (2007a), p. 48).

Only 25% of firms have documented recruitment and retention strategies. 35% of firms fund training that is provided by their professional institutions and 50% of firms use 'on the job' training (CIC, 2004). Many cited cost of training as an issue (as well as loss of time by those involved).

'Traditional' competences of design team liaison; tender drawing production and feasibility studies were rated most highly by building services design practitioners whereas project planning and managerial aspects were highlighted as most important by contractors. Significantly, no other competences were identified by the respondents of this survey suggesting the 'traditional tasks' put to the survey participants remain key. A significant proportion of consulting engineer respondents to this survey identified modelling and

simulation tools as a desirable area for training and re-skilling. The dominant qualification among consulting engineers is the honours degree though there are growing instances of masters degrees whereas, among contractors, there is evidence of a lower level of qualifications. Among consulting engineers, 20-33% hold CEng qualifications through CIBSE whereas, among contractors, the figure is considerably lower.

Increasingly, opportunities are presenting themselves for building services engineers (and other professions) to accredit themselves as 'competent persons' for the purpose of conducting a specific defined task. Boushear (2001) defines a competent person as 'a person who, by reason of their theoretical and practical training or actual experience or both, is competent to perform the task or function.....and is authorised [to do so]'. An extension is a competent enterprise; a business (with one or more employees) employing one or more competent persons. For example, self-certification of Building Regulations compliance in the UK can be carried out by the competent person(s) in a competent enterprise (otherwise this compliance work would require to be undertaken by the body responsible which would be a local authority). Competent persons must be certified by a certification body. The most commonly mentioned current example of this is the (regulated) approval of design work conducted to Part L of the UK Building Regulations. CIBSE's 'Low Carbon Energy Assessor' scheme forms one of several certifying bodies for this purpose (CIBSE Certification, 2008). In Europe, FEANI (2005) gives a contribution to the debate about

statements of competence (i.e. 'competent persons'), including expectations of competence among FEANI registrants and methods of maintaining competence.

Key points...

- A majority of construction firms experience skills problems in both existing staff as well as deficiencies in newly-recruited staff
- Among building services firms, 'traditional' design and contracting tasks continue to be coveted though simulation modelling skills are most frequently identified as a desirable area for training
- The honours degree is the most common qualification among building services consulting firms where 20-33% of engineers hold a chartered registration; qualification levels appear to be lower among contracting firms
- There is increasing opportunity to engage in work regulated in support of acts of parliament by certified 'competent persons' though these opportunities will not be restricted to qualified building services engineers

A perspective from the Engineering Council of the United Kingdom

The following represents the views expressed by a senior officer of the Engineering Council of the United Kingdom.

- The 36 professional institutions in the ECUK 'family' are likely to remain static now due to government pressure to avoid recognition of new engineering institutions though there are a number of other institutions 'waiting in the wings' (up to 14 currently). Many of the smaller institutions use their ECUK registrations to gain credibility.
- Overall female membership stands at approximately 3%. Membership in all categories has been in decline for some time reflecting a worldwide pattern among registered engineering professions. There is some evidence that some IEng members did not complete an intended pathway to CEng.
- UK engineers generate a net income for the UK; there is a surplus of exports in services over imports on UK-originated engineering work of some £2bn.
- FEANI has begun to be increasingly influential due to strong pressure from the European Commission. However, many of the professional institutions in Europe are aligned to university alumni causing some resistance to change (e.g. strong pressure from Europe for the UK to adopt their longer diploma study durations i.e. 5-6 years as opposed to 4 years in the UK). There is no reason to expect that the engineering professions across Europe will change or re-align.
- Only an extremely small proportion of UK institutions have licensing authority. There is little evidence that this has increased their standing though they are very small institutions in any case. For example, members of the Panel of Reservoir Engineers (within the Institution of Civil Engineers) are legally empowered to approve reservoir designs. There are also some examples within the Institution of Engineering and Technology (formerly the Institution of Electrical Engineers) in fields such as railway signalling in which certain registered specialists have quasi-legal powers (though not under government legislation). The IMechE is currently considering seeking statutory recognition for its chartered engineers but there is no real evidence that this would enhance the status of engineers in the UK.
- Protection of the title 'engineer' is unlikely in the UK partly because the government is anxious to resist red tape. Also, engineers cover a broad range of disciplines unlike other protected professions (such as architects) and this would make it difficult to regulate. ECUK actually pursues a small number of cases through the courts involving the fraudulent use of its registered titles (typically 2 or 3 each year).



There is evidence that other countries that have gone down this route have not seen any improvement in the status of their engineers. For example, New Zealand introduced its Chartered Engineers Act of 2002 giving a legally-protected entitlement to use the designatory letters 'CPEng' and, in Australia, the National Professional Engineers Register was introduced about 10 years ago. Only approximately 20% achieved registered status in Australia; the effect of both of these registers has been to help regulate CPD training. Canada has legally protected the title 'engineer' although the per capita number of registered engineers and technicians in Canada is little different to the UK.

□ The title 'building services engineer' originated as a compromise for the award of a Royal Charter. There is likely to be unease in certain quarters about changing it (if it were desired to change it) because it was approved for use by government in the first place.

- The status of engineers compared with other professions is complex. For example, medical doctors are 'monopolised' under the National Health Service whereas anybody can employ an engineer. Status in other professions (such as in law) becomes elevated when there is statutory control of function but, in the case of engineers, nobody has ever been able to define exactly what an engineer does partly because engineering is so professionally diffuse.
- Sustainable development issues represent real opportunities for many of the engineering professions and, in particular, for building services engineers.
- Mergers between institutions (and, hence, professions) tend only to occur when one of them begins to fail. IET formed from the IEE with a view to getting a 'broader church' although they have failed to attract other institutions to join them and this situation is not expected to change in the years ahead.

Key points...

