CALLED TO SERVE TWO

RONALD COX

Engineers Ireland

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Presidents of the Institution of Engineers of Ireland 1969-2018

Cumann na nInnealtóirí

THE INSTITUTION
OF ENGINEERS
OF IRELAND

FOUNDED 1835

Ronald Cox

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Presidents of the Institution of Engineers of Ireland 1969-2018

Ronald Cox

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He is a Member of the Institution of Civil Engineers, a Fellow of the Institution of Engineers of Ireland, a Fellow of the Irish Academy of Engineering, a Member of the American Society of Civil Engineers, and the current chairman of the Engineers Ireland Heritage Society.
Recent co-authored publications include *Ireland's Bridges (2003), Engineering Ireland (2006), Ireland's Civil Engineering Heritage (2013),* and *Called to Serve (2014).*

Introduction

Past Presidents of the Institution of Engineers of Ireland (IEI) have interpreted their role in a variety of ways, including chairing meetings of the council and executive, presiding at the presentation of technical papers, and representing the Institution and the engineering profession, both nationally and internationally. The tradition of presenting a presidential address during the term of office of each president was begun in 1856 by George Willoughby Hemans. Since that time, with few exceptions, each president has addressed the membership in their own individual style, often drawing on the experiences gained during their respective careers.

Called to Serve Two continues on from where *Called to Serve* (Cox & O'Dwyer, 2014) ended, has been extended to 2018, and published to mark the 50th Anniversary of the introduction of the title *Chartered Engineer* in 1969 and the unification of the engineering profession in Ireland.

In this book, textual abstracts from the presidential addresses are presented in an historical context. The full presidential addresses are available in various formats, the earlier ones in the Transactions of the Institution of Engineers of Ireland (available at http://digitalcollections.tcd.ie/home/), and more recently in the Annual Reports, in digital format, and often archived online. It is hoped that the abstracts presented in this publication will serve to whet the readers' appetite for a more detailed study of the contents of the individual addresses.

The presidential address abstracts are preceded by a continuation of the brief history of the Institution of Engineers of Ireland from unification with the Engineers Association (Cumann na nInnealtóirí) in 1969 up to the end of 2018. This is presented in order to provide a framework within which the presidential addresses may be considered. It consists of extracts from a similar history, compiled by Finbar Callanan, and published previously in Cox (2006), to which has been added a review of the development of the Institution (now known under its operating name of Engineers Ireland) since 2005. Also included are short biographies of each of the presidents from 1969 to 2018. The illustrations have been mainly sourced from *The Engineers Journal* and *Engineering Ireland.*

The sponsorship of the Electricity Supply Board towards the cost of this publication is gratefully acknowledged and in particular, the support and encouragement of Brendan Delany, ESB Archive & Heritage Manager, and the Heritage Group of the Irish Academy of Engineering.

ENGINEERS IRELAND

Engineers Ireland HQ, 22 Clyde Road, Dublin 4

Part One
The Institution of Engineers of Ireland
1969 - 2018

A history of the Institution 1835 to 2005, authored by Finbar Callanan, appeared in Engineering Ireland (2006) and has been extended by Ron Cox to cover the period from 2005 to 2018. The period of history covered in this publication is 1969 to 2018.

Following the work of the Unification Committee under the chairmanship of Jock Harbison (1921-1975), the passing of the Institution of Civil Engineers of Ireland (Charter Amendment) Act in May 1969 provided for the formation of a new body to represent the engineering profession in Ireland, namely the Institution of Engineers of Ireland (IEI). As well as widening the range of activities, the Act embraced most areas of specialisation in engineering and provided an umbrella and platform for the exploitation and development of these various specialisms and combined the aims and objectives of both Cumann na nInnealtóirí (The Engineers Association) and the Institution of Civil Engineers of Ireland (ICEI), resulting in the unification of the engineering profession in Ireland. The Act also, and most importantly, authorised the use of the title **"Chartered Engineer"**, confined to a category of engineers who satisfy the Council of their professional competence and experience, or who are authorised so to describe themselves by a professional body recognised by the Council.
[The full text of the Act is provided in the Appendix]

Prior to the unifying Act, the Institution of Civil Engineers of Ireland in 1965 decided to sell their premises at 35 Dawson Street and use the proceeds to kick-start a project to construct a new Engineering Centre, which it was proposed should house both the Institution and The Engineers Association (referred to henceforth as the Cumann). Central Council of the Cumann approved in principle of the proposals and indicated its willingness to co-operate in the establishment of the Centre. However, as it turned out, a suitable site or building could not be identified, and plans came to nought. The government vetoed what was considered to be an ideal site, whilst other sites failed to be granted planning permission on appeal. The Institution instead took up an offer from the Cumann to relocate their administration to 22 Clyde Road, the Institution at first renting offices from Irish Engineering Publications Ltd., and to house their library holdings on a temporary basis. University College Dublin, meanwhile, provided accommodation at Merrion Street for lectures and Council and other meetings.

Downstream of the Charter, there had been some problems to be dealt with, as the unionisation of the Electricity Supply Board (ESB) engineers had been gaining momentum and difficulties in the Local Authorities with regard to the truncation of an arbitration award was a source of considerable resentment, which threatened to deflect interest from the process of unification of the profession. It was initially a very difficult two years of intense activity and understandable tension as the seeds of a revamped organisation were being sown, whilst at the same time dramatic changes were taking place in the industrial relations activities and attitudes of many in the profession.

What was remarkable, however, about the years in question was the goodwill and pragmatic approach of all who had a concern for the unity of the Irish engineering profession. For members of the Cumann who had an intense loyalty to the organisation it was not easy to concede that the Cumann would 'go out of existence'. However, as time went on and the process of unification was developed, it became very clear that the ideals, structure, and activities of the Cumann would not only continue, but would be enhanced by the traditions, activities and ideals of the ICEI. Having celebrated its 40th anniversary in 1968, the Cumann, on 12 May 1969, with the full agreement of its members to the Charter, Bye-Laws, Structure, Governance and Title of the new organisation, ceased as such to exist.

The Cumann did, however, survive in the memory of all who had involved themselves in its growth during the four previous decades and in the almost 2000 members of all disciplines who brought such vigour to the new body. It also survives in the title of the present professional body, which in the Charter Amendment Act stated

that the title of the new body shall be The Institution of Engineers of Ireland and in the Irish language Cumann na nInnealtóirí.

Michael Lynn (1920-1982), then Deputy Chief Engineer of the Office of Public Works, devoted an immense amount of time to the new Bye-Laws and structures that were based largely on those of the New Zealand Institution of Engineers (now the Institution of Professional Engineers of New Zealand). Others who made notable contributions were Colm McLoughlin of the ESB, Paddy Mehigan of Nicholas O'Dwyer & Partners and Professor Michael Hogan (1898-1971) of UCD, who was a rock of common sense and the essence of courtesy to all during discussions between the Councils prior to unification.

The original objectives of the ICEI were extended by the Charter Amendment Act (1969) that states that the Charter shall henceforth be construed as providing that the purposes of the Institution shall include

- promoting the acquisition of that species of knowledge which appertains to the profession of engineering and advancing engineering science and furthering by all legitimate means the interests of the said profession and of its members;
- setting up and maintaining proper standards of professional and general education and training for admission to membership or to any category of membership of the Institution, with power to provide and prescribe instruction and courses to study and to conduct examinations for the purpose of maintaining such standards;
- ensuring that the description "Chartered Engineer" or the use of initials or letters having similar significance is confined to a category of engineers who have satisfied the Council of their professional competence and experience, or who are authorised so to describe themselves by a professional body recognised by the Council in that behalf;
- maintaining a proper standard of professional ethics and conduct.

The new professional body was recognized by Act of the Oireachtas as the sole body licensed to award the title 'Chartered Engineer' within the State and to maintain the register of Chartered Engineers.

Joe Fitzgerald

The joint Secretariat of the Cumann and the ICEI, inaugurated in April 1967, was a major asset in the easy transfer of administration to the unified body. Both George O'Hara, Secretary of the Cumann, and Joseph Fitzgerald, Secretary of the ICEI, had contributed significantly to the process of unification and each continued with their respective responsibilities pending the appointment of a Chief Executive, who was to be the Secretary of the IEI. Following the advertisement of the post of Secretary nationally and internationally, Tony O'Brien, who was an executive with Royal Dutch Shell, was appointed Secretary.

Tony O'Brien

In the mean-time George O'Hara had departed to take up a senior position with The Industrial Development Authority (IDA) and Joe Fitzgerald agreed to remain and take responsibility for the expansion of the engineering science side of the multi-disciplinary institution, which was then evolving rapidly.

The agreed administrative structure of the IEI was centered on two main streams - Engineering Science and Social Relations, the latter representing in the main the aims and objects of the Cumann, for example, 'to further by all legitimate means the interests of the said profession and its members'. Both streams had their own Executive Committee reporting to the Council. This structure, unwieldy as it was, worked extremely well in the formative years as it cemented relations between the two parent bodies. As time went on however, a revised and rationalised structure was proposed by the Secretary and strongly supported by the then President, Michael Lynn, and the Council, for the amalgamation of the two executives. This revision and other amendments were agreed, the governing structure subsequently put in place being that which exists in the most part up to the present time.

The Provisional Council of the Institution 1968-1969.

Back Row (L.to R.): K.Madden, R.Leonard, M.O'Brien, J.D.Sheehan, H.Pollock, P.Hennigan, C.McLoughlin, J.Harbison, Prof.Walshe, P.Mehigan, R.Hardwicke; Third Row (L.to R.): D.Hand, M.Harthy, T.Desmond, R.O'Colmain, V.McGill, P.McGovern, P.O'Sullivan, J.Martin, P.Dixon, G.Leyden, G.O'Hara (Secretary, Cumann na nInnealtóirí); Second Row (L.to R.): T.McCann, F.Callanan (Chairman, Central Council), C.Blair, M.Lynn, J.C.Dooge (Chairman), J.Silke, H.Delap, Prof.M.A.Hogan, P.Raftery, F.O'Sullivan (Legal Adviser); Front (L.to R.): R.C.Cox, J.Fitzgerald (Secretary, ICEI).

The early years of the unified body were not without their problems. Before and after unification there were difficulties for the profession in the ESB and the Local Authorities consequent on the non-resolution of salary claims and the increasing moves toward unionisation of the profession. Consequent on the pressures of the time, the IEI agreed to set up a trade union which, it was considered, would allow its members to undertake industrial action on behalf of its members and which the IEI as 'an exempted body' would eschew. This trade union was set up with the title of 'The Union of the Institution of Engineers of Ireland'. However, by the time it was up and running, significant numbers of the profession had already joined established trade unions and as a trade union the IEI union was never an operating or effective entity, although it initially attracted a membership from many of those who considered they needed union protection in their employment, but who did not wish to go outside their professional engineering institution for that protection.

During the period of years prior to and subsequent to unification, a number of reports were prepared concerning the problems arising in the profession, in the Local Authorities in particular, dealing with structure, grades, recruitment, conditions of employment and salaries. In January 1970 a Committee under the chairmanship of John Donovan, Managing Director of Esso Ireland, was formed by the IEI, following the rejection by the Minister for Local Government of an Arbitration Award handed down by Mr T.Finlay SC. This rejection itself, following on from a review conducted by a government-appointed committee under the chairmanship of Liam St. J. Devlin, had resulted in a serious deterioration of attitudes between Local Authority engineers throughout the country and the Minister.

Steps had been taken to arrange for the withdrawal of engineers services and to include the establishment of a 'Fighting Fund' and the action was only averted when the Minister, inter alia, agreed that *'In the event of The Institution establishing a Special Committee to study and report objectively on engineering in practice and administration in the Local Authority Service with particular regard to the economic disposition of manpower in the execution of works, levels of expertise and skills required, career patterns, recruitment incentives, post-graduate training and satisfactory deployment of engineers and support staff, the Departmental Committee that is reviewing local authority engineering organisations would welcome evidence and any assistance from such a Special Committee. Such a Committee would not be precluded from submitting, in conjunction with any recommendations on structure which they make to the Departmental Committee, proposals for consequential salary adjustments which would be passed to the Minister.'*

This high-powered committee of the IEI reported in May 1970 following an intense series of consultations with the various grades of engineers in the local authority service. It was a very comprehensive, detailed and wide-ranging report, covering all aspects of local authority engineering and the report - known as the Donovan Report - was duly submitted to the Departmental Committee. The Committee, under the chairmanship of H. P. Clerkin, Chief Engineering Adviser to the Department of Local Government, issued its report, subsequently referred to as the Clerkin Report, in December 1970. In many respects, this report was not incompatible with the Donovan report.

However, implementation of the recommendations in these reports was held up while a further report, encompassing the total local authority service, and entitled 'Strengthening the Local Government Service' was prepared for the Minister for Local Government by McKinsey and Company, Inc. This report, which was published in December 1971, also included a review of the Engineering Service and it came up with its own set of recommendations with regard to the role of the profession in the local government service.

It can be appreciated that the reports in question did not solve the main problem of the local authority engineers, which was fundamentally the truncation by the government of the Finlay arbitration award, which had been achieved by the profession having fulfilled all the requirements of rational, responsible and non-confrontational negotiation. The problem was, of course, the upset the award would make to traditional relativities, which, regardless of the merit of individual cases, had to be maintained across the board.

This matter was a serious setback to the profession and also a setback to the IEI as engineers in such large public-sector employments as the LAs and the ESB became unionised and the traditional loyalty to their professional body, which had been so noteworthy in the Cumann in particular, became eroded in the case of the unified body. This was in spite of the leading role in negotiations by the IEI to which the Secretary, Tony O'Brien, devoted considerable time and effort in addition to the efforts of the presidents, in particular Jock Harbison, to achieve a resolution to the situation in its early stages.

In spite of those difficulties however, progress was maintained during the decade of the 1970s in regularising the administration and committee structures, in developing the role of the Divisions and Regions, in organising important seminars, in reorganising the library and archive, and most importantly in furthering the concept of the Chartered Engineer (CEng) designation and defining its importance for Irish engineering in the future. This new concept for the IEI was a most important outcome from the Charter Amendment Act 1969 in that it gave, as we have seen, the IEI sole rights within the state to award the title Chartered Engineer to those whose educational qualifications and assessed post-graduate experience merited the award of the title. A system of professional interviews was set up and expanded.

In addition, a procedure for post-graduate training within their employments for graduate engineers leading to chartered status, which was proposed by a committee chaired by J.J.Kelly, Chief Executive of the ESB, was taken up by a number of state bodies in particular. In those employments where it was implemented it was very successful, not only in preparing graduates for the CEng assessment process, but also in affording graduates defined and varied packages of experience and responsibility which were extremely valuable in furthering their subsequent careers.

The IEI was extremely lucky in its choice of presidents following on the lead set by James Dooge and Jock Harbison who, with others, had so ably steered unification and worked so diligently in the foundation years. Each succeeding president, Michael Lynn, Robert Cuffe, and Hugh Delap, did invaluable work in steering the IEI through the subsequent difficult formative years. The advantage that they all had was their individual lengthy experience as senior and active members of the Cumann or of the ICEI or both.

President, Bob Hayes, welcoming An Taoiseach Garret Fitzgerald, to the "Crossroads" Conference held in Trinity College Dublin in 1974.

On becoming President of the IEI in 1974, Finbar Callanan revived the Annual Conference, which had fallen into abeyance, and the "Crossroads" Conference was held in Trinity College Dublin in October of that year. Additionally, the Council agreed to the establishment of a Conference of Engineering Education, drawn from employers and academics, to act as a 'Think Tank' with regard to current and future directions for the IEI. This development was coupled with visits to the various engineering schools with the objective of strengthening ties between the colleges and the profession. Close ties were also established with the National Council for Educational Awards (NCEA) in relation to technician education, a body with which Lucas Collins, had been closely involved on behalf of the IEI. In recognition of the increasing importance of mining in Ireland at that time, coupled with the possibility of a smelter being built, a general meeting of mining engineers was held in Portlaoise, which was addressed by the IEI President. Following the meeting, a new IEI Division for Mining & Metallurgy was established, which in subsequent years proved to be a very vibrant and enthusiastic addition to the IEI's activities.