- It seems reasonable to expect that a high representation by women in engineering would have a beneficial effect on status of the profession and yet female engineers account for just 3% of the UK total
- The extent of licensing of output among the UK's engineering professions is negligible and there is little evidence that its introduction would have any beneficial impact on the status of the professions here
- The protection of title 'engineer' is unlikely ever to happen in the UK
- The specific title 'building services engineer' was granted by Royal Charter; re-branding the profession would therefore be difficult
- The standing of engineers in society is hampered by the difficulty in clearly defining a recognisable single function for the profession

Perspectives from the building services institutions

The following represents the views expressed by a senior officer of The Chartered Institution of Building Services Engineers (CIBSE).

CIBSE has 18,417 members in total. All are building services engineers, the ratio of mechanical to electrical specialists being approximately 2:1. Currently, 11,249 CIBSE members are not registered with ECUK.

- Besides 'normal' qualifying routes (i.e. accredited university degree programmes), applications for membership can be considered via individual case procedure: a detailed qualification profile is reviewed and a top-up is required (i.e. preparation of a Technical Report).
- Skills deficiencies requiring training among CIBSE members are considered to lie in energy efficient design and operation of buildings, and in life cycle analysis methods. The emphasis here is placed on the broader context of building services engineers becoming more involved in the operational phase of buildings. There are also opportunities with the forthcoming introduction of Energy Performance Certificates under the European Commission's Energy Performance of Building Directive (EPBD).

- Clear routes to qualification are defined for engineers of any background. However the Technical Report route gives applicants some difficulty because of the need to write about first principles. Alternatives have not yet been identified. Because only 5% of CIBSE current members come from an accredited building services degree course, CIBSE plan to introduce bridging training for graduates entering the profession from other disciplines.
- Regarding licensing powers, CIBSE is not in favour of unnecessary legislation. The view was expressed that it would be better to 'give teeth' to the existing Building Regulations than to introduce new legislation. There is already a newly emerging and regulated role in energy assessors who have responsibility to approve Building Regulations compliances.

However, accredited energy assessors are not required to be chartered engineers and may therefore come from a variety of professions. CIBSE favour the 'broad church' concept of a building services engineer's role, rather than specific specialism.

- CIBSE did not express a strong view on the protection of the title 'engineer' and questioned the necessity of a change in the specific title 'building services engineer'.

The following represents the views of senior officer from the Construction and Building Services division of the Institute of Mechanical Engineers (IMechE).

- The Construction and Building Services division has about 5,500 members registered. It is thought that the majority will be practising as building services engineers. They will all be Chartered since the IMechE has only very recently offered applications for membership at other grades.
- A key role of Construction and Building Services members is considered to make buildings inhabitable. In the past this was often to deal with and solve architectural/construction preferences, such as curtain walling and glazing, giving an acceptable working environment. More recently, a major role in reducing energy consumption by buildings has emerged.
- In future, an ever-increasing role in the design of the building envelope, with the "ducts, pipes and wires" assuming less significance.



- Building services engineers tend not to get the recognition they deserve, but it is difficult to see what can be done about it. It is largely a matter of publicity and, as the role slowly shifts as described above, there is scope for making it more appealing to school leavers and, especially, engineering undergraduates.
- It is expected that building services engineers will enjoy a much higher profile within the design team in future to rival that of the structural engineer and an equal, or possibly greater, role than the architect.
- Building services engineers are generally well skilled for the work they do and there are no obvious areas requiring additional specialist training. Existing qualifying routes to CEng/Eng are adequate and salaries have recently caught up to what now might be regarded as fair.
- The issue of granting licensing powers to building services engineers is difficult as the role

differs between designer, contractor, manufacturer, and commissioning specialist. It is therefore doubtful these powers could be satisfactorily introduced for the benefit of all.

- Legal protection of the generic title 'engineer' is justifiable but is unlikely to happen now. However as the role of the building services engineer changes there is a need to reconsider the specific title although the term "engineer" must be retained. One serious difficulty is that the public do not know what a building services engineer does whereas for structural engineers it is self-evident.

Building Services Engineers account for proximately 13% of current total IMechE membership. Around 900 CIBSE members also have dual membership of the IMechE – some 16% of the IMechE Construction and Building Services Division membership, a figure that has remained more or less static for the past 5 years.

Key points...

- There are 23,000 building services engineers in the UK holding membership of either CIBSE or the IMechE
- Only a little over half of these are registered with ECUK
- Just 5% of CIBSE members come from an accredited UK building services degree programme
- Both CIBSE and IMechE agree that 'energy efficiency' forms the single most important focus for the work building services engineers do
- CIBSE Sees a future role for increased involvement in the operational phase of buildings (i.e. facilities management)
- There is little appetite for licensing powers for building services engineers
- There appears to be little prospect of protection of title 'engineer' and re-branding the specific title 'building services engineer' will be difficult due to the definition of alternative function

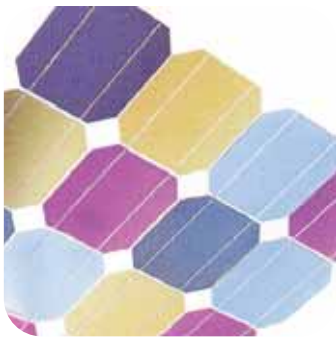
A perspective from the Institution of Structural Engineers



Although considered important by most of the consulting engineer respondents to the practitioner survey, the professional relationship with structural engineers was rated slightly less important than that of construction project managers overall. The following represents the views of a senior officer of the Institution of Structural Engineers (IStructE).

Key points...

- The relationship between services engineers and structural engineers has always been excellent and, essentially, complimentary. It is not expected that this position, or the individual roles, will change in the foreseeable future
- Protection of title 'engineer' would be highly desirable but it will never be achieved in the UK
- The IStructE strongly believes that the granting of licensing powers is an important step in improving the status of engineers as evidenced by the powers already vested in structural engineers in Hong Kong, for example



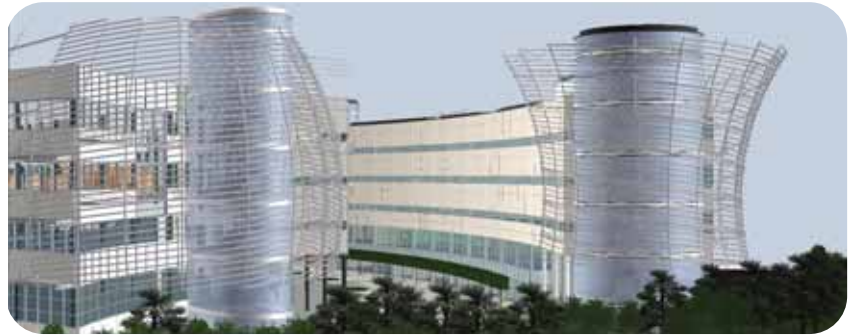
A perspective from the Royal Institute of British Architects

Nearly all respondents of the practitioner survey considered the working relationship they have with the architecture profession as 'vital'. There appears to be little evidence that a shift in attitude towards this position is likely for the foreseeable future at least. By some margin, this represents the most important professional relationship for building services engineers. The following represents the views of the Royal Institution of British Architects Practice Committee.

- The focus is on energy and sustainability – building services consultants must be able to make client presentations in a way that the clients will understand. This is a huge issue as the capital cost can be significant. So, they need to be part of the integrated design solution and take the client through the stages and costs
- High quality environmental engineers need to be involved from day one of any project. They need to consider the qualitative impact of environmental design, and be creative to generate a strategy that will deliver the best design solution. A holistic view is required – integration with structure and envelope is essential. The front-end work is becoming more demanding with energy assessments and sustainability evaluations. The

worst situations are where clients minimise risk of expense if the project does not proceed by not employing building services engineers at the beginning; and where subcontractors detail the installation. The performance approach (i.e. contractor design) is generally not satisfactory. The services engineers need to be paid for front-end work, and clients have to accept this approach. A payment system based on the quantity of machinery that can be inserted into a building is counterproductive.

- Even development control is leading to an enhanced role for services engineers. Originally development control was about land use. In the late 20th Century, economic issues such as job creation were added. Now it is energy assessment and sustainability. There are requirements to show how much better a proposed building will perform, compared with the minimum standards of the Building Regulations. It is not uncommon to receive conditions for approval that involve energy targets and sustainability provisions. Development Control expect a sustainability statement as part of the documentation. In London at least 10% of energy must be from renewable sources.



- Building services engineers or environmental engineers need three primary skills – strategic approach (concepts etc.) ability to communicate ideas and confidence that any ideas will not fail later. Project co-ordination is a major issue, so a detailed service of design and co-ordination is important. There is also an ever increasing number of specialist reports required. The services engineers need to be more creative, and offer alternative technologies for reducing carbon levels.
- A forward thinking practice is important – with quality individuals and track record - among the best practices that demonstrate these attributes are: Max Fordham, Buro Happold, Atelier 10, Fulcrum, XC02, Faber Maunsell, Hoare Lea; and younger firms such as King Shaw, Ernest Griffith and Battle McCarthy.
- Britain seems to have the lead in Europe – there are often requests from Europe to nominate practices.
- Highly intelligent people are essential, and not necessarily engineers – there needs to be an opening-up of the rigid engineering qualification system.
- The above point was discussed with a senior building services practitioner working for a prominent firm of consulting engineers in London. The practitioner confirmed that they are looking to widen the scope of

those who can be employed and do not actively recruit from building services degrees. A science background continues to be important – mostly physicists, some mathematicians – as well as a range of engineers. This practice is now considering project management and humanities graduates for project administration.

Key points...

- Energy and sustainability are considered to be the key foci for building services engineers
- Re-branding 'building services' would help – 'environmental engineering' was suggested by the architects
- Attributes of developing concepts; communicating ideas; and having confidence in solutions are qualities that architects value most in building services engineers
- UK building services engineers are well respected in Europe
- Recruitment from a broader range of graduates with less rigidity for engineering qualifications would help to broaden the scope of the building services profession

A perspective from the Chartered Institute of Building

Three respondents in the practitioner survey rated the professional relationship they had with construction project managers as 'vital' and all but one of the remaining respondents rated it as 'important'. The views of the Chartered Institute of Building (CIOB) on the professional impact of building services engineers were thus obtained by discussing key issues with the Deputy Chief Executive. The results are summarised in the following.

- Like most other professional institutions in the built environment, members of CIBSE have the protection of chartered status. These are of course voluntary associations but misrepresentation can be prosecuted by the Trading Standards Office. Statutory rights enjoyed by the architects carry much greater powers for misuse of the title.
- Building services is perceived as the junior partner of built environment professions, but there are excellent salaries due to the shortage of graduates.
- Competition with mechanical and electrical engineers is seen as a confusing situation. The Institution of Engineering and Technology (IET) is mainly composed of former members of the Institution of Electrical Engineers (IEE). Obviously, it has members from a range of industries, and even though there are no specific references to building services in the Institution's structure, some members are interested in intelligent and green building

with high level technologies. The IMechE has a distinct and organised Construction and Building Services Division, which is focussing its attention on energy usage and climate change. The American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) is viewed as a strong international organisation. Nevertheless, it all adds to a picture of fragmentation. Thus building services engineers can be found in variety of professional organisations; and at the very least there is a divide between mechanical and electrical. In addition, some of these professional institutions are only partially interested in the built environment.

- Only CIBSE is fully dedicated to the built environment. Yet, it is a small institution; and size is important in raising profiles because money from subscriptions is required.
- The immediate opportunity for raising the profile of building services engineers is through early involvement in projects – with contributions on energy and sustainability; as well as national / international debates on climate change. Unfortunately, this is becoming a very crowded professional niche.

The Built Environment Technologies Network (BETNET) group in the IET focuses its attention on 'electrical installation technology'. Many IET members practice as electrical building services engineers. Currently, 648 CIBSE members hold dual membership with the IET.

Key points...