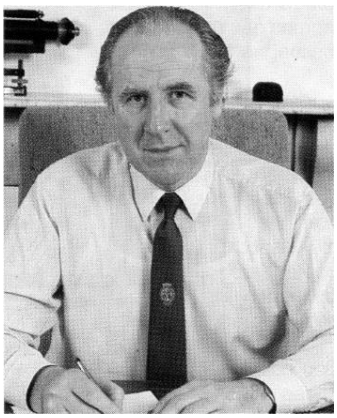
Changes in the administration of the IEI saw Tony O'Brien being appointed Director, Joe Fitzgerald being appointed Secretary, and Maeve Condron being appointed Accounting Officer. These appointments represented the evolution of the IEI into a much-expanded organisation. In 1975, O'Brien left the IEI to return to the oil business and was succeeded by Joe Fitzgerald, who retained the title of Secretary, Matthew (Matt) O'Donovan being appointed to the new post of Assistant Secretary. During his time with the IEI, O'Brien had made an important contribution, not least to the various vocational groups for which negotiations were still proceeding either solely or in conjunction with the trade unions and to which a large proportion of members now belonged.

Also, in 1975, the IEI and the engineering profession mourned the untimely death of Jock Harbison following a short illness. As President of the Cumann and as a council member of the ICEI, he is regarded as having made the greatest contribution of all to the unification of the Irish engineering profession. He was truly the father figure of the united organisation and maintained a profound interest in the growth of the unified body up until his untimely death.

Part of the large attendance at the Annual Conference in 1975

This period of the IEI's history was also over-shadowed by the economic consequences of the oil crisis of 1974/5, which awakened an apathetic world to the genuine threat of interruption of oil supplies from the Middle East and its serious consequences for the world's economies. It certainly awakened consciousness in Ireland of the urgent need to review and develop its own resources to safeguard security of supply for the future. During this time, the IEI maintained its activities, including strengthening its links with academia through the efforts of presidents Jack Barry, Director of the College of Technology at Bolton Street, and Professor William Wright of Trinity College Dublin. President John Donovan, during his term of office, strengthened considerably the IEI's involvement with industry and his wide business experience was invaluable in the administration of the IEI, the Engineers' Club and *The Engineers' Journal,* the last named proving to be an increasingly important communication medium in the expanding organisation.

The ongoing problems of the local authorities were still a cause of great concern, with considerable unrest within the profession that included a work-to-rule by the local authority engineers, which caused considerable difficulties within the authorities in question. Eventually a working party representing all interests, including the Department of Local Government, the IEI, and the unions, was set up under the chairmanship of Tom Hardiman, then Chairman of the National Board for Science & Technology (NBST), to endeavour to bring all outstanding matters to a conclusion. The IEI's interests were led by Patrick Lynch, then county engineer of Galway, and Eoin McNeill, Senior Engineer at Dublin County Council. The Engineers Working Party Report of 1978 at last represented an agreement with regard to structure and remuneration on a dispute which had lasted almost ten years, and which had certainly not enhanced the image of the local authorities as a worthy career choice for engineers. This far-reaching report did much to repair the damage, and while other details had still to be sorted out over subsequent years, there was a very firm foundation on which the profession could build for the future.

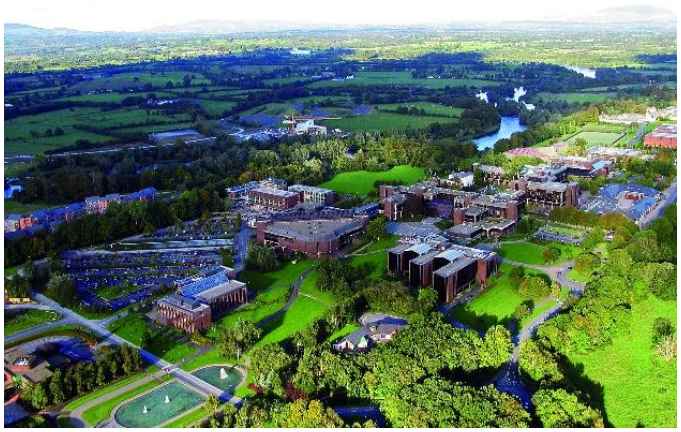


Finbar Callanan

In 1978, Lucas Collins, then Assistant General Manager of Irish Rail, became IEI President, and in addition to the many other functions of the presidency, he set about a review of the staffing and administration of the IEI of the future in the light of the increasing number of graduates being produced by the universities and the regional technical colleges. Ireland was industrialising rapidly and the success of the IDA in attracting new industries into Ireland presaged a growing demand for engineering graduates at all levels. This had obvious consequences for the IEI in how it was to be equipped to play a full and fruitful part in the growth of Irish engineering and in serving its many disciplines. With the forthcoming retirement of Joe Fitzgerald from the post of Secretary, a selection process was put in place to seek a successor as Director of the IEI, who would be Chief Executive. Having completed the selection process, and there not being a satisfactory outcome, it was decided to approach Finbar Callanan, who at that time was Chief Civil Engineer at Bord na Mona, and who had very wide experience of the IEI and of the Cumann, to invite him to take up the post. He agreed to accept the position and, on the 1 June 1979, took up the post of Director of the Institution of Engineers of Ireland, in which he was to remain for the following seventeen years.

Ten years on from unification, the IEI was well established in its structure and in its activities. Divisions, Vocational Groups, Sections and Committees were all very active and membership had climbed to 3,200. This represented an increase of almost 50% in the ten years since unification. However, the largest portion of that increase occurred in the year 1978/79 when under the leadership of the then President, Lucas Collins, and by working through the Administration, Regions, Divisions, Vocational Groups and Committees, a major effort was made to attract new members and to persuade former members to re-join. As a result of that initiative, membership in that year increased by 500. In spite of that success, however, it was still considered that membership of the IEI was not keeping pace with the expansion of the profession in Ireland. To that end it was well recognized that a very vigorous effort had to be made to extend the activities and influence of the IEI as a strong national organization, fully worthy of representing the Irish engineering profession in all its disciplines.

There was, however, a serious problem with financing a significant development programme. The income of the IEI was at the time drawn primarily from membership subscriptions and, in addition, the prolonged postal strike in 1979 did not help matters. The first part of the expansion programme was put in place with the formation of an Energy Division and the setting up of specialist sections within the Electrical Division, namely for Electronics & Communications and for Computer Engineering. Sometime later, in March 2005, a new Division for Fire Engineering & Industrial Safety was established to cater for the significant membership involved in those specialist areas. The formation of these new Divisions and Sections represented a further development of the objective of the IEI, i.e. to be fully representative of all disciplines of engineering including the 'new' disciplines, which were becoming of such importance to a developing economy.



University of Limerick campus (formerly NIHE Limerick)

The IEI President, Morgan Sheehy, then Managing Director of Ove Arup Ireland, together with the IEI Director, Finbar Callanan, undertook visitations to TCD, UCD, UCC, UCG, QUB, NIHE Limerick and Cork RTC with the objective of establishing the strongest possible links with the schools of engineering, and to observe how the IEI could become more closely involved in supporting and furthering the expansion of engineering courses, which were vital for the growing economy. In addition, the Professional Development Council was established to be representative of academia, industry and the IEI and to continue the valuable work undertaken by its precursor, the Conference of Engineering Education, established in 1974.

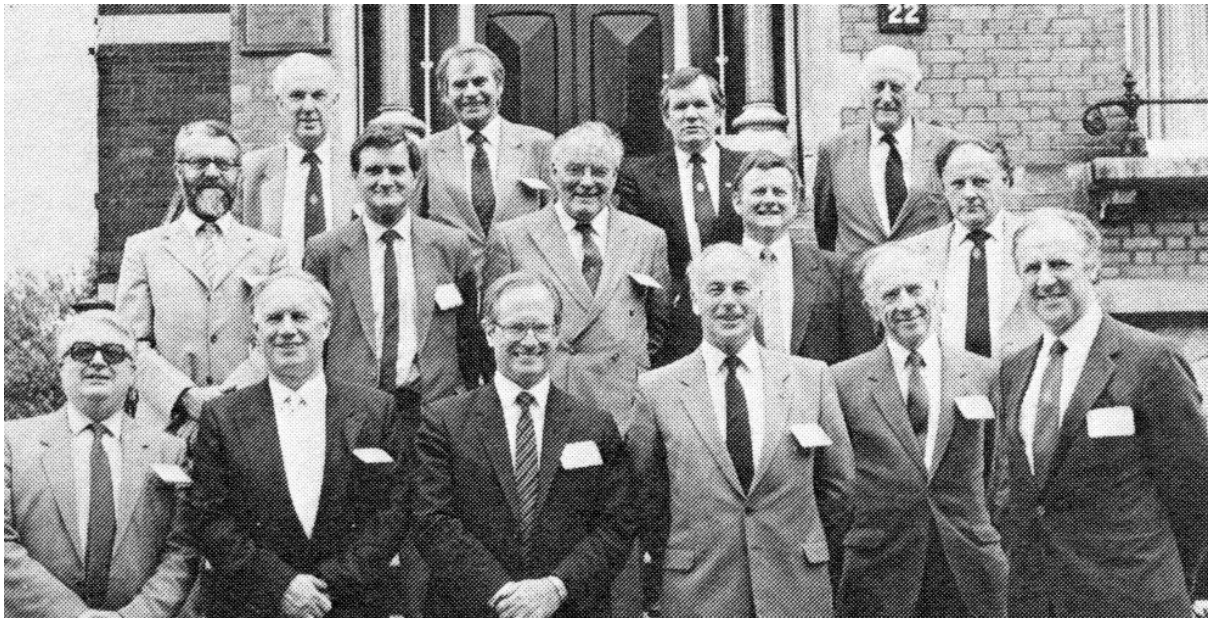
This was also a time of numerous meetings of Local Authority engineers in Clyde Road and elsewhere, as well as meetings of the Local Government Staff Negotiations Board and the Local Government Staff Panel, with regard to matters arising out of the Engineers Working Party Report. These negotiations and the subsequent salary negotiations were given full support by the IEI, the Director having a direct negotiating role. The Local Authority engineers owe a debt of gratitude to all who gave of their time and effort over many years, often in difficult and contentious circumstances, to ensure that the engineering profession, as represented in the local authorities would be enabled to work in a well-structured, forward-looking, and properly remunerated service.

Negotiations and representations continued for the other vocational groups, including Aer Lingus, Aer Rianta, ESB, RTE, Posts and Telegraphs, CIE, and the Defence Forces. This new era of negotiating in association with the unions representing engineers in the local authorities and the ESB caused fewer problems than originally expected and a constructive liaison was maintained at all times. The IEI also maintained a very well-appreciated negotiating role for individual members who from time to time needed the support of their institution.

At the beginning of the 1980s, the actions to be taken to fulfil the objective of expanding the membership and activities of the IEI became clearer. Amongst these was the initiative to draw up accreditation procedures to be implemented by the IEI in assessing the various professional engineering courses, including new courses coming on stream, in the universities and colleges of technology. Accreditation of such courses had traditionally been carried out by the various British engineering institutions, but it was decided that such procedures should in future be carried out by the national professional engineering institution (IEI).

To this end, an Accreditation Committee was established in November 1980, chaired by Lucas Collins, its brief being to prepare a report on a national system of accreditation of professional engineering courses. The report of this committee, which set out in great detail proposed accreditation procedures, was presented to the Executive and Council of the IEI in 1981. The report having been approved, it was circulated to all the schools of engineering that would normally have been expected to apply for accreditation. The report was one of the most important ever prepared by the IEI.

A completely new, demanding, and important area of activity, was opened up that greatly enhanced the image and status of the organisation. The process of accreditation then initiated by the IEI was invaluable in affording the organisation an influential voice in subsequent international negotiations about the equivalence of qualifications in Europe and elsewhere in the world.



Meeting of Civil Accreditation Committee with representatives of Joint Board of Moderators (JBM - ICE/IStructE) at Clyde Road 7 July 1986.
Front Row L to R: John Sutherland (JBM), David Rogers (JBM), Morgan Sheehy, Prof.Tony Cousins, Prof.Eamonn Hanrahan, Finbar Callanan
Second Row L to R: Prof.Declan O'Keeffe, Prof.Tom Casey, Prof.Eamonn Dillon, John Higgins, Matt O'Donovan
Back Row L to R: Dr Ron Cox, Dick O'Flaherty, Oliver McNulty and Prof.John De Courcy.

The initial accreditation exercise by the IEI under the new procedures was carried out in Trinity College Dublin in March and April of 1982. This was followed by the very first accreditation of courses in the National Institute for Higher Education in Limerick (NIHE Limerick), later to become the University of Limerick. During 1983 and 1984 all the remaining universities and colleges of technology requested accreditation and were visited. The accreditation system was controlled by an Accreditation Board under the chairmanship of Patrick Lynch and operated through specialist committees serving the various disciplines.

Coincident with the above activities, the IEI Director, with the support of the Accreditation Board, the Presidents, and the Council, pursued negotiations with the various British engineering institutions with the aim of reaching agreement on a system of mutual recognition of accreditation procedures. The first such agreement was reached and signed with the Institution of Electrical Engineers at Clyde Road in July 1982 and formed the basis of all the subsequent agreements. Agreements were reached with the Institutions of Civil, Mechanical, Building Services and Chemical Engineers, and the Institute of Metals. In subsequent years, accreditation of established and new courses has continued, re-accreditation generally being at five-year intervals.

It had always been recognized that recruitment of new members was vital to the continuing growth and invigoration of the IEI. A number of worthy initiatives had been undertaken with limited success, but it was clear that if the IEI was to increase its membership numbers in line with the growth of the engineering profession in Ireland, recruitment had to become an executive function rather than a committee project. For that reason, a Development Officer, with a background in marketing, was recruited with the sole task of developing and maintaining contacts with the profession and recruiting new members. This initiative worked very satisfactorily over subsequent years and resulted in a steady increase in membership of about 11% per annum throughout the 1980s. This was achieved in spite of the deep recession throughout that decade which saw the greatest emigration of engineering graduates in our history with a consequent attrition in IEI membership.

At this time, it had also become very clear that members required more from their institution than simply the designated titles awarded or the learned, educational and social activities that it provided. Consequently, every effort was made to provide advisory services with regard to career progression and job search coupled with other advantages, such as favourable terms to members for medical, life, car and home insurance and pension

benefits. This was something that had proved of very considerable value to the American Society of Civil Engineers in retaining its membership. As the membership of the IEI grew, it began to become more attractive for companies to offer favourable terms to IEI members for the services they provided, and which were availed of by the members when they were provided. These initiatives were a significant boost to membership and greatly aided the recruitment effort. It is of interest to note that in the seventeen years between 1979 and 1996, membership of the IEI increased by almost 400%.

To assist young civil engineering graduates, who were experiencing difficulties in obtaining employment during the 1980s, the IEI maintained liaison with the National Training Authority (AnCO) who, through the good offices of the county and city engineers, and the active involvement of the then IEI President, Oliver Feighan, introduced training schemes within the local authorities for graduate civil engineers to enable them to obtain their first experience. Additionally, the Director travelled with senior representatives of AnCO to Boston in the USA and made a presentation to the then Mayor Ray Flynn and a large attendance of engineering contractors and consultants with the object of seeking training places for Irish graduates in the USA. This initiative opened up other opportunities and subsequently AnCO set up a system of scholarships to enable some hundreds of electrical, electronic and mechanical engineering graduates from Ireland to obtain their first valuable work experience in Japan. The IEI Director was also involved with William Cadigan, President of the Illinois Chapter of the American Society of Civil Engineers, in the formation of the Irish Engineers & Contractors of Chicago, another group that assisted in the placing of graduates seeking engineering experience.

L to R: M.B. O'Donovan, John McKenzie, Secretary of the Civils, The President, John Derrington, President of the Civils, Geoffrey de Deney, Clerk of the Privy Council and Finbar Callanan.

The internationalisation of the IEI continued through the 1980s, and in 1988 the then President, Pierce Pigott, together with the Director, were the first guests from the IEI to attend the Annual Convention of the American Society of Civil Engineers. This set a pattern for subsequent years with reciprocal visits to Ireland by the presidents and chief executives of the American professional engineering institutions. In 1989, the IEI President, Brian Sweeney, together with the Director, addressed a large meeting of Irish engineers in Boston on the future prospects for development in Ireland and the opportunities that would arise for members of the engineering profession who wished to return to Ireland.