- There is a perception that building services engineers have lower recognition among built environment professions in spite of excellent salaries and opportunities
- The fragmentation arising from electrical and mechanical specialisms as well as from the 'dabbling' by other mainstream professional institutions in building services-related activity needs to be addressed
- The relatively small size of the profession makes it vulnerable
- Again, energy and sustainability form key foci and an early involvement in projects would help to raise the profile of building services engineers

Future challenges

The key challenge to the future success of the profession is its ability to recruit and retain sufficient numbers of well qualified and skilled staff. A majority of consulting engineers currently experience difficulty in recruiting and retaining staff with building services qualifications in the UK and there is some evidence that there are difficulties in recruiting engineers with other qualifications for training into building services. According to CIBSE, just 5% of current members come from accredited building services degree programmes prompting the need to consider top-up training and qualifications for graduates in other disciplines. However, a gradual decline in numbers of UK school leavers entering engineering degree programmes challenges this notion. The decline in engineering graduate output is not confined to the UK. In Europe, FEANI reports a 15-year relative decline in engineering graduate output and outlines a series of initiatives to arrest this problem (FEANI, 2007). Among them is a plan to create an awareness of the positive contributions to society by engineers and technologists – noting that engineers in developing countries enjoy higher status than those in developed countries due to what is termed ‘technological saturation and fatigue’ in developed countries.

A recent salary survey (Building Services Journal, 2007b, p. 63) suggests that the salaries on offer to younger people entering the profession are not as competitive as those at the top of the profession. It

suggests that employers will pay whatever is needed to get experienced people in at the top whilst trying to entice young people in at the bottom based on the overall benefits package and the opportunities provided by the role itself. However chronic shortages of young graduates coming into many engineering professions, including building services, remain. In response, the Engineering Technology Board intend to launch a £20M campaign in 2008 running through to 2012 to raise the profile of all engineering professions in the UK (Building Services Journal, 2007c, p. 44). The purpose will be to attract more talented people and women in particular, as well as to inspire young people to study maths and science at school.

Hamilton (2000) has pointed out that the UK compares favourably on salaries earned by engineering graduates in relation to other disciplines; whilst recognising that status for engineers in the UK lags behind many other countries. Three of the eleven practitioners surveyed agreed that a better public perception of what building services engineers do is important in status-raising. This information adds to evidence reported elsewhere in this study for a need to engage with society in a campaign to highlight the key professional function of energy and sustainability as a means to status-raising. As the public attention is drawn increasingly to climate change and the environment, the current timing for this is highly propitious.

An increased participation in building services by women would help to elevate status and recognition of the profession. Just 3% of ECUK-registered engineers in the UK are women. Among construction professionals, the situation is little better with 92% of all staff employed by engineers and quantity surveyors in 2003 being male (CIC, 2003) – a bias that had not improved between 1995 and 2003. The proportion of female practitioners was found to be significantly better for architects and planners – professions that enjoy considerably higher status than building services (CIC, 2003).

Opportunities

Numerous opportunities present themselves for the development of future professional services and specialisms by building services engineers. Many of these emerge from energy and carbon-related issues within the sustainability agenda.

CIBSE identifies current issues of sustainability; climate change and globalisation as matters of engagement in promoting competence and knowledge (i.e. strategic objective 4 of 6; CIBSE Strategic Plan 2006-10).

In October 2003, The London Borough of Merton became the first local authority in the UK to introduce a specific policy for the use of directly-embedded renewable energy in new non-residential developments (The Merton Rule Policy Briefing, 2006), stating...

“All new non-residential development above a threshold of 1000m² will be expected to incorporate renewable energy production equipment to provide at least 10% of predicted energy requirements”

Since then, a number of other local authorities have launched similar policy statements.

Proposals for a UK Green Building Council (UKGBC) modelled on the USA Green Building Council have been made (Building Services Journal, 2007d, p. 61). The latter was set up in 1995 with a register for LEED (Leadership in Energy and Environmental Design) – accredited assessors. The UKGBC’s mission is...

“To rationalise the plethora of initiatives and policies on sustainable design and create a clear set guidelines agreed by green bodies, government and those involved in construction”

The Building Research Establishment is included among the membership – it evidently sees the UKGBC as a means of increasing the uptake and use of its Environmental Assessment Method (BREEAM).

The European Commission’s Energy Performance of Buildings Directive (EPBD) requires that member states introduce legally-binding carbon emission targets for new and refurbished building designs as well as certification of existing buildings (Communities and Local Government, 2008). The first of these was introduced in the UK in April 2006 in the form of revisions to Parts L1A, L1B, L2A and L2B of the Building Regulations*. Accredited energy assessors are required to ‘sign-off’ designs carried out to these

standards. The main vehicle for design assurance under these revised regulations is a tool called SBEM (Simplified Building Energy Model) developed by the UK Building Research Establishment for the special purpose of building regulation compliance checks.

Besides design measures for new and refurbished buildings, accredited energy assessors will be required to provide a variety of certification schemes, to be rolled out between 2008 and 2011 under the EPBD. There are three main schemes: Energy Performance Certificates (recording how efficient a building is on a scale of ‘A’ (very efficient) to ‘G’ (very inefficient); Display Energy Certificates (to be displayed at all times in large public buildings or institutional buildings providing a public service to a large number of people) and air conditioning inspections for the purpose of assessing the efficiency, sizing and replacement of plant, to be carried out at intervals of not less than 5 years. The domestic version of this assessment system, in the form of Home Information Packs (HIPS) which are required to have an energy statement. These have already been partially rolled out in the UK and figures recently released by LearnDirect show that the most requested change of job from 900,000 enquiries in 2007 was that of domestic energy assessor (Observer, 2008) confirming the rising public awareness, and importance they attach to, energy efficiency.

Various UKAS**- registered organisations (Building Services Journal, 2006a, p. 79) are developing accredited energy assessor schemes, an example of which is CIBSE Certification Ltd’s ‘Low Carbon Energy Assessor’ scheme (CIBSE Certification, 2008).

Until recently, fire safety legislation in the UK has been piecemeal and evolved mainly in response to specific fires. However a new risk assessment-based fire safety order was enacted in 2005 (Regulatory Reform (Fire Safety) Order 2005). This, coupled with a renewed interest in tall building construction in the UK is expected to see some renewed interest in fire safety engineering. Nonetheless, an increasing involvement in fire engineering and an interest in a tangible fire engineering specialism by mainstream building services engineers seems remote. There is a separate Institution of Fire Engineers in the UK whose members are most likely to vigorously pursue any increased opportunities in this area.