Prior to this, it had been recognized that the United Kingdom was probably the most significant employer of young Irish engineering graduates. Accordingly, it was decided that an IEI Region should be established in London to cater for Irish graduates based in London and the southeast of England, where the greater proportion of the graduates were working. A General Meeting held in the Irish Club in London, and addressed by President John Lang, agreed that a Region should be established. The first chairman was Patrick Lynch, a former President of the IEI, and then based in London. The Region proved remarkably successful in subsequent years in the various activities it undertook and in the involvement of so many members.

Under the chairmanship of Pierce Pigott, and with the active involvement of the Divisions and Sections of the IEI, Continuing Engineering Education programmes developed very actively with a constant schedule of seminars and courses. The new Divisions were enthusiastically active in this regard and the Regions also ran exceptional programmes of lectures, papers and site visits, as well as very successful social events. The recession of the 1980s, however, did militate against the idea of continuing education, as firms that were feeling the pinch were reluctant to invest scarce funds in training. A firm footing was nevertheless established for continuing education that included the provision of updating and refresher courses on a variety of subjects, both in Clyde Road and in the third-level colleges. Special mention must be made of the seminars provided by Max Abrahamson, a noted lawyer and Honorary Fellow of the IEI, on the subject of contract law and the IEI Conditions of Contract, which were revised at the beginning of the 1980s.

In 1983, the IEI Agricultural Division broke new ground by organising a very successful International Congress on Engineering and Food (ICEF). This international conference, the first to be organized by the IEI, attracted over 200 delegates from over 30 countries. This set a benchmark for other international conferences, such as the Mechanisation of Field Experiments in 1984 (also organized by the Agricultural Division), the Technology Transfer Conference (held in 1985 under the auspices of the European Federation of National Engineering Organisations (FEANI)), and the 9th European Conference on Soil Mechanics and Foundation Engineering in 1987 (organised in 1987 by the IEI Geotechnical Society). All these conferences were held in Trinity College Dublin.

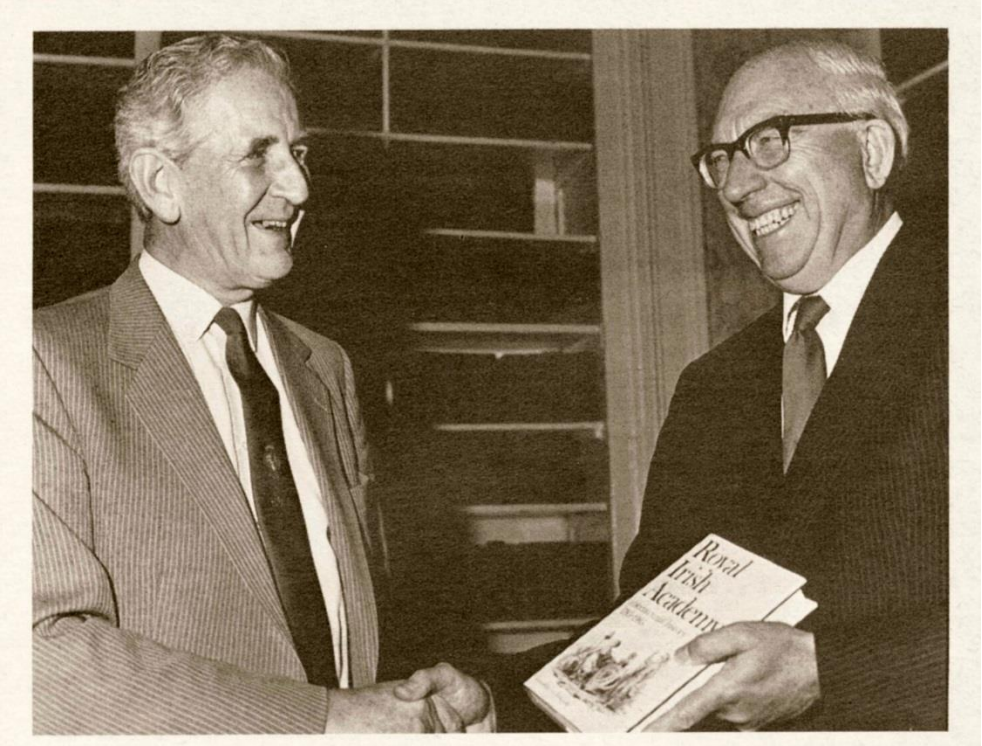
The involvement of the IEI in the European Federation of National Engineering Organisations (FEANI} continued actively with Finbar Callanan taking over as national representative in succession to Professor Wright who, as Vice-President of FEANI, had played such a significant role in representing the IEI in the organisation. Callanan was nominated as President of the Industry Commission of FEANI and had responsibility for the organisation of the 14th International Seminar of FEANI 'Case Studies in Technology Transfer', held in Trinity College Dublin the same week as the IEI's 150th Anniversary annual conference.

The important and significant work achievement of FEANI was the establishment of a register of European engineering qualifications and the creation and furthering of the Eur Ing title - a Pan-European designatory title denoting a recognized equivalence of academic education and training for European engineers, the objective of which was to facilitate the free movement of engineers throughout Europe. This title and its procedures were agreed by FEANI and the first ceremonial conferrings took place in Paris in 1987. The first Irish recipients of the award were the then IEI President, Michael O'Donnell, Professor James Calderwood, and Finbar Callanan. The Irish and British chartered engineer designations were recognized by FEANI as equivalent to Eur Ing.

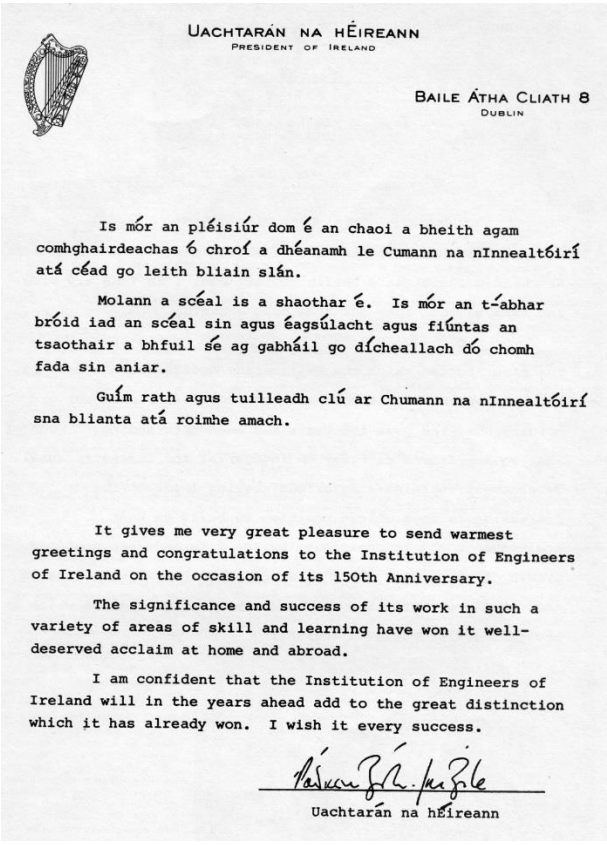
In 1988, following a meeting of the World Federation of Engineering Organisations (WFEO) in London, a meeting was convened by Professor Jack Levy, Director of Engineering of the UK Engineering Council, of national delegates from Britain, Ireland, the USA, Australia, Canada, and New Zealand. The objective of the meeting was to discuss the possibility of agreeing to a process of mutual recognition of professional engineering qualifications. The countries in question had each in place an established system of course accreditation and mutual recognition had already been reached in that regard between Ireland and the United Kingdom. The meeting agreed to pursue the matter with the relevant authorities in their own countries and seek to arrive at a consensus. The IEI Council authorised its Director to actively pursue the matter as it was seen as being potentially of great benefit to the Irish engineering profession.

In November 1989, at a meeting in Washington, the USA, Ireland, Australia and New Zealand became the first to enter into a formal agreement to recognize each other's accreditation procedures. Subsequently, Britain and Canada also signed the agreement, which became known as the Washington Accord and which proved to be a significant step forward in international engineering understanding and cooperation. A subsequent meeting in Dublin in 1994 opened the way for Hong Kong and South Africa to join, which they did in 1995 and 1999 respectively.

Further efforts were made by the Institution to expand the Accord to include the mutual recognition of professional qualifications (CEng, PE, Eur Ing) but, in spite of much good will on all sides and a greatly increased understanding of each other's systems, it did not prove possible to achieve that aim. However, the Washington Accord was a most important achievement in so far as it opened the doors of opportunity for graduate engineers amongst significant countries. Since its first signing, the Accord has played an important role in the internationalisation of the engineering profession.



Dr T K Whitaker, President Royal Irish Academy (right), presenting a copy of "Royal Irish Academy – A Bicentennial History" to Mr J Lang, Senior Vice President, IEI, on the occasion of the Executive Committee meeting of The Institution of Engineers of Ireland at the Royal Irish Academy, Dawson Street, to celebrate the 150th Anniversary of the IEI and the 200th Anniversary of the RIA.



UACHTARÁN NA hÉIREANN
PRESIDENT OF IRELAND

BAILE ÁTHA CLIATH 8
DUBLIN

Is mór an pléisiúr dom é an chaoi a bheith agam comhghairdeachas ó chroí a dhéanamh le Cumann na nInnealtóirí atá céad go leith bliain slán.

Molann a scéal is a shaothar é. Is mór an t-abhar bróid iad an scéal sin agus éagsúlacht agus fiúntas an tsaothair a bhfuil sé ag gabháil go dícheallach dó chomh fada sin aniar.

Guím rath agus tuilleadh clú ar Chumann na nInnealtóirí sna blianta atá roimhe amach.

It gives me very great pleasure to send warmest greetings and congratulations to the Institution of Engineers of Ireland on the occasion of its 150th Anniversary.

The significance and success of its work in such a variety of areas of skill and learning have won it well-deserved acclaim at home and abroad.

I am confident that the Institution of Engineers of Ireland will in the years ahead add to the great distinction which it has already won. I wish it every success.

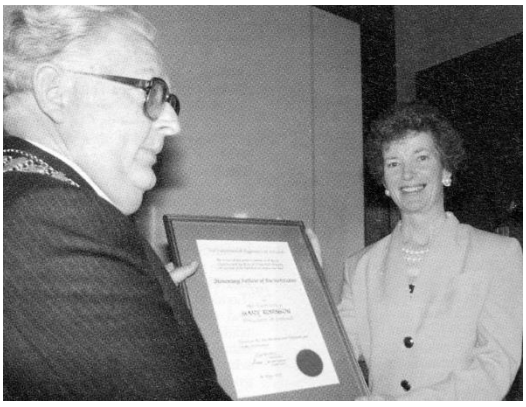
Uachtarán na hÉireann

The year 1985 was a most significant one for the IEI as it marked the 150th anniversary of the founding of the institution in 1835. Many functions were held to celebrate the year and a unique event was held in the Custom House on the 6 August 1985, by kind permission of the Minister for Local Government. A meeting of the Executive was held to commemorate the foundation meeting in the same location as 150 years previously. It was a year of constant activity under the presidency of Robert Hayes, with over thirty individual events in Dublin alone, including a memorable McLaughlin Lecture given by Professor John de Courcy entitled 'A History of Irish Engineering'. The Women in Engineering Year was launched in the following February. This was a very successful venture with a number of activities designed to advance engineering as a very appropriate career choice for women, including seminars and talks by prominent women engineers, media presentations, and the issue of a special postage stamp by An Post. In 1986, just 4% of the IEI membership were women, although the number studying engineering was approaching 15% of the engineering student population.

As the 1990s approached, a major problem facing the IEI was the pressure on space in Clyde Road caused by the greatly increased activities and numbers of meetings, and also the increase in staff numbers occasioned by the expansion in membership. Accordingly, plans were made to build an Education Centre to the rear of the premises, incorporating a lecture theatre, a conference room and an extension to the Engineers Club restaurant. An economic recession meant that it was a difficult time to consider building, but the growth of the membership and the substantial support of fund raising activities by the Regions, the members, and a variety of firms, coupled with the close involvement of President, Séan Wallace, and President-Elect, Michael Higgins, encouraged the IEI to proceed with its plans and the new complex with a 150-seat lecture theatre was opened in 1991 by the then Minister for the Environment, Padraig Flynn.

In the same year, the IEI was honoured by Mrs Mary Robinson, the newly elected President of Ireland, who agreed to accept Honorary Fellowship of the IEI. In 1994, it was decided to avail of the opportunity to take a tenancy of the adjacent premises, number 23 Clyde Road, to provide additional office space for staff and to free up space in number 22 for meetings and courses.

Since unification, the IEI had sought to contribute as much as possible to the many areas of national concern where engineering was seen to have a significant role. Apart from its reports and representations to government with regard to matters of national policy where engineering was involved, the IEI also had a serious concern with manpower planning and the need to keep increasing the supply of engineering graduates at degree, diploma and certificate level. In that regard, it participated fully with the Royal Irish Academy (RIA), the NBST, and the Department of Labour in the manpower conferences of the early 1980s that proved so important in pointing the way to future developments.

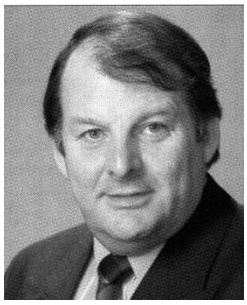


President Mary Robinson receiving her Certificate of IEI Honorary Fellowship

At that time also, a very positive effort was made by the IEI, through its Young Engineers Section (founded in 1980), to project engineering to school leavers through a series of well-attended lecture and demonstration events in TCD. These were a forerunner of a variety of events organised by the IEI in subsequent years in Dublin and in the Regions to further engineering as a career. There was a greatly increased interest in engineering as a career amongst school leavers and, even during the worst of the economic depression of the 1980s, there continued to be a great demand for places on engineering courses, which of course bore fruit in the eventual economic expansion of the 1990s.

The Library and Archive at Clyde Road provided a service for members and researchers. Matthew (Matt) O'Donovan, in addition to his duties as Secretary, particularly on the learned body side of the Institution, had an abiding interest in its preservation and expansion. The one-time Honorary Librarian, Noel Hughes, devoted considerable time and effort over many years to the good order and cataloguing of the Library and his book *Irish Engineering 1760-1960* drew considerably on the historic volumes and records of the library. Amongst those who made significant contributions to the work of the Library and Archive, were Past-President Peter O'Keeffe, Professor John de Courcy, Jock McEvoy, Ron Cox, Eoin O Cionna and the Librarian, John Callanan. In 2010, much of the pre-1970 archival material was transferred to the care of the staff of the Irish Architectural Archive (IAA) in 45 Merrion Square in Dublin to form the Engineers Ireland Archive, accessible by members and the general public in the reading room of the IAA. In place of the library at Clyde Road, a Technical Information Centre was established and manned by John Callanan. In 2015, recognising that information sources had become largely web-based, the information centre was disbanded.

The practice of the IEI Regions hosting the Annual Conference in turn, which commenced in Limerick in 1979, and continued in Kilkenny in 1980, was a resounding success. The practice did much to strengthen the Regions themselves and the contribution of the members to the organisation of the IEI throughout the country. Major annual conferences have been held every year since then and have addressed a range of national issues.
The IEI continued to foster close relations with other professional bodies and trade associations in matters of common purpose, particularly in the construction industry. This has been particularly so in the case of the Association of Consulting Engineers of Ireland (ACEI), which body has at all times been fully supportive of the IEI and whose members have contributed significantly in time and involvement to its activities.



Frank Burke

Through the 1990s, the IEI expanded considerably as recruitment and new activities and services, coupled with an improving economy, saw membership increase to a total of 13,000 by 1996. Staff reorganisation resulted in the Director becoming Director-General, supported by four Directors appointed to be responsible for Education, Development, Finance and Membership & Qualifications, representing the prime administrative functions. Notable fund-raising efforts over a number of years enabled the outstanding debt on the Education Centre to be paid off by 1997.
At the end of March 1996, Finbar Callanan retired from the position of Director-General and was succeeded by Frank Burke.

The Irish Academy of Engineering

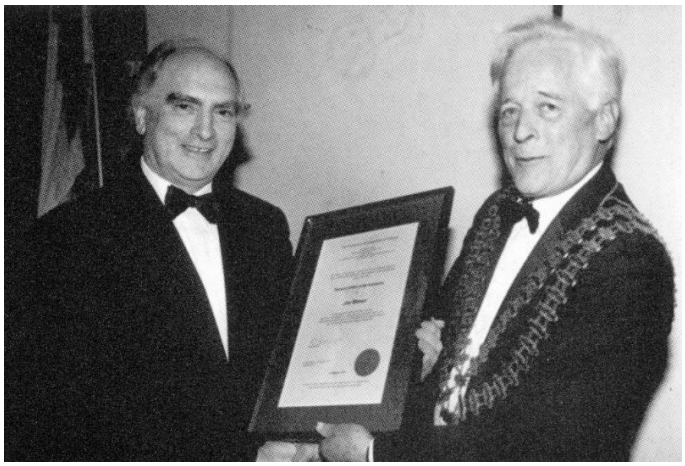
Prior to his retirement, Callanan had made a proposal to the Council of the IEI that an all-Ireland Academy of Engineering be set up, its membership to be made up of the most senior and eminent engineers in the island of Ireland. The idea was that such an Academy would harness the experience and wisdom of such members, many of them retired, who would provide a most useful and influential 'think tank' concerning matters in which engineering plays an important role. Elsewhere, such an Academy had been formed in Britain in the early 1980s (The Royal Academy of Engineering). It had been most effective in its operations and had earned an enviable reputation for the work it produced. Similar academies had also been set up throughout Europe and further afield, all with the same concept of availing of the contributions of the most eminent and experienced engineers and applied scientists in the service of their respective countries. The proposal to set up the Irish Academy of Engineering (IAE) received enthusiastic support from former IEI Presidents, Liam Fitzgerald and John Killeen, as well as from IEI Honorary Members, Sir Bernard Crossland and Sir Philip Foreman, and from Gordon Millington, OBE, Hon FICE from the North of Ireland. Killeen, who had worked very diligently to get the Academy up and running, was appointed its first President with Finbar Callanan being appointed Secretary. The IAE was formally launched on 26 May 1997 by Phillip Callery, the then President of the IEI. The Inaugural Address was given by Dr Tony Barry, Chairman of CRH plc, who spoke of the importance of the Academy in a developing technological economy and the contribution that it could make to engineering thinking and policy making in the Ireland of the future.

The IAE is a learned society of the engineering profession, the objective of which is 'to advance the science and practice of engineering in Ireland as an essential element in national development and the enhancement of living standards'. As an all-Ireland body, the Academy performs a most important role in linking the engineering profession in both jurisdictions on the island in matters of common interest affecting the island. It is a completely independent body with its own governing council and was established by the IEI to be so. The Academy continues to receive financial support from the IEI (now Engineers Ireland) to assist it in pursuing its objectives, its administration having been initially managed by the ACEI, which provided secretarial and accountancy services and accommodation for meetings of the Academy. During the session 2008-2009, the IEI was able to provide accommodation in Clyde Road into the future for the administration staff of the IAE.

Membership of the Academy is currently limited to 150. Nominees for membership must be shown to possess demonstrable achievement and eminence in their careers and election to the Academy is recognized as a significant acknowledgement of such achievement and eminence. In pursuit of its objectives, the Academy produces reports and commentaries on what it recognizes as important and relevant topics on which it wishes to comment. These reports may be prepared either by the Academy acting on its own, or in conjunction with Engineers Ireland or other parties. Such reports have featured investment in education, spatial strategy, energy, transport, mathematics and management in engineering education, environment, and future industrial and economic development among others. The reports are widely circulated to government elected representatives, and other organisations and individuals to whom such reports are deemed to be relevant.

The Academy is very active in the European Council of Applied Sciences & Engineering (Euro-Case) and maintains a close relationship with the Royal Academy of Engineering, with whom it has exchanged study visits. It also maintains contact with the Swedish Academy. The Academy seeks to maintain a close relationship with the two administrations on the island of Ireland and to be recognized as a valuable source of independent comment on matters of overall policy North and South, in particular where engineering has an important role.

In order to maintain high rates of growth in the economy, it was realised that the numbers of graduate engineers and technicians available to the various sectors of the economy needed to be increased substantially and that this could only be achieved by increasing government and private investment in the third-level educational institutions.



Joe Moran, Chief Executive, ESB receiving his Certificate of IEI Honorary Fellowship from the President, Pat Jennings

In the decade from 1995, the demand for new graduate engineers had been increasing by 14% per annum, but the supply of new graduates from the universities had not kept pace and had been increasing at the rate of only 4% per annum. For this reason, the IEI, in late 1999, in partnership with the Department of Education and Science, Forfás, FÁS, and many leading high-technology industries, established a substantial Science, Technology and Engineering Programme for Schools (STEPS) to encourage secondary-school students to choose engineering as a career. It was initially set up to approach sixth-year secondary-level students, but was later extended to cover primary schools.

It was evident that the prime objective of the professional engineering institution from its inception was to function as a learned society in updating and advancing the knowledge and expertise of its members. This role had obviously grown in importance with the rapid pace of technological change and the recognition that the half-life of new knowledge was estimated to be five to seven years. Apart from the academic course followed in a university or technological institute the other important element in the formation of a young engineer was a

period of satisfactory training and experience. Persons are required to satisfy the academic requirements for corporate membership and to obtain suitable training and experience in the practice of engineering for at least four years after graduation before applying for chartered status. Normally this four-year period is expected to comprise two years basic training followed by two years training appropriate to the graduate's engineering specialisation.

Guidelines were prepared that set out the desirable features of both the training and responsible experience periods. These laid down that the training should preferably be on an organised structured basis under the guidance of a professional engineer who could provide the necessary direction and advice and monitor and certify the young engineer's progress. Some flexibility however, has been allowed depending on the particular specialisation and the firm or organisation providing the training opportunities. After completing the basic training and being introduced to different facets in the practice of engineering, a young engineer is gradually encouraged to exercise judgment and undertake responsibility in a professional capacity.

Engineers, in common with fellow professionals in other disciplines, regard their initial formation as only a foundation on which to build their competence and expertise. Their effectiveness and the contribution that they make in practising their profession is largely influenced by the extent to which they are up-to-date and capable of operating at the leading edge of the technologies that are relevant to their day-to-day work. Engineers Ireland continues to be engaged in an active Continuing Professional Development (CPD) programme to continually update the professional skills of engineers right through their careers and concentrates its efforts on creating a close and mutually reinforcing link between the organisation, its members and their employers. The aim is to accredit every significant employer of engineers that has a CPD programme meeting the exacting standards of the professional body.

Whilst much of the requisite knowledge can be and is acquired in the normal course of the work of engineers through interaction with colleagues, customers and suppliers, it most likely needs to be supplemented through private study and attendance at courses and seminars. Engineers Ireland, through its divisional boards, regional committees and specialised groups, organizes an extensive programme of lectures, seminars and diverse other activities to meet identified needs. It also assists and works in close cooperation with the engineering schools and other organisations offering suitable programmes of further study.

Since its foundation, much had been achieved by the Institution through the foresight, dedication and commitment of its members to advancing the interests and standards of engineering and the engineering profession in Ireland. There would be continuing challenges if the members of the engineering profession were to keep abreast of the rapid pace of technological change, thus ensuring that the profession makes its proper contribution to the continuing development of the Irish economy and improving the quality of life of its citizens. To quote from an earlier IEI Mission Statement: “Our members serve society through the highest standards of professional engineering. We seek to improve the quality of life for all, creating prosperity and adding value through innovation and the promotion of health and sustainable development”.

In 1996, the lEI organised a very successful series of events under the title of “A Celebration of Irish Engineering”. The idea behind this celebration was to bring home to all sections of Irish society the past and present contributions of engineering to Irish life and national development. The “Celebration” received encouraging support from academia and employers and was a significant boost to the lEI and to Irish engineering in general, as it tracked a course from a largely agricultural society to a new era when engineering could be seen as one of the main engines of change. A feature of that time and succeeding years was the return to Ireland of many of the graduates who had emigrated in the 1970s and 1980s and who returned to Ireland enriched by the valuable international experience that they had garnered in the meantime and which contributed so much to the subsequent phenomenon of the “Celtic Tiger”.

Prior to his IEI presidency, Philip Callery devoted considerable time to the position of Chairman of the lEI Road Transportation Committee, out of which a comprehensive series of submissions on road accidents were presented to government that presaged many of the actions taken by government in succeeding years to limit

death on the roads. Others who gave very valuable service in this and other areas of transport policy were Past-Presidents Patrick Jennings and Richard Grainger, the Chief Civil Engineer and Chief Mechanical Engineer respectively of Irish Rail.

In 1997, Gordon Millington was elected President, the first member from Northern Ireland to occupy the position and his election was an appreciation of his work for the lEI throughout his career, not least in his efforts in furthering north-south relations and his major role with others in setting up the very successful Northern Ireland Region of the lEI, of which he was first Chairman. The Millington Report on Accreditation, which was revised under his chairmanship, was a very valuable exercise in updating the former procedures in the light of experience gained since the early 1980s.

The growth of the economy was reflected in the continuing expansion of the lEI membership and its influence. In 1997, a steering group was established to oversee the workings of the lEI under the title of 'New Directions'. The impetus of the review was threefold. Firstly, it was felt that a root and branch review would be fruitful; secondly, in the light of a doubling of membership in the previous five years, to consider if it were possible to obtain a further doubling in the next five year period; and finally, it was felt that there was a need to review the purpose, governance and structure of the lEI to ensure its continuing relevance and success well into the following century. This strategic review and corporate plan was unveiled in May 1998 and subsequent years saw the vigorous implementation of the strategies that had been proposed.

Under the guidance of IEI President Jack Kavanagh, special emphasis was given to the promotion of the Chartered Engineer concept. Revised procedures for assessment for chartered status had been drawn up and the value of the designation in enhancing the profession by the recognition of academic qualification, followed by well-attested experience and responsibility, was continually emphasized, not only to the proposed applicants, but also to all who had a concern for the education and post-graduate training of engineers.

Following the unification of the profession in Ireland in 1969, the role of technician engineers and technicians within the lEI received considerable attention. There was always a very strong realization that the availability of such graduates from the Colleges of Technology and the Regional Technical Colleges had been a significant plus in the development of modern Irish industry, and it had been a constant objective to enhance the appreciation of their skills, qualifications and status within the lEI and with industry and the public.

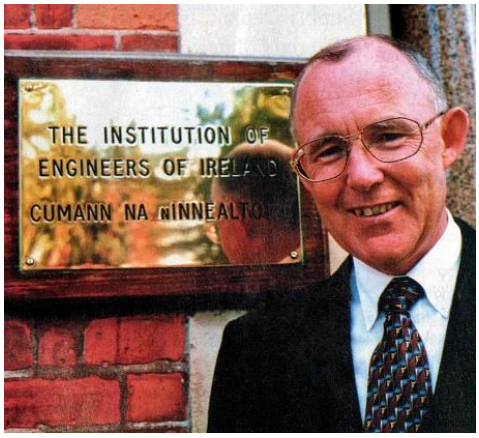
In that regard, Michael O'Donnell, Director of the College of Technology, Bolton St and a Past-President of the lEI had been a strong advocate of the need to accommodate technician engineers and technicians within the lEI's structure, and to recognize their qualifications and contribution within the family of engineering. His contribution was very great, as was his knowledge and advice as Chairman for many years of the Membership & Qualifications Board in assessing the great variety of qualifications of all candidates applying to the lEI for any of the grades of membership. He had strongly supported the AEng review committee, which had met under the chairmanship of Tim Corcoran, and which had produced a report on the procedures to be adopted for the award of the designatory title AEng (Associate Engineer) to those who had qualified with a three-year diploma in engineering, and who had appropriate and responsible engineering experience following graduation. Additionally, procedures for providing ladders of advancement from diploma to degree level for graduates, and who wished to avail of such opportunities, were reviewed and revised.

The implementation of a corporate plan set the scene for much of the lEI's activity as it moved into the next century. The programme of Continuing Professional Development (CPD) was instituted in 2000 and continues to expand. The lEI established strong links with industry and other organisations employing engineers and engineering technicians, with the objective of encouraging the development of vigorous and well-defined training programmes for their engineering personnel. These programmes were accredited by the lEI, for their value in furthering the formation and contribution of engineers in the pursuit of their employment, and in their approach to chartered status. This was a most successful venture and the take-up by employers was most encouraging. In 200l, during the presidency of Liam Connellan, the Department of Trade and Employment agreed to provide matching funding for a three-year programme to accelerate the implementation of this CPD

programme in the light of its national significance. Additionally, in 2002, in pursuance of the Corporate Development Plan, the number of IEI Divisions was increased from 10 to 12 with the addition of an Information Division (ICT) and a new Local Government Division. These changes reflected the expansion in the nature, disciplines, requirements and volume of the membership.

A historic step was taken in 2001 with the accreditation of the first four software engineering degree courses offered in Irish colleges. This was significant in that it marked the formal introduction of a new discipline to the IEI that allowed such graduates to apply for chartered membership. Much of the credit for these important developments must go to Professor Jane Grimson, the first woman president of the IEI, who worked diligently to forge a valuable Memorandum of Understanding between the IEI and the Irish Computer Society, thus ensuring that this new and important engineering discipline was appropriately recognized by the IEI.

Director-General Frank Burke had resigned from the IEI in 1999 to set up a private consultancy and, on his retirement was replaced temporarily by Past-President Pierce Pigott pending the appointment of a successor. During his tenure of office, Burke had done invaluable work, particularly in strengthening and expanding the international links of the IEI with FEANI and with the Washington Accord. He was also a founder member of the IAE.



Paddy Purcell

In September 1999, Paddy Purcell was appointed Director-General and, until his retirement in 2004, served with considerable dynamism and enterprise in implementing the corporate plan, which had proved of such benefit to the activities and governance of the IEI as it faced ever-changing challenges. A revised and comprehensive Code of Ethics was drawn up that received widespread favourable comment, and which set the ethical standards for the membership of the engineering institution to follow for many years ahead. Additionally, the corporate governance of the organisation continued to be strengthened and the public relations, particularly communication with the media, government, and the public were considerably enhanced.
Since unification, the IEI had always placed emphasis on the necessity to continually encourage second-level students to opt for engineering as their career choice. Increasing competition from the wide variety of course options at third-level meant that there was a greater necessity than ever to sell engineering as an attractive option for school leavers. Following the successful launch of the STEPS programme in 1999, it was extended in 2001, and a major STEPS road-show launched by the then Taoiseach, Bertie Ahern, the show being visited by many thousands of students. The project continues to receive endorsement and financial support from industry and the government.

Along with the then Registrar, Denis McGrath, the Director-General was very active in the international forums in which the IEI was involved and was in 2001 a signatory to the Engineers Mobility Forum (EMF), the aim of which being to establish an international register of professional engineers with equivalent vouched education and training. In the case of Ireland, chartered engineers with seven years post-graduate experience and a proven record of CPD involvement would be eligible. The other signatory countries were UK, US, Hong Kong, China, Australia, New Zealand, South Africa, Canada, Japan, Korea and Malaysia. The Director-General also signed the Sydney Accord, a mutual accreditation agreement related to technology qualifications (three-year diploma) the other signatories being UK, South Africa and Canada, with the expectation that Australia, New Zealand, Hong Kong and China would also sign in due course. Paddy Purcell retired in June 2004, having left a significant and memorable mark on the IEI and was succeeded as Director-General by Kevin Kernan, the organisation's Industry Liaison Director.

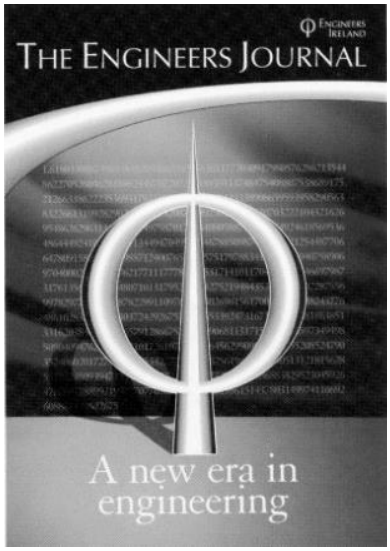
Successive holders of the office of President, Gerald Byrne, Brian Kearney, Peter Langford, Paddy Caffrey, and Anne Butler, each shared a vision of the objectives to be fulfilled in advancing the cause of engineering in Ireland and invariably these objectives were achieved to the benefit of the profession and the Institution.