Likewise, the Institution of Plumbing and Heating Engineering caters for the public health specialism. The total number of registered (CEng/Eng) members of this institution and the Fire Engineers amounts to just 4.1% of CIBSE membership.

A majority of consulting engineers identified '[simulation] 'modelling' and related tools as a specific current training need, giving evidence of the desire to gain expertise in these areas for future competitiveness (Appendix 3; practitioner survey). Sophisticated tools for life cycle planning, design and management of buildings are now a reality and current work is focused on integrating these tools in a way that lends them to widespread use at all levels of the practitioner community (e.g. Hew et al. (2001), Augenbroe (2002), Bouchlaghem et al. (2005)).

Key points...

- **There is a need to campaign for increased numbers of school-leavers to enter engineering degree programmes as well as for new training packages aimed at graduates in other disciplines**
- **There is a need to increase the number of women in engineering (currently standing at just 3% of ECUK registrants)**
- **Current timeliness to campaign on behalf of the key energy and environment responsibilities of building services engineers as these issues increase in public awareness perception and importance**
- **New and emerging opportunities as certified energy assessors for building services (and other) professionals are apparent**
- **Practitioners appear to be increasingly aware of the need for training and skills in modelling and simulation methods**



* Building Regulations 2000 (2006 Ed) Part L1A (Conservation of Fuel and Power for New Dwellings); Part L1B (Conservation of Fuel and Power in Existing Dwellings); Part L2A (Conservation of Fuel and Power in New Building Other than Dwellings); Part 2B (Conservation of Fuel and Power in Existing Buildings Other than Dwellings) (London: Office of the Deputy Prime Minister)

** United Kingdom Accreditation Service

Emerging patterns of professional engagement

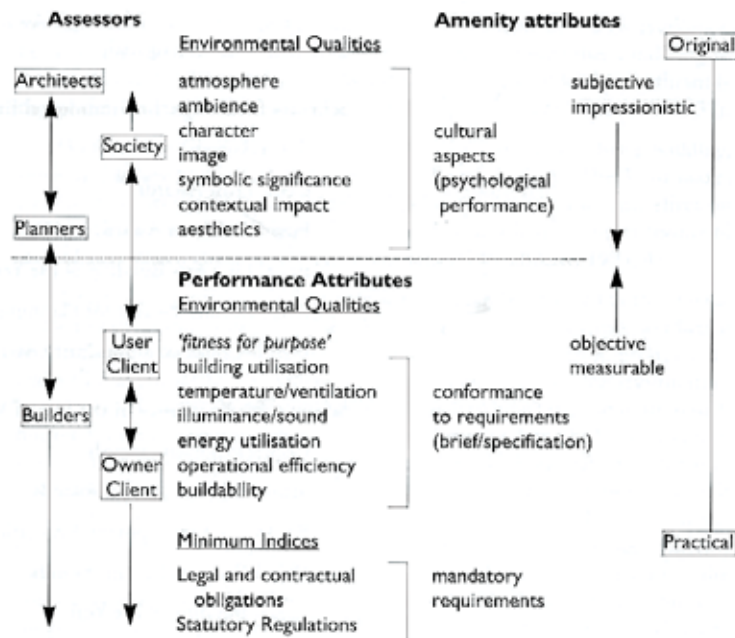


Figure 1. Giddings and Holness 1996

Research into workplace design has shown that the focus to date has been on environmental quantities – temperature, ventilation, illuminance, sound, etc. These now have good design guidance criteria and the targets are generally achieved in practice (Thomas, Giddings and Little 2006). These performance attributes are viewed as baseline requirements and only attract comment on occasions where the guidelines are not achieved. One of the difficulties is that building services engineers' outputs are not visible, and therefore cannot be shown to others in order to stimulate debate. Moreover, it is the creation of amenity attributes such as atmosphere, ambience, character etc., which are associated with high-level professional activity and status. One option is that building services engineers could operate at the interface with interior design to demonstrate how environmental quantities can be used to generate

environmental qualities. Many of the issues can be summarised in figure 1.

Opportunities for building services engineers to communicate their product are likely to arise from the developments that have taken place in alternative methods of construction procurement. These opportunities will be about making the product more transparent to a wider audience than the project delivery team. Construction procurement methods in the UK can be essentially classified in three groups:

- client-led design
- contractor-led design
- contractor financed

The first group includes Traditional Procurement, in which the design is provided by independent consultants in direct contract with the client. A separate contract for the

construction is placed with a building contractor, who then sublets elements of the work. Selection of the contractor is normally by competitive tender from a pre-selected list. The advantages are that the design can be completed and documented before it is sent to tenderers for pricing. It also enables the design team to be established in the early stages of the project. However, towards the end of the 20th Century, this procurement method started to be criticised. It was considered that the pre-construction period was excessive; and it was not delivering projects on time and within budget. Egan's (1998) assertion that building projects could be delivered on time, with a cost reduction of 30%, without reduction in quality – suggested that Traditional Procurement had become outdated. Other criticisms, such as lack of single point responsibility, and a management structure that differed from the contractual arrangements added to the call for change. Alternative methods are summarised in figure 2.

Management Contracting grew out of clients' desire to reduce their risk and contractors' intent to create more of a development role for themselves. In addition, the growing trend for building contractors to sublet all of the work, resulted in a procurement role for them that was limited to project management (Hughes et al. 2006). This was the beginning of the architect and design team's reducing influence as a perception of equality between designers and the management contractor was promoted.