On 23 October 2005, in the presence of the IEI President, Anne Butler (2005-2006), the then Minister for Enterprise and Employment, Micheal Martin, opened a new Education Centre and ancillary offices to the rear of the Clyde Road premises, a €4 million investment. This valuable addition to the Headquarters was a very positive vote of confidence in the future of the Institution and was a fitting tribute to the members of the profession in Ireland, and in its way a singular tribute to all who, in the previous 170 years since the foundation of the Institution in Dublin's Custom House, contributed by their involvement and commitment to today's thriving profession. During those years, much had been achieved by the Institution in advancing the interests and standards of the education, training and practice of the engineering profession in Ireland. It was considered that there would be continuing challenges if the members of the profession were to keep abreast of the rapid pace of technological change, thus ensuring that the profession made its proper contribution to the continuing development of the Irish economy, and to improving the quality of life of its citizens.

Kevin Kernan

During the presidency of Anne Butler, in October 2005, the Institution was re-branded as *Engineers Ireland (EI)*, the operating version of the organisation's full legal title of *The Institution of Engineers of Ireland*. This was done in order to make the organization better known amongst the general public and those young people who were contemplating an interesting, varied and very rewarding career in the profession of engineering.

> ***Engineers Ireland*** **was thus well placed to play a most important role in the further development of the economies of both jurisdictions within the island of Ireland.**



The emphasis was now on the word 'engineers' and the new corporate identity brought with it a renewed energy and created new initiatives to promote the engineering profession. The Institution's portfolio of communications material was reviewed and the website redesigned, resulting in a strong, consistent corporate identity and improved communication with and between Regions, Divisions, Societies and Members.

The *Engineering a Knowledge Ireland 2020* report, prepared by a Task Force chaired by Liam Connellan, indicated that Ireland required an increase in supply of engineering professionals and technicians of 7% per annum, IT professionals and technicians of 6% per annum, and engineering and IT PhDs of 13% per annum. The report, published jointly by Engineers Ireland and the Irish Academy of Engineering, was of major significance to the profession and documented the pivotal role that engineers had played in Ireland's economic success.

Changes were made to the format of the Annual Conference, making it more relevant to greater numbers of members. The new format was launched in April 2006, featuring parallel sessions and workshops on topics of interest to younger members, as well as a forum for debating issues of interest to all types of engineers. The practice did much to strengthen the Regions and the contribution of members to the organisation of IEI throughout the country.

During 2006, under the presidency of John McGowan (2006-2007), a new Corporate Plan 2006-2009 was introduced, which built on the preceding corporate plan, while focussing on the following two core strategic objectives:

- Achieve recognition by society of the professionalism and technical competence of the various grades of engineers, leading ultimately to broadened statutory reservation of functions for engineers, and
- Increase the number of engineers on the island as an enabler of continued economic development, while seeking to maximise the membership of Engineers Ireland (EI).

In June 2006, EI hosted a series of International Engineering meetings at Clyde Road. 37 delegates from 11 countries came together to discuss matters of mutual international recognition. The CPD Accreditation Scheme for employers reached a new landmark with 60 of Ireland's leading lifelong organisations having earned the right to use the distinctive CPD accredited company logo. Engineers Ireland's accreditation processes received a major boost with the extension of the Institution's membership of the Washington Accord for a further six years.

For the first time, the presidential address was webcast, facilitating global access by members and the general public. The Annual Conference, with the theme *Engineering Action*, was held in the conference facilities at the Croke Park Stadium, where energy was a major issue. Membership reached an all-time high of 22,784. A new three-year agreement was concluded with publishing partners IFP Media, including *The Engineers Journal.* The STEPS programme underwent a major review and was rebranded as STEPS to Engineering and became more closely integrated with the national Discover Science and Engineering (DSE) programme.

Minister for Education, Mary Hanafin, TD, launching the renewed STEPS to Engineering programme

In February 2007, *Engineering! A Week of Wonder!*, promoted by the STEPS to Engineering team, was inaugurated with the aim of increasing public awareness of the diversity of engineering and its contribution to society. Funding was received from the DSE fund and from the Department of Trade, Enterprise and Employment (DETE) to develop and expand the STEPS to Engineering programme and the *Engineered! A Week of Wonder!* In February 2008, the latter was launched by President of Ireland Mary McAleese, and over 12,500 persons participated.

In September 2007, John Power became Director General in succession to Kevin Kernan, who had served the Institution well during his six years at Clyde Road. Engineers Ireland continued to have strong links with government, particularly with the departments of Enterprise, Trade and Employment, Energy and Natural Resources, Transport, Finance, and Education and Science, at both official and ministerial levels, and the EI contribution to the development of public policy continued to be recognised and appreciated by government.

In his presidential address, Jack Golden (2007-2008) outlined how the study of leadership had evolved and emphasised its importance for engineers and the engineering profession. He believed that our leadership as engineers would have a vital role to play in shaping our society and in overcoming challenges such as population growth, global warming, and the development of our natural resources.

John Power

The Annual Conference was held in Limerick and dealt with the economic, social and infrastructural challenges facing Ireland downstream of the "Celtic Tiger" years. The conference was an opportunity for engineers throughout the island to influence important decisions for the future of our economy, and this was recognised by the participation in the conference of three government ministers.

Following the decision of Council in 2006 to raise the standard for Chartered Engineer (CEng) to Masters degree level from 2013, a task force under the chairmanship of Liam Connellan was established to oversee implementation and to initiate a wider debate around what it would mean to be an engineer in the future. In 2007-2008, the STEPS to Engineering programme reached 80,000 students through 1,800 events and over 300 entries were received for the new EXperience engineering project for primary school students. Success in securing additional funding from the DSE fund and the DETE provided the means of continuing the expansion of core activities on behalf of the membership. It was stressed that the Marketing and Communications areas were critical functions for Engineers Ireland and for the engineering sector in general.

International Women's Day was celebrated for the first time with a student seminar to create a positive awareness amongst female students about the opportunities that existed in the engineering profession. A fourth edition of the publication *Engineering Your Career*, researched in 2006 by Professor Gerald Byrne, was sent to all secondary schools in the country. Companies involved in the CPD Accreditation scheme were employing in excess of 21,000 engineering professionals and the scheme broke new ground with the first hospital department, the first indigenous software company and the first organisation in the North West region, all receiving the hallmark of "CPD Accredited Company". During 2007, over 115 training courses, seminars and "technie brekkies" were organised by the CPD training team, and almost 3,500 attended the events, both in the Education Centre at Clyde Road and in the Regions.

It was considered that, in a number of respects, the engineering profession in Ireland was fortunate in that it was well established and enjoyed a good status in society. Many of our more able young people was embarking on engineering courses directly on leaving school and it was widely acknowledged that the standard of graduates coming out of Irish engineering schools compared favourably with those of many other developed countries.

The year 2008 had marked the end of the so-called "Celtic Tiger" era and the country had entered a period of recession, but it was felt that the "Smart Economy" approach by government offered a way out.

A major and far-reaching decision was made in September 2009, when Council decided to decouple ordinary membership (MIEI) from chartered membership (Chartered Engineer) and to open-up membership to a range of graduates from pass and honour degrees in engineering and cognate disciplines. At the same time multiple paths to chartered engineer were to be provided. This was considered important as it was anticipated that many engineers would continue to emerge from universities and third-level institutes of technology without masters-level qualifications and would need to acquire additional qualifications through a variety of routes, including part-time programmes, a mix of accredited prior learning, CPD and academic endeavour. The National Qualifications Framework provided a solid foundation for the challenges resulting from the Engineers Ireland decisions taken in 2007. Membership was opened, not only to Level 7 and Level 8 university graduates from

accredited courses, but also to Level 7 and 8 graduates from cognate undergraduate courses in the physical sciences, computing and mathematics whose careers, in practical terms, positioned them as engineers.

In 2009, Engineers Ireland (EI) found itself debt-free and the redevelopment of the premises at Clyde Road fully paid for. The ground rent on No.22 was also bought out. The EI management set itself the following goals:

- To be the trusted and influential voice of engineering in Ireland by 2012;
- To double the fee-paying membership to 35,000 by 2012;
- To double its income; and
- To be an organisation that delivers excellence through, and for, its people.

Regulation of the engineering profession in Ireland was seen as an urgent issue.

In 2009, the 40th anniversary of the 1969 Provisional Council was celebrated, membership of which had consisted of the joint Councils of The Engineers Association and The Institution of Civil Engineers of Ireland prior to unification. In its 175th Anniversary Year (2010), Engineers Ireland launched a new web site and reviewed and updated its Code of Ethics. A 175th Anniversary Concert was held on 16th July 2010 at the National Convention Centre in Dublin before an audience of some 1000 members, families and friends. Fifty members were invited to Aras an Uachtaráin to mark the anniversary.

Pictured at the Annual Ball in 2010 were the Engineers Ireland President, Dr Chris Horn, Domhnall Blair, and John Power, Director General, Engineers Ireland. Domhnall was presented with an award in recognition of his services to the Institution over the previous forty years.

There was further encouragement of CPD and a Job Seekers' Network was established to assist unemployed engineers. The CPD Accredited Employer Scheme continued to grow and had 120 members. Carlow IT became the first educational organisation to achieve CPD accreditation. The critical outreach role played by the STEPS to Engineering programme was helping to demystify maths and science in primary and post-primary schools. Sustained emphasis on innovation for the global market was seen as the highest national priority in yielding sustainable development. The president, Chris Horn (2009-2010), represented the engineering profession on the Taoiseach's Innovation task force, which reported in March 2010. The report emphasised the central and critical importance of engineers and engineering in the future of the Irish economy.

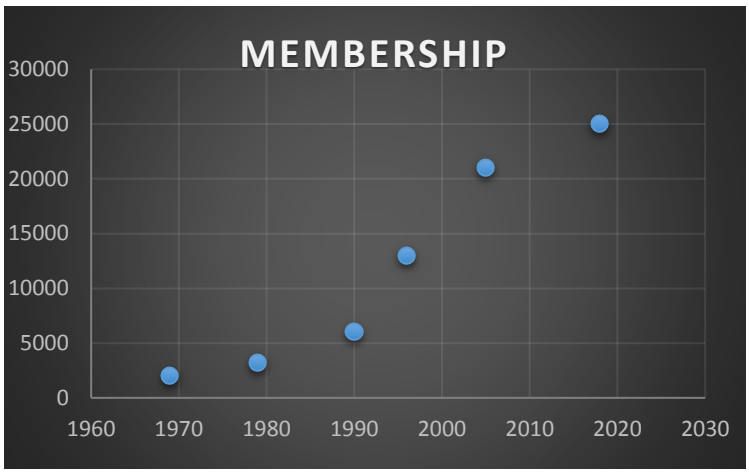
A task force, under the chairmanship of the then Vice-President, P.J.Rudden, produced an important report on the teaching of mathematics and sciences in the school secondary system. There was a meeting with the Chinese Academy of Engineers and recognition agreements were signed with Engineers Australia, Bahrain, and the Institution of Electronic and Electrical Engineers. A new overseas Region was established in the United Arab Emirates (UAE).

The 2010 Annual Conference was held in Cork and examined the leadership role that engineers must play in the next decade. Like other annual conferences, it provided an excellent networking opportunity for delegates and was an occasion, not only to renew old friendships, but also to meet new colleagues in the profession. As importantly, it was seen as an opportunity to learn of best practice across the profession and to be inspired by some of the exciting and innovative developments in Ireland.

The Director General, John Power, considered that the goal of the Institution must be to continuously raise the profile of engineers, Engineers Ireland, and the engineering profession. He considered that we needed to create an environment among policy makers whereby they automatically think of Engineers Ireland as the trusted and respected voice of engineering in Ireland. The financial integrity of Engineers Ireland was maintained in a difficult year for the economy thanks to the diligence and proactive management of revenues and costs by John Power, and the Financial Controller, John Byrne. In July 2010, proposals for the "Regulation of the Engineering

Profession in the Republic of Ireland" were submitted to the Minister for Environment, Heritage & Local Government. The essence of the proposals was that every engineering process or project that has an individual or public health and safety dimension, is of significant value/cost, or potentially damaging to the environment, would only be authorised by a Chartered Engineer.

During the presidency of Martin Lowery (2010-2011), EI highlighted the contributions made by Irish engineers and Irish engineering to many aspects of Irish society. The inaugural Excellence Awards, held on 6th November 2010, showcased the contribution made by modern Irish engineering to the enhancement of the quality of life and living in Ireland. In the same month, a CPD Symposium was held, CPD being seen as a strategic means of strengthening the engineering profession in Ireland. Engineers Week highlighted the importance of Maths to the economy and the STEPS to Engineering programme continued its vital contribution, 84,000 attendees enjoying 750 events during the year. A new graduate programme, "The Future Professionals Programme", was launched in partnership with industry. A memorandum of understanding was signed with the National Standards Authority of Ireland to cooperate in areas of mutual interest.



In April 2011, Council approved a process whereby graduates of Level 6 accredited courses could become members of EI. Council had previously in November 2010, approved a document mapping out pathways by which members with differing educational backgrounds could become Chartered Engineers. By broadening the membership base, it was hoped to extend the influence of EI on engineering in Ireland and create a culture of ongoing learning and professional development as members pursued the gold standard of CEng. Damien Owens was appointed Registrar in July 2010 in succession to Denis McGrath. Accreditation of Level 9 engineering degree programmes began with visits to DCU and UCD, accompanied by a review team from the Washington Accord.

Engineers Ireland gained "Excellence through People" accreditation for its Secretariat The accreditation is the National Standard for Human Resource Management. A "Members Benefit Scheme" was introduced and a "Refer a Friend" scheme. Total membership continued to grow. "Engineering Project of the Year" was launched online and enabled the general public to vote for their favourite project. The Annual Conference in 2011 was held in Galway with the theme "*Engineering New Wealth for Ireland"*, where the focus was on entrepreneurs, innovators and leaders to meet the needs of the economy.

In April 2012, Council agreed a new strategy for Engineers Ireland for the period 2012-2015.
The essence of the strategy was:

- Who We Are: the professional body for engineers and engineering in Ireland;
- Our Vision: a society enhanced by the acknowledged contribution of engineering professionals:
- Our Mission: our members as leaders and problem solvers commit to excellence in enhancing the quality of life for all; and
- Our Theme 2012-2015: the recognised professional standard and role of the Chartered Engineer.

The four goals of the new strategy were:

- Reputation: Enhance the reputation of the engineering profession in Ireland, by continuing to advance Engineers Ireland as its leading expert voice;
- Support: To support and grow membership and work with the members to enable their career progression;
- Professional: Keeping members' professional engineering competence current and world-class; and

- International: Supporting international mobility and increasing international recognition through compliance with accreditation and competence standards to safeguard the profession.

In addition to these four goals, which were outward-looking towards society and which were to be reflected on the EI website, there were two additional internal goals: to ensure excellence in the EI people, systems and processes, and to ensure the financial integrity of the organisation. In April, EI signed a new protocol with the Irish Academy of Engineering redefining their respective goals going forward.

Also, in April, Council confirmed new Bye-Laws to replace those adopted in 2003. The Taskforce on Bye-Laws was chaired by former president Anne Butler. The principal change was to remove the necessity for Council elections when there were less candidates than vacancies. The number of members elected to Council and Executive was reduced and the number of co-options on the nomination of the President increased. In this way, it was aimed to be more representative of the emerging sectors of the profession and reduce the historic dominance of civil engineers on Council and Executive. The Code of Ethics, Membership Regulations, and Guidelines for Boards and Committees were consolidated into the new Bye-Laws. The changes were designed to give stronger governance to Engineers Ireland to be a more representative body for the current and emerging profession in Ireland.

During the presidency of P.J.Rudden (2011-2012), the first of an annual series of infrastructure reports entitled 'The State of Ireland' was launched dealing with the five key areas of Transport, Energy, Water, Waste, and Communications. The Annual Conference was held in the Titanic Centre in Belfast on the theme "*Engineering Enterprise in Times of Change"*. The conference presentations centred on themes of creativity, enterprise and knowledge-sharing to drive sustainable economic development on the island of Ireland in public and private sectors, in particular energy and manufacturing.

In June, EI was formally approved for recognition of engineering programmes under the Washington Accord until 2016. A new STEPS website had been launched in February 2011 and a project was commenced to re-design the Institution's main website, which was launched in April 2012. The education outreach programme, STEPS, continued to be a great success story and thanks were due to the many members who donated almost 5,000 hours to help deliver the STEPS activities during the year. The Excellence Awards, then in their second year, constituted a major recognition of the achievements of Irish engineering, awards including Chartered Engineer of the Year, Best Engineering Paper, and Outstanding Contribution to Engineering. Engineers Week reached an audience of some 30,000 young people across the country.

The *Engineers Journal* began life in 1948 as *Irish Engineering*, the official organ of The Engineers Association. In 1950, it changed its name to *The Engineers Journal* (and for a while to *Irish Engineers*). The journal continued to be published in hard copy format until the end of 2012. Due to a drop in advertising revenue, and escalating print and distribution costs, it was decided to publish the journal online. The first issue of the *eEngineersJournal* appeared online in March 2013 and was generally well received by members and the general public.

From 1st January 2013 the academic requirement for progression to chartered engineer became a Level 9 Masters' Degree in engineering, or equivalent. A review of the regulations for CEng, completed by the Membership Team, were approved by Council in September 2012, the new regulations to become applicable from September 2013. Professional Report clinics were held around the country and access for members was provided to the online technical and business database EBSCO. A TV advertisement promoting the engineering profession and stressing the importance of the Chartered Engineer in society was broadcast to a wide audience. CPD was to become mandatory from 2017 for the younger holders of professional titles, the proposal being a minimum of five days CPD per annum. Competence revalidation was to apply to all registered professional title holders who achieved their first title after 1st January 2017.

Michael Phillips, President in 2012-2013, summed up the main aim of the Institution in the following words: *'Engineers Ireland as an organisation has to be flexible to meet the changing requirements of its members, and to ensure its relevance to the engineering profession – both employers and engineers – and to Government.'* Regulation of the engineering profession in Ireland had always been high on the Institution's agenda and the

introduction of formal legislation by the government was awaited. EI was continuing to educate government on the need for the registration of the engineering profession.

In 2013, Engineers Ireland (EI) was highly engaged in consultations between the Department of the Environment, the Association of Consulting Engineers Ireland (ACEI), the Construction Industry Federation (CIF), the Royal Institute of Architects in Ireland (RIAI), and the Society of Chartered Surveyors Ireland (SCSI), regarding the new Building Control Regulations and the Public Works contract. On January 1st 2014, EI took on the Chair and Secretary functions of the Construction Industry Council for a two-year period.

In November 2013, to coincide with the Excellence Awards event, the *Irish Times* published a 32-page magazine previewing the short-listed projects and featuring interviews with some of Ireland's leading engineering employers on issues that concerned the industry. The Engineers Ireland Excellence Awards are held annually in association with the Electricity Supply Board. The awards are chosen and presented by the Institution membership in recognition of the achievements of engineers who have demonstrated exceptional engineering skills through their work. In addition to the flagship Engineering Project of the Year award, other awards include the Local Authority Engineering Initiative award, a Technical Innovation Award, and special awards in the fields of Geoscience, Heritage and Conservation. There is also an International Engineer of the Year Award, acknowledging the contribution of the Irish engineering diaspora and the excellent work of Irish engineers around the world, and an award for Chartered Engineer of the Year.

Innovative Student Engineers of the Year (2014)

During the presidency of John O'Dea (2013-2014), the STEPS programme continued to go from strength to strength and Engineers Week attracted some 36,000 participants in around 500 events across the country hosted by 160 organisations. Awards were presented to a number of students under the banner "Innovative Student Engineer of the Year". The Institution's Employment Services continued to develop its presence and career support for its members. Under the graduate programme, there were over 60 engineers on placement within outside organisations. The "Job Desk" was experiencing a significant increase in activity line with the rise in economic growth. Employment Services had also developed a Career Development Training course for engineers looking to make a career move or who were seeking promotion.

Regina Moran, president for the 2014-2015 session, attended the first Women in Engineering career seminar, organised by the STEPS team, and held in October 2014 in Dublin Castle. Engineers Ireland became licenced to award the EUR-ACE accreditation label for masters' degrees. EI and FEANI signed an agreement to introduce the FEANI Professional Card from 2013, thus increasing mobility in Europe for EI members and a forerunner of an EU-wide professional card. Engineers Ireland CPD courses and seminars were significantly diversified in 2014 in response to the outcomes of a Training Needs Analysis Survey.

The expansion of the training programme saw a growth of 40% in the number of training events. The membership was offered ten high-quality eLearning modules free-of-charge, and providing world-wide 24/7 access to verifiable CPD.

Caroline Spillane

In June 2015, the Director General, John Power, retired after eight years' service to the Institution. He served the organisation well, proving to be the right man at the right time as Engineers Ireland weathered one of the most significant recessions in living memory. The current Director General, Caroline Spillane, prior to undertaking this role, was the Chief Executive Officer at the Medical Council of Ireland. A capital investment programme was undertaken, totalling over €200K, that focussed on continuing developments in IT infrastructure and further improvement of the facilities at Clyde Road. A major project was the long overdue rewiring of the old building.

Other work included the introduction of two purpose-built interview rooms designed specifically for professional interviews, and the conversion of a committee room into a more welcoming waiting area for interview candidates and other visitors. The Membership System and other applications were moved to a 'cloud' environment to provide increased resilience and business continuity for the main operations at HQ. The web site, EngineersJournal.ie, and the fortnightly eJournal, together form a 'shop window' for Engineers Ireland, and are a regular and visible reminder of the benefits of membership. The web site promotes the fact that Engineers Ireland is for engineers of all disciplines with specific sections for civil, electrical/energy, mechanical, biomedical, technology/software and chemical.

Pictured at the launch of the State of Ireland 2017 report.
(L.to R.) Dr Stephen Kinsella (Dept. of Economics, University of Limerick),
Damien Owens (EI Registrar), Tony Hanway (CEO, Virgin Media Ireland),
Frances Fitzgerald T.D., EI President Kieran Feighan, EI DG Caroline Spillane

Inspiring the next generation of engineers is seen as a vital part of the Institution's role as the representative voice of the engineering profession. The STEPS programme – the only national outreach programme dedicated to the promotion of engineering – continues to enable volunteer engineers to make a direct impact on students by acting as role models in the classroom, at primary and secondary level. The Annual Conference in 2016 was held in Kilkenny, when the President of Ireland, Michael D Higgins, an Honorary Fellow of the Institution, gave an inspirational opening address. He exhorted that engineers should not just be policy implementers, but be active contributors to the formation of policies. In the following January, a new continuing professional development policy *My CPD* for members came into effect and a new web portal was provided to facilitate members to record their CPD online. The range of technical training programmes for engineers was expanded across all sectors.

The Regional Branches, Engineering Divisions and Societies are the life-blood of the Institution and a major review was undertaken in 2017-18 to ensure that they adequately reflect contemporary engineering disciplines and special interest areas. John Byrne, formerly Finance & Operations Director was appointed Director of Sectoral Engagement and tasked with the job of developing, driving and implementing a project aimed at ensuring increased engagement with the various Sectors and their links with industry and academia.

The Engineers Ireland Strategy 2017-2020 outlining the *modus operandi* for expansion of membership in Ireland and abroad was launched in January 2017 by the Minister for Public Expenditure & Reform, Pascal Donohoe TD. The new vision statement "*A community of creative professionals delivering solutions for society"* is intended to guide and inspire the organisation and its members into the future. A central function of Engineers Ireland's role is enhancing trust, respect, influence and understanding of the engineering profession. The Institution will continue to enable the engineering community to progress their professional development, make an impact on society, and encourage and educate future generations of engineers.

IEI / ENGINEERS IRELAND

DIRECTOR / DIRECTOR-GENERAL

1970-1975	Tony O'Brien
1975-1979	Joe Fitzgerald
1979-1996	Finbar Callanan
1996-1999	Frank Burke
1999-2004	Paddy Purcell
2004-2007	Kevin Kernan
2007-2014	John Power
2014-date	Caroline Spillane

Chartered Engineer of the Year 2017

Captain Eoghan Carton, Engineer Officer, Irish Defence Forces

Part Two

The Presidential Addresses 1969-2018

The long tradition of annual presidential addresses dates back to 9 December 1856, when George Willougby Hemans delivered the first such address to a meeting of the Institution of Civil Engineers of Ireland, held at its then HQ at 41 Upper O'Connell Street, Dublin. Subsequent presidential addresses have afforded a convenient opportunity to provide a 'state of the nation' review of the work of the Institution, its recent achievements, and those of its members, and to add some thoughts for the future. Many presidents took the opportunity to talk about the experience gained through long careers in a particular branch of engineering or industry.

The Charter Amendment Act of 1969 enabled the unification of the Engineers' Association (Cumann na nInnealtóiri) with the Institution of Civil Engineers of Ireland to form the Institution of Engineers of Ireland (IEI). John ('Jock') Harbison is regarded as having made the greatest contribution of all to the unification of the Irish engineering profession. He was one of the main driving forces behind unification of the profession and it was entirely fitting that he should become the first President of the IEI in November 1969. He had formerly been a Council Member and President of the Engineers' Association 1965-1966.

Chairman of the Provisional Council, Professor James Dooge, hands over the Chain of Office to Jock Harbison (former President of the Cumann, 1965-66) at the first meeting of the Council of the IEI at the RDS, Dublin, 1969.

In his presidential address in October 1970, **Jock Harbison** reminded the audience that engineers were aware of having always had a material and significant role in the community. He felt that *'In Ireland many of our attitudes are borrowed from elsewhere. Being as small as we are, located between two dominant civilisations of the Old and New Worlds, it would be surprising were we not strongly influenced.'* He also opined that too often, where limited wealth was available, only minimum investments were made without considering the ultimate effects. As a lover of music, Jock felt that it was a terrible shame that they could only talk of and plan a single modern concert hall for Ireland, but find no adequate social or economic reason to build it.

It was in the area of trying to mould an attitude to Science and Technology and its better comprehension within the community that Harbison saw a most vital role for the Institution and comparable bodies. There was a most serious moral obligation to cultivate in the profession, not merely engineering excellence, but a sense of responsibility in the applications of technology. He considered that this must similarly promote awareness and understanding of scientific technology in the community generally so that the most valid arguments were possible. Jock felt that there was no better environment in which to start this process than in the secondary schools, perhaps by recasting the Leaving Certificate subject General Science to create a realistic understanding of Technology, whilst being carefully associated with Mathematics.

Harbison stated that the Institution was as vigorous then as ever before and keenly desirous of being a meaningful element of the social fabric of *'this small and hopeful community'*. For long seen as a learned body, whose membership connoted a qualification, it, following unification of the profession, stood as something much more. Jock felt that the Institution formed an independent point of reference, with the comprehensive viewpoint of a complex of people with differing, but interrelated, skills in technology, deriving therefrom not a little power in shaping future events and things.

The larger proportion of the engineering profession was at the time employed by state and semi-state bodies, and Jock felt that urgent recasting of structures, attitudes and relationships was vitally necessary if the well-

being and effectiveness of those establishments was to be secured. Most of the remainder of Harbison's address dealt with the problems facing the employment of engineers in the ESB and the public sector, in particular some 500 in the Local Authority service. Recommendations had been made by the Tavistock (1966) and Devlin (1969) committees, but a long period of static management and outmoded practices led to an explosion when an arbitrated pay-award was rejected by Government and industrial action threatened. However, the Minister for Local Government agreed to accept a report prepared by the Institution's Donovan Committee (1970), on restructuring for improved operations and better relationships, and which pointed the way to higher productivity and effectiveness. However, at the time of the president's address, there was nothing to show the members for their forbearance. Jock was bold to say that *'(whereas) one respects the necessity for full deliberation on radical matters, … it breeds uneasiness and plain bloody suspicion.' He was quite sure that 'delay attributed to comparabilities or established structures or immutable statutes will not (in future) be acceptable in lieu of action in remedy*'. At the time, the formation of a trade union for chartered engineers within the Institution was being considered, but Harbison felt that militancy was very distasteful, out of keeping with tradition, and to be adopted only when all else had failed.

Harbison concluded his address by noting that the Institution showed signs of vigour, regeneration and commitment that properly represented the engineering profession in the 1970s. The metamorphosis of the Institution is history, and yet must be continuous, and he requested all members to use their influence to attract new members.

Michael (Mick) Lynn took over from Jock in 1971 and supported the proposals by the Secretary for a revised and rationalised structure for the Institution, which saw the amalgamation of the Engineering Science and Social Relations executive committees. It was considered that success in the field of social relations was essential for the continuing strength of the Institution. Lynn stated that it was also important for the profession, as adequate rewards for professional services were necessary elements for morale and quality of work and as prerequisites to attract, in sufficient quantity, the kind of talent required for the profession then and in the future.

In Ireland, at the time, the majority of engineers were employees of the State – either directly or indirectly in local authorities and state-sponsored bodies. Lynn observed that in many of these undertakings there was an urgent need for the development of modern management practices. Furthermore, there was a general lack of effective performance appraisal systems that would give regular and fair assessment of an employee's performance and potential and that would ensure for him the progress and prospects deserved. Lynn suggested that there was also a need for a great increase in employee training, including developing capacities outside of their immediate fields of activity (what we now refer to as continuous professional development or CPD).

The Devlin Report (1969) represented a genuine attempt to improve structure and managerial procedures in the Public Service, but two and a half years on from its publication, Lynn felt that the lack of progress in implementing its recommendations was, to say the least, disappointing. Looking at the then engineering scene, he felt that most older engineers would be regrettably aware that vocationalism and dedication to professional service had diminished. The trend had been towards an industrial scene with employers and managers on the one hand and organised unions of employees on the other. One saw it in public commissions and committees appointed without professional representation.

Regarding the other side of the Institution's affairs, Lynn reminded the members that the charter specified as main objects the promotion of engineering knowledge, the advancement of engineering science and the ensuring of proper standards of education and training for membership of the profession. Procedures for the assessment of post-graduate training and experience required for chartered status (CEng) were being placed on a more formal basis. It was generally accepted that Continuing Engineering Education was necessary to give engineers a working knowledge of new techniques. Discussions were on-going with the Council of Engineering Institutions (CEI) in the UK to reconcile standards for admission of candidates to the profession (MIEI) and to use

the same examinations and assessment procedures. Lynn reported that a draft set of rules on Professional Conduct and Ethics had been prepared and would shortly be adopted and published.

Formal relationships between technicians and professional engineers had been developing over a number of years and had reached the situation where the Institution assessed and accredited technical courses which led to the admission of qualified technicians as Associates of the Institution. A niche had been created for technicians where they could enjoy benefits comparable to those of engineer-members, but at the same time be free to order their own affairs, subject only to rules and Bye-Laws mutually agreed between them and the Institution.

Lynn reviewed recent progress in the Irish economy and particularly in the engineering industry, indicated by new buildings, housing schemes, roads and drainage, improved communications and broadcasting, and in the growth of new industries. There had been an employment boom and a significant growth in the private sector, particularly in engineering consultancies. With Ireland's entry to the European Economic Community (EEC), it was hoped that consultants could take advantage of the greater opportunities offered in the European sphere. There had been a movement of engineers into management, in large measure due to the development of more sophisticated managerial techniques replacing the intuitive judgements of the past. Recent surveys had shown that the great majority of engineers discharged functions which were at least partly managerial, and thus there was a need for training in managerial skills.

In concluding his address, it seemed to Lynn that *'…in the future, engineers will need to be more positively people-oriented and to have a more sensitive concern for human values. Otherwise the paradox may arise that they are seen as enemies of the community while they are engaged in the engineers' business of converting natures resources for the benefit of man; indeed their work may be brought increasingly under the control of others considered more qualified to exercise judgement in matters concerning amenities and the quality of life'*.

Mike Lynn (L) passing on the presidential chain of office to Bob Cuffe in 1972

Taking up the presidential reins from Mick Lynn in 1972, **Robert (Bob) Cuffe** began by noting that rapid technological change commenced when man succeeded in harnessing sources of power. After watermills and windmills came the steam engine and the beginning of real technological development, driven by the discoveries of oil, gas, electricity and nuclear energy as sources of power, resulting in ever accelerating development over the past one hundred years. Accordingly, energy usage per head of the population had become a real indicator of the material development of a country

Cuffe, who spent most of his career with the Electricity Supply Board (ESB) devoted much of his presidential address to the topic of power generation, pointing out that electricity was not a primary energy source since it was derived from one or other of the sources mentioned above. He noted that, at the time, 70% of the primary energy used in Ireland was imported in the form of coal or oil, the balance used being mainly peat and hydropower. Bob opined that nuclear energy would become an option if it became a reasonable proposition. [Due to a drop in electricity demand in the 1980s, the capital cost of building a nuclear energy plant was ruled out].