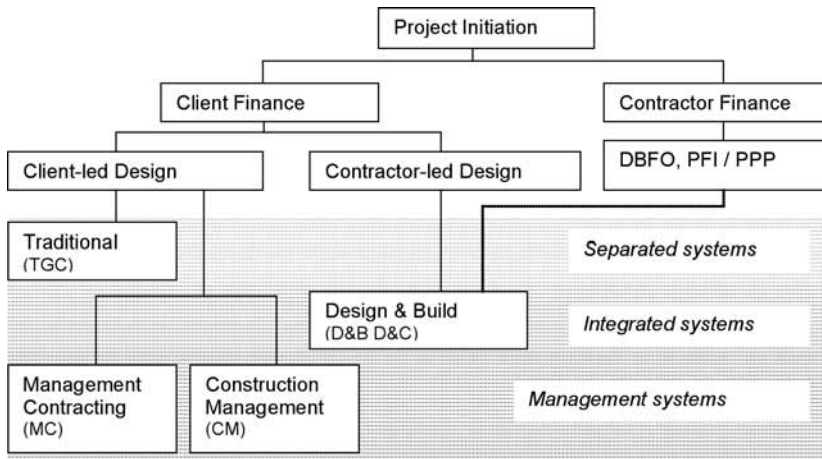


Figure 2.

In Construction Management, the contractor even shed responsibility for the trade contractors, each of which has a direct contract with the client. This arrangement, devised for experienced clients, created a construction manager who was more like a consultant than a contractor.

Further clamour to speed the process and reduce costs produced contractor-led design. A procurement system known as Design and Build or Design and Construct, was intended for simple buildings with relatively low design content. Unfortunately, this intention has become overlooked and some complex buildings have been mistakenly procured by this technique. The design team is reduced to the level of subcontractors while a main contractor occupies the central role and interacts directly with the client. Although this may be appropriate for simple repetitive buildings, there have been seriously flawed outcomes on more sophisticated projects.

In order to avoid these failings, a variation known as Novated Design and Build was introduced. The

principle is that the client and the design team lead the pre-construction phase. When the main contractor becomes involved, the design team acts as another subcontractor. The intention was that the design should be fully resolved before construction commences, after which the design team should be available to advise the contractor. However, often in practice, the introduction of the main contractor to the leading role and interacting with the client has resulted in proposals for increased buildability. These are presented to the client as cost-saving measures, but to the usurped design team, they are perceived as impoverishing the design.

In contractor financed procurement, such as Design Build Finance Operate; Private Finance Initiative; and Public Private Partnership – even the authority of the client is reduced. The central role is occupied by the funder developer operator organisation. The design team, contractors, suppliers, service providers and users, are all effectively sub-contractors. This procurement method is for public sector projects in the context of reduced public

sector expenditure. The site and future occupiers are usually provided by the client – after which the funder developer operator has full control for a period of up to 30 years. The only control on behalf of the public is the output specification provided by the client. In practice, specification clauses have too often been generalised in nature and open to negotiation. In these circumstances, design quality has been low on the funder developer operator agenda, in order to guarantee profitability (Masterman 2004).

Traditional routes to building procurement are characterised by, a) large number of people needing to communicate directly with the client, b) complexity, c) contracts won on price rather than added-value and, d) complex and ineffective supply chains. A potential remedy to many of these complex issues lies in the concept of the integrated team (Holley et al., 2005). The integrated team idea requires that all suppliers in a supply chain for a given client or project form a single body of contact with the client. It is expected that the partnership would subsequently go on to work (albeit with flexibility – some players may not be needed on certain projects whereas other may need to come in ad hoc) on other projects and by working together with a collective focus on adding value, the team expects to foster long term customer loyalty.

Sir John Egan stipulated that 20% of construction business should be delivered through the use of integrated teams by the end of 2004, rising to 50% by the end of 2007. The Strategic Forum for Construction is monitoring progress towards these, and other, strategic industry targets (Accelerating Change, 2002).

Once the integrated supply chain team is established with openness, trust and a willingness to regard all problems as mutual, the integrated team can move on to a logical next step; partnering. This involves an alliance between the client and the integrated team built on mutual objectives with agreed mechanisms for dispute resolution and ongoing service improvement to deliver a project ('project partnering') or a series of projects ('strategic partnering'), (Samuelsson-Brown, 2002). The proportion of work by multidisciplinary firms increased significantly between 1996 and 2002 (CIC, 2003); a development likely to increase the integrated team ethos. 17% of all construction work in 2003 was procured through partnering (CIC, 2003) although the lowest participation in partnering is among surveying, planning and architectural firms where negotiation forms the dominant method of procurement (multidisciplinary firms partner on the highest proportion of projects). This suggests that Sir John Egan's target for integrated teams (an essential component of partnering) is being met.

A consistently greater satisfaction by clients with the quality of installation than with design in building services work has been reported (King and Samuelsson-Brown, 2004). Furthermore, UK building services often cost more than in other countries due to a combination of onerous client expectations and over-design leading to the proposition of introducing value engineering methods in design i.e. seeking alternative and, potentially, lower cost solutions without

sacrificing functional imperatives (Hayden and Parsloe 1996). Little evidence that such methods have taken root can, however, be found.

Since the early 1980s, competition has become the overwhelming ethos in commercial activity. It was initially the Monopolies Commission that publicly questioned the practice of profession-wide standard charges for services (Nicholson 2003). Fee bidding now applies to all professionals, and the concept of fee scales has been abandoned. For example, the section of the Standard Agreement for the appointment of an Architect (S-Con-07-A) (RIBA 2007b) is typical of recent professional practice. It sets out a range of options for fee calculation including percentage of construction cost, lump sums, time charges and the new 'value-added' concept of fees. It also highlights the fact that fees are a matter of calculation and negotiation based on the services to be provided, the procurement method, the programme and the cost, type and complexity of the project. All consulting engineers surveyed reported a wide diversity of fee-setting methods although no one dominant method was apparent. However, most identified competition as the underlying ethos in the various methods of fee-setting they experienced.

Key points...