Cuffe felt that the associated interactions between countries, peoples, groups, professions and individuals were inescapable features of life. Entering the European Common Market entailed more dealings with other countries, that is with the people in them. Under the Treaty of Rome, there was to be free movement of professional and other people between countries with rights to work there, shoulder to shoulder with locals. In order to progress we most now learn more of how people do things in our partner countries, how they have been educated, what matters for them religiously, politically, economically and technically, so that we can get to understand them. Bob continued: *'One must get away from the idea that the traditional methods used here are the best. It may sound absurd, but I think not a few of us may have subconscious national or group prejudices, residues in fact of ideas accepted as norms at our most impressionable age. If we are to understand those in our partner countries, we in the engineering profession must put some effort into learning how they do things and why…a necessary understanding of conditions, personnel and methods used in the European Community'.*

At home, the works of our own profession impinge more and more on others. Bob felt that an effort must be made to understand and take into consideration the views of others, such as ecologists, planners, economists, lay persons, and politicians, and that it was no longer sufficient to provide the technically best solution to an engineering problem; multi-disciplinary teams may be called together to study and assess proposals. The leader or decider must now have some degree of technical understanding of the problems involved and of the attitudes and difficulties from the different disciplines concerned.

Lastly, Cuffe referred again to the matter of understanding and instanced some cases in the sector of engineering with which he was most familiar – electricity supply. Major benefits had resulted from the interconnection of European power networks and the various systems assisted each other in emergencies, and also at times when surplus power could be sold to other networks. All these interconnections came about by understanding each other's difficulties and acquiring an appreciation of the mutual assistance and gains that become possible with interconnection. He noted that substantial savings had resulted from the interconnection of the systems in Ireland prior to the temporary disruption caused by the 'Troubles'. Cuffe believed that a deeper understanding of each other's troubles and anxieties in other spheres would help, just as it had helped in the case of the coupling and joint operation of the previously separate electrical systems.

Reverting to the matter of Ireland entering the EEC, in a recent Nordel Report, the compilers quoted from Havamal, an old Norse collection of adages:

'If you have a friend whom you well trust
And wish to be like him well served –
Share his likes, exchange frequent gifts
And often go to visit him.'

Hugh Delap became President of the Institution 46 years after his father held the office. Delap began his address by saying that *'prior to 1856, it had not been thought necessary, or had not occurred to anyone, that the president for the time being should formally inflict his thoughts on a captive audience, who by tradition would be barred from answering back.'* Delap used the word 'inflict' deliberately. The records show that one of the early presidential addresses contained over 60,000 words, opened with a 270 word-long sentence, extended over three meetings, and concluded with an apology for its inadequacy!

Since the first address in 1856, subject matter had varied widely, but more often than not covered some aspect of the profession with which the speaker had been particularly concerned. Hugh had spent most of his career with the OPW, but some of his predecessors had already spoken at length about their time with the organisation, so he took inspiration from his father's address by looking instead at the state of engineering in Ireland in 1973 and making some predictions for the future. He looked briefly down a couple of vistas and suggested what might lie ahead. In attempting to be or to judge the performance of a prophet, he said that one should distinguish between predictions and premonitions. A prediction, he suggested, was a forecast based on known facts and

trends, whereas a premonition comes from somewhere more mysterious, the dictionary definition being 'a forewarning – a feeling that something is about to happen'. He cited the following example of a premonition: the distinguished Irish scientist, George Francis Fitzgerald, in the 1890s, lecturing to a physics class on atomic theory as then accepted – the atom being defined as the ultimate particle, homogeneous and so hard and small that it could not be divided – commented *'that gentlemen, is what we are told, but I have a strong feeling that when we know more we shall find that the interior of the atom is at least as complicated as the common housefly'.* This was a classic case of a genuine, straightforward, irrational premonition.

In the energy field, Delap predicted that, by the beginning of the next (21st) century, atomic power would predominate, oil having become scarce (the extent of the world's oil reserves was not at the time fully understood). He noted that the proliferation of atomic fission reactors is coupled with the statistical certainty that, sooner or later, there would be serious accident. There was also the awesome problem of disposing safely of ever-increasing quantities of lethal and, in human terms, everlasting waste products. Making a totally uninformed guess, based only on a firm belief in the intellect and ingenuity of the scientist and engineer, Delap suggested that early in the next century controlled nuclear fusion would at least be in sight, with the promise of an inexhaustible supply of cheap fuel, available everywhere, and, more importantly, having a clean waste product.

Continuing with his view of the future, Delap looked next at trends in the technology of transport by road, rail and air. He commented that *'A city which did not achieve unlimited access and parking for private cars would not, I suspect, be worth living in or visiting. To destroy a city it would not be necessary to aim at perfect conditions for cars. Each major improvement carried out to facilitate the car would, if successful, increase the number of cars, leading in time to a demand for still more "improvements". The city would die in stages.'* He cited the example of Nottingham that had abandoned urban motorways in favour of curtailing or controlling access and providing an efficient, rapid and free public transport system and a safe pedestrian complex. He hoped that rail transport would be retained and developed or restored, including the reopening of suburban stations, encouraging commuters to leave their cars at home.

Delap hoped that before long, air companies would agree to confine competition to safety and comfort – and freedom from hijacking – and to settle for a speed that makes sense when considered in relation to the time wasted stacked over one's destination, travelling on the ground, being searched for drugs or weapons, or simply waiting for one's flight to be called – mind-deadening delays which already account for the greater part of many journeys.

Delap considered that the myriad use of electronics would greatly increase, for example in the automatic control of industrial processes, and he hoped that production engineering would see the greatest change. Substitutes for the assembly line were already being tried and he believed that increasingly all processes will have to be reviewed with the welfare of the operative, in its widest sense, the prime concern of management.

Concluding his address on a more serious note, Delap referred to two matters of more immediate concern to members of the Institution and, indeed, to every engineer in the country, the first being the challenges to be faced by Ireland's entry to the EEC and the recognition of professional engineers throughout Europe. He felt that the Commission would likely recognise as professional engineers those with the title 'chartered engineer' and it was thus important that all Irish engineers be encouraged to join the Institution and seek appropriate status.

The second matter concerned the continuing serious problems in the Local Authority sphere. Having reviewed the various committee reports (1969-1971) recommending solutions to the problems, Delap said quite firmly that *'until the Local Authority structure has been brought into line with the needs of today, with a positive commitment to improving the career-pattern and training of its engineers, and until there is a real improvement in communication and in job satisfaction, troubles such as are occurring at present (1973) will certainly recur.'*

Delap ended by quoting from the 1856 presidential address of George Willoughby Hemans. He said: *'One object of such Institutions as this, next to the enquiry after scientific truth, should be to cement firmly, by friendship and union, to elevate and dignify the profession of which its members are composed.'*

Finbar Callanan began his address by noting that he was the first representative of the peat industry to become President of the Institution (1974), a 30-year old native industry with advanced technology in peat production, that had achieved international acclaim. In the period between the previous presidential address and then the world had gone through the dramatic and very chastening experience of an oil crisis. Arabic countries had forced developed countries to come to their senses and to a sharp realisation that the resources of this world were finite. Callanan said that *'we must draw on all our inventiveness and resources to ensure that advanced economies achieved on the back of cheap and abundant oil, do not slide into a major recession.'* He noted that Ireland currently had an 80% dependence on imported energy. He opined that *'progress in the future can only be achieved, bearing in mind that energy sources will become dearer and more scarce, and that in the absence of universal agreement, the present situation has within it the germs of large-scale economic upheaval and the possibilities of confrontation on a worldwide level.'* He continued: *'in spite of world problems and in spite of the unfortunate fluctuations at present apparent in our economy – notably in agriculture and the construction industry – we must now consider ourselves poised for a more vigorous Ireland.'*

Finbar observed that a new era of industrialisation had commenced, commercially viable mines were being developed and the population was growing, but he suggested that the past was not always an effective sign-post to the future. We needed to provide about 30,000 new jobs per year over the next fifteen years and to look to technology to provide a base for many of these jobs. Finbar then went on to trace the history of the establishment of professional organisations, from the Royal Society (1660), the Society of Civil Engineers (1777), the Institution of Civil Engineers (1818) and our own institution, founded as the Civil Engineers Society in 1835, later to become in 1845 the Institution of Civil Engineers of Ireland and, in 1969, the Institution of Engineers of Ireland.

Approximately two-thirds of Irish engineers were at the time employed in the Public Sector, which was an indication in itself of how low the industrial base in Ireland was compared to that of other developed countries where the majority of engineers were employed in the private sector. Finbar suggested that *'if Ireland is going to advance industrially then more engineers will be needed in the years ahead. We must seriously consider the future availability of engineers, their numbers, their education, the discipline they will follow and their ability to keep pace with their European fellow engineers, many of whom have at their backs the tradition of an industrial revolution that commenced more than one hundred years before ours.'*

And this is where Finbar considered the Institution had a vital role to play. He continued – *'In our capacity as a representative body for employee engineers in the Public Sector we have tried to exercise our persuasive arts on Government and management to urge them to bring the organisational structures in which engineers operate into reasonable accord with modern standards. There are some difficult areas, but with the exercise of goodwill all round we can hope for progress eventually. In other areas we have been able to make useful proposals and take part in constructive discussion covering restructuring – proposals which as far as engineering in Ireland is concerned represent a considerable breakthrough in the correct and productive employment between the public and private sectors.'*

Finbar noted that there were some amongst the members who frowned on the amount of time and effort put into matters of industrial relations. There were some who believed that the Institution should keep out of this difficult area altogether and leave it to the unions. Finbar said *'this we cannot do - with over 90% of our members in salaried employment there is no way in which we can divorce the man at work from the environment in which he carries out his work. We see it as part of our function not only to ensure adequate remuneration for our members, but also to see that their engineering skill is used properly.'*

With all that had been said about social relations, Finbar believed that it was as a learned body and voice of the profession that the Institution would play its most important role. He felt that the primary university degree might no longer suffice to see one through an engineering career and that post-graduate education was on the increase. The Institution had recently introduced the Sponsored Approach to Chartered Membership, whereby young graduates are steered through a supervised course of training and responsible experience for at least four years prior to being examined by the Institution for chartered status. Finbar considered that the main aim was to make CEng the hallmark of the professional engineer – one who has achieved a desired standard of education, practical training and responsible experience and, by virtue of membership of the Institution, would accord to its Ethics. The establishment of two new grades of non-corporate membership, Technician Engineer and Technician, was seen as a natural follow-on from the Government's support of technological education, and Finbar saw this as a significant growth area in the Institution. He hoped to see Irish engineering education placing more emphasis on the disciplines needed to support an industrialised economy, for example the development of a petrochemical industry based on oil and gas finds in Irish waters.

Callanan concluded his address with the following thoughts: *'There are so many problems ahead in Ireland in which our profession will be involved and we must give continuous consideration to our duty to meet new challenges. Questions of the environment, pollution, urban planning, and industrialisation all involve our profession and we must contribute our share of help, advice and criticism. Each of us has the responsibility to thank God for any particular talents we have and using them for the benefit of our fellow man. In this regard our Code of Ethics states* "In his relations with the public he shall apply his skill and experience to the common good and the advancement of human welfare".

In October 1975, **Jack Barry** delivered his presidential address to the Institution in Jury's International Hotel in Ballsbridge, when he dealt with the many aspects of engineering in Ireland, in particular focussing on technological education and the role of the Institution in this field. He stated that it was his desire to initiate a three-year programme of Institutional activities culminating with an International Engineering Conference in Ireland in 1977, the centenary of the Institution's 1877 Charter and that his two vice-presidents had agreed with the concept.

He commented that science and technology had greatly influenced society, particularly in recent decades and that the contribution of engineers had been enormous. He continued: *'The tentacles of the engineering profession have penetrated deeply into the life pattern of man and in consequence we have grave responsibilities to society. We must not abuse our specialist position and must endeavour to give our fellow citizens the harvest of our developing technology. Many engineers occupy positions of influence and of power and collectively through their Institution can vitalise many sectors of the Irish scene.'*

College of Technology, Bolton Street, Dublin

Barry began by looking back at the education scene in the 1950s, where, apart from university courses, professional engineering education was available through evening courses at colleges of technology and technical institutes. Part-time day release courses for apprentices were developing across the country and a vertical education system was evolving. The first step at the College of Technology in Dublin was the introduction of two full-day Higher Technological courses for the more brilliant apprentices who were prepared for the examinations of the professional institutions, and also for the only available technician certs at that time. Evening courses at all levels continued, but with the expansion of Irish industry, full-time day courses of three or four-

year duration were initiated in conjunction with industry. He continued that *'many changes and adaptations of the full-time courses had been made and that the status of the College at the time was unique in that it was the largest educational establishment in Ireland dealing with the needs of the Irish economy. In 1975, approximately 7,000 students were enrolled, needing some 500 teachers, but that all normal expansion had ceased since 1968, primarily due to shortage of space. The College was unique in that it housed students at craft, technician, graduate and post-graduate level and provided educational ladders in vertical, oblique and horizontal directions.'*

Barry referred to the government proposals of December 1974, which included recommendations for National Institutes of Higher Education (NIHE) at Dublin and Limerick and the establishment of a Council for Technological Education to plan and coordinate courses, and to validate and award non-degree third-level qualifications in the NIHEs and RTCs. Barry commented that in the 1920s, the government of the day decided to merge the Royal College of Science with UCD, resulting in Merrion Street closing its doors to students of the technological education system, and that it had taken fifty years for technological education to recover from its beheading.

At the time of Barry's presidential address, the technical colleges had been given the option of linking with the universities, which he considered a dangerous situation. He opined *'instead – why not offer the universities the opportunity of linking with the colleges of technology … and let us be the benefactors not the sole beneficiaries.' 'The NIHEs were conceived in the bosom of technical education and options such as constituent colleges within the university system was yielding to archaic thinking'.*

Barry stressed that the Institution must be watchful of developments in engineering education and ensure that its future members are given opportunities at least equal to those given to other member states of the EEC. He foresaw many changes in technological education in Ireland and that responsibility rested with the government and government-sponsored authorities. He opined that the Institution of Engineers of Ireland had a vital role in the emerging changes, not only nationally, but in the EEC debate on reciprocity of qualifications. The Institution had been moulded in tradition and, in order to further its influence, it must strengthen regional activities and stimulate local entrepreneurial initiatives. Barry felt that *'the work to be done goes to the heart of the further education system, which in turn is central to the effective operation of industry and commerce and therefore vital to the strength of the economy and the fulfilment of the nation's social aims.'*

Barry commented that '*when we talk about the economic and organisational problems of the growth and diversification of demand, we should be equally aware, on the positive side, that the sparking point of the whole of our technological education system is at the working face of the economy, where the action is taking place. Since these represent the whole dynamics of the system they should not be prejudiced by our attempts at rationalisation. Growth and diversification to meet emerging educational needs should not be retarded. The scope for rationalisation is in the distribution of educational provision, to avoid the duplication of scarce resources.'*

'It is right that the educational provisions which will follow should be designed by rational minds, but it is equally important that they be redesigned by minds which understand the spirit and purpose of the higher education service, its vocational aspects; that it begins and ends in industry and commerce, but always has the highest respect for the dignity of the person. It is of fundamental importance that the characteristics of responsiveness and sensitivity to the needs of both society and of the economy be preserved in the changes which the relevant organisations will bring about.'

Barry concluded his address by urging industry, government departments, semi-state boards and agencies, and in particular the Civil Service and Local Appointments Commission, to be watchful for any abuse of the title Chartered Engineer.

John Donovan, in his presidential address in 1976, elected to speak about the role of the manager in a multi-national company (John spent most of his career with Esso Teo. in Ireland). He posed a number of questions,

including “Is there a conflict between the interests of the multi-national and those of the host company?” and “What are the benefits achieved through the operations of a multi-national?”.