- A wide variety of construction procurement methods has emerged during the past 15 years and, significantly, most of them have an integrated team ethos and partnering in common
- These engagement methods offer opportunities for building services engineers to both become involved earlier in the construction process as well as to communicate their product to a much wider audience, both of which will help to raise the profile of services engineers among their peers
- A perception of better satisfaction with installation than with design among clients can be addressed through these methods
- A variety of fee-setting methods has emerged during this period but most of them have an element of competitive bidding in common — a major departure from the historical method of using agreed fee scales

Licensing of product

Legislation in the UK is expressed through acts of parliament. In recent times acts have included provision for regulations or orders to be made within an act. As an example, the Building Regulations form a statutory instrument under the Building Act of 1984. Regulations have the same force of law as acts but are limited by the act under which they were enacted. Orders can be defined to govern when the various stages of an act come into force. Regulations often refer to British Standards or Codes of Practice as a means of conforming with the regulations. A comprehensive review of legislation influencing building services can be found in Pennycook (2007).

In the UK, none of the built environment professions are licensed with statutory powers and responsibilities. Only in their duty to the client do they undertake applications to statutory authorities. They advise about the implications of statutory requirements, and the information that must be submitted for consents by the authorities – including various Building Regulations; Development Control; Party Wall and Disability Discrimination legislation; Housing Grants, Construction and Regeneration Act 1996; the Late Payment of Commercial Debts

(Interest) Act 1988; and the Construction (Design and Management) Regulations 2007. In spite of this provision, the 2007 Corporate Manslaughter Act makes it more likely that prosecutions will come about as a result of failings in issues concerning public health and safety (Building Services Journal, 2007e, p. 27).

Hamilton (2000) pointed out that a common view on enhancing the standing of engineers is through a system of licensing and the protection of the title 'Engineer'. He argued that where medical and veterinary practitioners have been licensed, they have not necessarily enjoyed enhanced status. In Japan and America, certain engineering technology activities have also been licensed, but they too report little improvement in status.

A clear majority of the practitioners surveyed in this study were not in favour of giving licensing powers dealing with specific aspects of legislation to building services engineers. This view was supported by interviews conducted with CIBSE and ECUK officials, although the IStructE is in favour, based partly on experience with structural engineers in Hong Kong.

Brand and protection of title

Periodically, the question of the title 'Building Services Engineer' arises. Many in higher education, for example, feel that a change to a more intuitive title would help to alleviate the misunderstanding of the role of building services engineers that appears to contribute to student recruitment difficulties. Others have argued for change in order to reflect a gradual realignment in professional duties as new emphases emerge from the regulatory environment (e.g. UK Building Regulations) – see for example Building Services Journal (2006b), p. 3; Building Services Journal (2007f), p. 21. However, a

clear majority of the practitioners surveyed in this study were not in favour of a change in professional title.

Table 1 gives a limited international comparison of engineer, technologist and technician registrations in several countries that have previously had close historical and cultural ties with the UK. Only Canada has legal protection over the generic title 'engineer' and, although it has a greater number of engineers than in other countries, the ratio of technicians and technologists is no different. This suggests that legal protection of title has little perceived impact on status.

Table 1: International comparison of engineer, technologist and technician registration

	UK	Ire	SA	NZ	HK	AUS	Can
a) Engineers	188,701	15,177	14,727	5,250	11,568	47,555	160,000
b) Technologists	40,466	2,468	2,944	125	1,713	708	29,991
c) Technicians	13,363	781	3,099	230	0	2,831	9,899
Engineers per 1000 population	3.10	3.70	0.33	1.28	1.65	2.33	4.79
Ratio a:b	5:1	6:1	5:1	40:1	7:1	67:1	5:1
Ratio a:c	14:1	19:1	5:1	22:1	-	16:1	16:1

Key:

- UK:** EC^{UK}
- Ire:** Engineers Ireland (EI)
- SA:** Engineering Council of South Africa (ECSA)
- NZ:** Institution of Professional Engineers New Zealand (IPENZ)
- HK:** Hong Kong Institution of Engineers (HKIE)
- AUS:** Institution of Engineers Australia (IEAUST)
- Can:** Canadian Council for Professional Engineers (CCPE)
Canadian Council for Technicians and Technologists (CCTT)

Key points...

- None of the UK built environment professions and a negligible number of engineering professions currently have licensing powers under acts of parliament for their products
- A majority of building services practitioners surveyed in this study is not in favour of having licensing powers — a collective view that is endorsed by CIBSE
- A majority of building services engineers surveyed in this study is not in favour of a change to the title 'Building Services Engineer'
- An international comparison suggests that legal protection of the title 'Engineer' has little impact in status-raising for the profession



Conclusions

A review of the building services engineering profession in the United Kingdom has been carried out with a view to exploring:

- **The standing of building services engineers in the wider context of the UK's engineering professions**
- **Professional relationships between building services engineers and other built environment disciplines**
- **Current roles, competences and training needs**
- **Future challenges and opportunities**
- **Licensing of outputs**
- **Rebranding and protection of title**

Building services engineers form a young profession, being one of the last of the mainstream built environment professions to establish itself at the end of the 19th Century, and not receiving the recognition accorded by Royal Charter until 1976. The growth in diversity among UK engineering professions, and a corresponding decline in influence by some, added to economic growth in the built environment sector, have all contributed to building services establishing itself in a recognised and respected niche today after a period of being historically 'downtrodden' by some of the dominant engineering professions. The average annual growth rate for the past 5 years in registered building services engineers is 3.8% per year, which compares with a decline of just under 1% in all registered UK engineers – essentially following a developed-world trend.

This growth has taken place whilst the number of registered structural engineers (the other mainstream engineering profession in the built environment) has remained more or less static. Both the IMechE and IET have special interest groups for building services and built environment but they are relatively small compared with the dominant and focused membership of building services engineers within CIBSE and the professional engineering landscape in the UK is not expected to change in the foreseeable future.

Building services engineers continue to regard the professional relationship they have with architects as the most important one although they also place high importance on the professional relationship they have with construction project managers with an important but less vital emphasis on a range of other built environment professions. Architects in turn place greatest value on building services engineers who can develop concepts; communicate ideas; and have confidence in their solutions. They place value on the contribution they can make in issues concerning energy and sustainability and consider that re-branding the profession would help to raise its profile ('environmental engineering' was suggested) together with recruitment from a wider range of graduate types – not necessarily from the 'rigid' engineering qualifications system. Construction managers raised fragmentation arising from the mechanical and electrical specialisms within building services together with the small but growing involvements of other professional institutions – in particular the IMechE and IET. There is almost unanimity among built

environment professionals that there is an immediate opportunity for raising the profile of building services engineers through early involvement in projects – with contributions on energy and sustainability; as well as national/international debates on climate change. Unfortunately, this may become a crowded professional niche.

There is broad unanimity that the focus of building services engineers is, and should continue to be, energy and sustainability. Less is mentioned by stakeholders about services design although traditional tasks, such as the production of drawings and feasibility studies, are viewed as most important by consulting engineers whereas planning and site management remain key tasks among contractors. Significantly, energy modelling and its related tools are viewed as an important training priority for the future by some engineers. The honours degree continues to be the most common qualification and 20-33% of engineers in consulting companies surveyed are registered at CEng, although contractors tend to be less well qualified. Although there is considerable emerging opportunity for accredited 'competent persons' such as energy assessors, to engage in compliance auditing for new and emerging Building Regulations, many of these opportunities are likely to be taken up by professionals outside the engineering arena. It is therefore clear that building services engineers must focus on the key skills and attributes of innovation; communication of ideas and robustness of solutions to prosper with increasing influence within the increasingly integrated built environment team. Mechanical and electrical services form the only two established and recognised

specialisms in UK practice with mechanical specialists outnumbering electrical by a ratio of 2:1. There is no reason to expect a wider range of specialisms to emerge in the foreseeable future.

Recruitment and retention of building services engineers continues to be a problem among most employers. It is likely that a re-positioning in emphasis away from the 'rigidity' of the engineering qualification system mentioned previously may actually be underway as many of the larger multi-disciplinary practices quite deliberately seek graduate employees from disciplines other than building services and, in some cases, other than in any branch of engineering. Bridging courses for training graduates from non-engineering backgrounds are already being considered by CIBSE among others. Increasing the recruitment of women, who currently form just 3% of registered engineers in the UK and fare little better among built environment professions other than in architecture and planning, would help to raise the status of a profession considered to be a 'male closed shop'.

Among consulting firms, the proportion of work delivered by multidisciplinary firms has been increasing sharply during the last 10 years. This has helped to bring about integrated team working which lies at the heart of partnering. It offers significant opportunity for building services engineers to leave behind their, historically perceived, junior partner role by operating at the heart of the integrated team with innovation, well-communicated ideas and robust solution delivery.

Energy and sustainability have come firmly into the public gaze in the UK giving building services engineers the best opportunity for decades to clearly define their crucial role in this important sector. A more defined and respected role within the built environment team as well as clearer public understanding of the function of the profession will have considerable impact in status-raising.

None of the evidence gathered in this study suggests that there is any appetite for giving licensing powers to building services engineers to practice as approved agents under specific acts of parliament or related regulations or orders. There is some evidence that those professions that have licensed powers (including a very small number of engineers in specific disciplines in the UK) have not enjoyed an increase in status as a result.

The introduction of protection of the generic title 'Engineer' in the UK appears to be extremely unlikely. The difficulty in clearly defining the function of engineers in a collective sense remains a key obstacle in this matter. In addition, government resistance to further 'red tape'. In spite of the architecture profession's view regarding the re-branding of 'building services', there appears to be little desire for this among engineering practitioners and professional institutions alike. Practitioners are wary over loss of identity among the built environment professions and the Chartered Institute of Building Services Engineers (CIBSE) is wary of changing a title that has been granted by Royal Charter.

Appendix

TABLE A1

UK engineering institutions with registered members (Based on records dated 31st December 2006)

Institution Title		Registered Members		
Abbr.	Full title	CEng	IEng	EngTech
IET	Institution of Engineering and Technology	55,012	19,001	4,945
IMechE	Institution of Mechanical Engineers	40,958	117	0
ICE	Institution of Civil Engineers	39,200	2,956	406
IStructE	Institution of Structural Engineers	11,882	1,250	0
IChemE	Institution of Chemical Engineers	10,612	72	0
BCS	British Computer Society	7,677	233	0
IOM3	Institution of Materials, Minerals and Mining	7,419	791	90
CIBSE	Chartered Institution of Building Services Engineers	6,210	1,580	665
IMarEST	Institute of Marine Engineering, Science and Technology	6,089	2,351	290
RAeS	Royal Aeronautical Society	4,989	1,307	414
IHT	Institution of Highways and Transportation	3,849	547	0
CIWEM	Chartered Institution of Water and Environmental Management	2,707	442	12
EI	Energy Institute	2,693	203	14
RINA	Royal Institution of Naval Architects	2,117	136	28
IGEM	Institution of Gas Engineers and Managers	2,053	615	283
InstMC	Institute of Measurement and Control	1,597	588	57
IoP	Institute of Physics	1,415	0	0
TWI	The Welding Institute	555	291	608
INucE	Institution of Nuclear Engineers	436	168	12
SoE	Society of Operations Engineers	416	3,364	2,470
IED	Institution of Engineering Designers	387	1,514	167
IHEEM	Institute of Healthcare Engineering and Estate Management	381	630	124
IoA	Institute of Acoustics	303	23	0
IAgrE	Institution of Agricultural Engineers	200	264	113
IPEM	Institute of Physics and Engineering in Medicine	187	29	2
IFE	Institution of Fire Engineers	186	22	65
BlInsNDT	British Institute of Non-destructive Testing	151	324	134
ICME	Institute of Cast Metal Engineers	138	127	26
ILE	Institution of Lighting Engineers	127	448	80
IRSE	Institution of Railway Signals Engineers	12	27	21
SEE	Society of Environmental Engineers	12	11	3
IWO	Institution of Water Officers	10	335	34
IHIE	Institute of Highway Incorporated Engineers	0	1,599	223
IPHE	Institute of Plumbing and Heating Engineering	0	113	1,064
IMI	Institute of the Motor Industry	0	0	1,026

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