John said that there appeared to be an attitude that profits made at the expense of the local community were suspect, while those made abroad were to be encouraged. He admitted that this was an over-simplification, but that a good deal of the criticism surrounding the ‘multi-national’ had its origins in that concept. Donovan’s experience had been in the management of a trading company and it was from that standpoint that he offered up his thoughts.

He stated that the task of the Chief Executive was to ensure that the parent company is fully informed of the local situation- economic, social or political as may be appropriate - that the local interests are fully informed of the company's position, and that, in the final analysis, the long-term interests of his company - that is, the local affiliate, plant or whatever - as well as those of the parent - are fully taken into account. He noted that this would be as true for the expatriate as for the native and he believed that the principle was well established and accepted.

Donovan commented that *‘it is broadly accepted that multi-national companies, and perhaps in particular, petroleum distributors, have been to the fore in such matters as productivity pay schemes, pension schemes and other benefits. While, at their time of introduction, these reflected the advanced thinking brought to the attention of local management, through international association, the subsequent spill-over effect has not always been wholly welcome as other industries were brought under pressure to advance pay rates on foot of, frequently , less productive proposals, or to introduce and improve benefit schemes without the market growth necessary to sustain these schemes.’*

Donovan continued: *‘As the customers of the multi-national supplying company are, in the main, economic partners as well, the effect on customers of the policy and practices of that company must be taken into account as well as the overall economic scene. This, I would suggest is enlightened self-interest towards meeting the objective I have already indicated-the long term viability and prosperity of the company. If the national economy is buoyant and expanding, the future prospects of a multi-national company at local level will be enhanced. Conversely, when the local scene offers a set-back, particularly - as in 1973 - when the effects of the O.P.E.C. activity were the dominant feature in the economic world-wide downturn, the multi-national becomes a convenient whipping boy, and its every action and comment become the source of suspicion and criticism.’*

Donovan suggested that most industrial companies, whether multi-national or not, are more concerned with a stable climate for enterprise, offering the prospect of making a reasonable return on investment, than with the political system proving the climate. He believed that local industry gained by the intake of new firms from other countries and that the introduction of methods, practices and concepts was greatly accelerated through their example. To the extent that they worked through existing structures in society, he felt that they helped to refresh and develop institutional and personal attitudes. To the degree that their origins were from outside the immediate surroundings, he considered that their views could assist in crossing the barrier that might otherwise close eyes and minds to developments in other areas of the world.

In addition, he noted that, due to the emphasis which most multi-national companies placed on development of local management potential, opportunities arose for training and experience to be obtained by local personnel in foreign environments, and that such people, on their return, increased the stock of available skilled and trained managers to manage enterprise in lreland for the benefit of the community at large. Donovan concluded that *‘Such training and development was undertaken by the multi-national companies fully accepting that some of the trained people would be lost to them. The cost involved is accepted partly to ensure that the company itself will have the right people when they require them and partly as a contribution to the host economy, which should be strengthened by the introduction of more competent managers.’*

Pictured at Clyde Road for the first Council meeting of Charter Centenary Year. Front row: M. B. O'Donovan. Asst. Sec.; L. Collins, Vice-President; Prof. W. Wright, President; M. Sheehy, Vice-President; J. Fitzgerald, Secretary.
Second row; P. J. O'Keeffe; D. A. Blair; T. P. Hardiman; G. P. Leyden; M. V. Martin; T. Killeen; M. O'Donnell.
Third row: D. Buckley; J. J. Higgins; B. G. Cantwell; J. G. Wynne; D. A. Downes; E. O Cionna.
Fourth row: Dr. M. I. Stephenson; S. Concannon; W. F. Roe; H. P. McAlinden; P. T. Pigott; M. T. Hillery.
Back row: D. P. McDermott; L. M. McCumiskey; J. D. McDonnell; J. A. Carrick; J. Gwynn; J. H. Fitzpatrick.

The following year, **William (Bill) Wright,** Professor of Engineering at Trinity College Dublin, spoke about the academic aspects of the route to Corporate Membership (of the Institution). He noted that the Institution was still an examining body in its own right, but that only a handful of students elected to attain Corporate Membership in this way. He put forward two possible reasons for this: the increasing availability of university education, and the fact that it was well-nigh impossible to reach the required academic standard on any basis other than that of four years of full- time study. The academic function was discharged almost in its entirety by the universities, but he felt that this did not diminish in any way the responsibility laid on the shoulders of the Institution by its legal charter, the responsibility to maintain academic as well as professional standards.

Wright then concentrated on the longer-term trends in the universities, and attempted to show that engineering, more than any other discipline, occupied a very special position at the crossroads of then university thinking. He proceeded to consider the 'educational dilemma'. With the arrival of the modern-style engineering department on the university scene, which took place, in most cases, in the second half of the nineteenth century, the engineers were faced with two well-established, perhaps even entrenched, groups. On the one hand, the longer-established professional schools of law and medicine and, on the other, those academics interested in the pursuit of knowledge for its own sake. This state of affairs immediately forced the engineers to adopt a Janus-like stance, trying to face in two directions at once and it has been thus ever since. On the one hand, the pull towards the relevant, the vocational and the begrudging of a minute spent on anything else; on the other hand the insistence on the immersion in the sea of knowledge, without too much concern as to which particular branch of knowledge, or which particular sea.

He considered that there were problems with either extreme approach. Over-emphasis on relevance must inevitably mean less emphasis on the more basic and fundamental studies and there was the danger that a technique which appears relevant to-day, may turn out to have a half-life of application of perhaps only five years or so. Clearly, what is required of the engineer is not so much knowledge on one technique, though this may be necessary, but the basic knowledge and flexibility of outlook required to grasp the principles of new techniques as they arise and to apply them effectively, coupled with the expectation that each new technique will be found to be more complex than the one it replaces.

At the other end of the spectrum, Wright felt that it would not be proper to concentrate entirely on basic and fundamental subjects, with no concern at all for relevance. This would be to make the engineering student indistinguishable from the pure scientist and defeat the object of the exercise of bringing engineers into the universities. The distinction between the two has been pithily put as follows *"the scientist discovers what has been created; the engineer creates what has never existed".*

Wright continued: *'The first year of most engineering courses has to be rather basic, so as to ensure a sufficient knowledge of fundamental physical science together with some degree of facility in the field of mathematics. It is after this that a timing problem arises. Do we continue with a second year of basic studies ? Do we drop basic studies entirely and concentrate solely on applied? Do we adopt an intermediate position between the two extremes and, if so, how much weighting do we give to the pure and how much to the applied?'* Wright did not believe that there existed a single, valid, all-embracing answer to these very important fundamental questions. But the mere fact of having posed them served to highlight the dilemma which faced university teachers in the field of engineering. In Wright's view, the problem of relevance versus disinterested study was more acute in the case of engineering education than in any other profession.

He continued that engineering of all disciplines was best placed to provide a bridge between the two cultures of arts and science, because it touched so many other disciplines at so many points: physical and earth sciences, mathematics and computer science of course, but also, to some extent, law, economics, business and management studies, statistics and sociology. When we talk of relevance, the spotlight is on the engineers. This inevitably produces a state of tension in engineering schools: the pull from outside the university in the direction of greater immediate relevance, balanced by the pull from within to maintain a time-honoured approach – Wright saw this as the most significant problem for the future of engineering education.

He considered that the immediately perceivable directions of change were as follows:

- A greater emphasis on inculcating the engineer's way of thinking;
- An increasing awareness of the importance of continuing or recurrent education;
- A deeper and wider study of the place of the engineer in society; and
- Increasing emphasis on research of an applied nature, likely to produce results of value in the short term.

The set-piece lecture to one or two hundred students, necessary though it may be, is not of much value. What is of much greater value is small group teaching, whether in the laboratory, seminar room or design office, under the guidance of an experienced engineer and here, certainly, greater use could be made of part-time teachers drawn from outside the universities. The strategy should be to emphasise basic general principles during the time spent in the university, to spend less time on current techniques and to spend the time so saved in indicating to the student how he might teach himself in the future. A study of how to seek out sources of information and how to apply the information, once it has been acquired, would mean less time spent on close-ended academic problems and more on the open-ended type, which after all is what occurs in real life.

With regard to the engineer in society, Wright felt that everyone is interested in the status of his or her profession in society and it is idle to pretend otherwise. The status of the engineer in Irish society is reasonably high, but could be higher and, if it is to be raised, it is the engineers themselves who must do this. Surely the proper place to start is at the beginning, namely at the level of the university student. More time could be spent on the study of non-technical subjects, particularly where they relate to the position of the engineer in society.

Wright considered research to be the life-blood of a university school or faculty and that nowhere was this of greater significance than in engineering, a subject which was ever changing and always in the process of

development. He felt that the most effective way in which a university teacher could ensure that he is up-to-date in his subject is by undertaking research and by comparing notes with research workers in his field, both in Ireland and elsewhere. The enthusiastic researcher inevitably conveys his enthusiasm to his students with mutually beneficial results. Whilst research of the purer type properly continues to be carried out in engineering schools, nevertheless the trend was towards applied research, accelerated by the increasing tendency on the part of grant-giving bodies, whether governmental or industrial, to lend their support to research with a likely short feed-back time.

It seemed to Wright that engineering schools, because of their very nature, were particularly well placed to act as pacemakers to their universities, and that the universities in Ireland were fortunate in that they can count, in the future, as they have done in the past, on the strong support of the Institution in their endeavours.

In a lengthy presidential address delivered in October 1978, **Lucas Collins** considered how the Institution might prepare to meet the needs of the engineering profession in its second century following the granting of its Charter in 1877. He therefore discussed the nature of the engineering profession and submitted some views on the future role of the Institution.

Having traced the development of engineering through the ages, Collins considered the essential characteristics of a learned profession. Since a learned profession is based on knowledge not shared by the rest of the community, regulation is needed to ensure that only qualified people are recognised as members and that they serve the community with integrity. As the judgment of professional competence itself requires professional knowledge, it is necessary for a learned profession to be self-regulating in regard to the admission of new members. The process is one of peer evaluation and must be done by the profession itself acting usually through a professional organisation. In the same way, the integrity of its members is a concern of a profession and is usually maintained by requiring adherence to a code of conduct. In the case of the engineering profession in lreland, the lnstitution of Engineers of lreland is the regulating body and its powers are defined by the 1877 Charter and as amended by the Charter Amendment Acts of 1960 and 1969.

Collins considered that the essential functions of the lnstitution were:

- to act as a learned society to promote the advancement of engineering science;
- to act as a qualifying body to control the admission of new members and to ensure that they have achieved specified standards of general and engineering education and of engineering training and experience;
- to guarantee and protect the integrity of the profession by maintaining a proper standard of professional ethics and conduct: and
- to promote the interests of the profession and of its members.

Collins then examined some of these issues by posing a number of questions to which he responded with comments – these are summarised in what follows.

Due to the decline in professional incomes as compared with those of less skilled workers and due to the growing power of the unions, engineers and other white-collar workers have become interested in joining unions. There had been a corresponding tendency for employers to adjust salaries and conditions only as a result of claims submitted by unions or of decisions by salary review bodies on which unions are represented. There was therefore at the time increasing pressure on professional engineers to seek union representation. Collins stated that for professional engineers who are employees, union membership is not only permissible but in many cases may be essential, but he qualified this statement by saying that no member of the Institution may take any action in course of a dispute which is in conflict with his membership of the lnstitution or with its code of conduct. He concluded that members of the Institution should join only those unions which take account of the code of conduct of the Institution. Collins considered that a professional body such as the Institution was in the position

of a trustee, which derives its authority from the community by virtue of its charter, and which is responsible to the community to maintain the objectivity, the integrity and the performance of its members. The role of the Institution is quite different to, and in some respects incompatible with, the purely sectional role of a trade union.

Collins continued: Professional institutions are status bodies which bestow a qualification and seek to maintain and enhance its prestige. They must be open organisations granting membership to all suitably qualified applicants. Trade unions are sectional in character and are closed organisations with exclusive attitudes towards membership. The lnstitution has within its membership engineers who are independent practitioners, employers and employees. In acting fully as a trade union the lnstitution could be faced with the difficulty of negotiating with one section of the membership on behalf of another section.

Collins commented that trade unions have legally protected rights in regard to industrial action and this did not apply to the Institution which was not a trade union. From a practical point of view, even if the Institution enjoyed the same legal protection as a trade union and was able to organise industrial action as effectively as a trade union, it would not be able to pay striking members from its funds as such action would be opposed by other members. He therefore concluded that the Institution could never act fully as a trade union. At the time, the negotiating role of the Institution had been inherited from the Engineers Association (Cumann na nlnnealtóiri). The Cumann negotiated salaries and working conditions on behalf of its members until 1969 when it was amalgamated with the Institution of Engineers of lreland. After that time the Institution continued the activity and negotiation was done by vocational groups each of which acted on behalf of engineers working in a particular organisation or type of occupation. Vocational groups existed for state and semi-state bodies and for local authority engineers.

It appeared to Collins that the lnstitution should examine the desirability of recommending to members who wanted collective bargaining, but who found that a vocational group did not meet their requirements, that they should join established unions. An alternative was to revive the moribund Union of the Institution of Engineers of lreland. Collins set down the essential conditions which a union should fulfil as follows:

- They should be unions for professional people.
- Their aims should be consonant with those of the Institution, and they should be prepared to collaborate with the lnstitution on matters of joint concern.
- They should accept that engineers should not be required to do anything contrary to their professional code.

In answer to the question 'Should engineering be a registered profession?', Collins said that the fundamental purpose of legislation for the regulation of a profession was the protection of the public interest. The Institution was a voluntary association, as there was no legal requirement to join or to register; secondly, disciplinary action as a deterrent to improper conduct applied only to members of the lnstitution, and those who chose not to join were not bound by any ethical code. lt was true that the lnstitution was obliged by the 1969 Charter Amendment Act to maintain a register of all Chartered Engineers, but since it is not necessary for an engineer to be registered, expulsion from the lnstitution did not prevent him from practising. In Collins' view, registration of the engineering profession would be acceptable only on the basis of self-regulation by the Institution. The Institution would certify the fitness of all persons wishing to practise engineering and would regulate their qualifications and professional conduct. The lnstitution would be the national body for registering all engineers who could not then practise unless registered. This would give the Institution a monopoly position similar to that occupied by the legal and medical professional bodies. In return, there would probably be some extension of the State's powers to ensure on behalf of the community that the Institution could not abuse its monopoly position. This could take the form of a joint registration board under the control of the Institution with a few representatives

appointed by the Government to exercise a supervisory role. Legislation to cover disciplinary procedures might also be introduced.

Turning to why engineers should become Chartered Members of the Institution, Collins made it clear that an academic qualification alone was not a guarantee that a person is a professional engineer. He continued that *'it is also necessary by means of adequate and appropriate training and experience to reach a position of being capable of independent judgment and responsibility. For this reason the Institution admits to chartered membership only those engineers who are able to satisfy the Institution regarding their professional competence and experience. The engineer who does not become a Chartered Engineer does not subject himself to any test of professional fitness. This imposes on non-professional people the necessity of relying on their own inadequate judgment in this important matter'.*

'Moreover, the engineer who does not join the Institution has no obvious obligation to adhere to a professional code and the public is not then protected against malpractice. The Institution, as the body which represents the engineering profession and promotes its interests, deserves the fullest support of all members of the profession. By not joining and by not seeking the title Chartered Engineer, engineers harm the profession and diminish their own status and prestige.'

Collins considered that there was not a public awareness of the title Chartered Engineer and that, consequently, everything must be done to inform the public of the significance of the title and to secure for it its proper status and respect. Only in this way will it become an enviable qualification which is desired by all engineers.

The engineer, when acting as a consultant in private practice, fills a service role. When acting as an employee the role is quite different and is a collaborative one. The collaborative role of the professional in industry does not usually pose any problem as there is a widespread acceptance of the organisational concept of line and staff functions. In the public service, however, the collaborative role is often beset with difficulties. Collins felt that this was due to a false concept of the managerial role.

Collins alluded to the emphasis in recent years on management as a professional discipline and its elevation to a status even greater than that of the learned professions. He felt that this stemmed from the myth that management is itself a learned profession. It is the possession of uncommon knowledge and skill that identifies a learned profession. A manager may possess knowledge and skill but not of an uncommon kind. Furthermore, many successful managers have had no formal education or training in management. Management is not, therefore, a learned profession.

Finally, in commenting on the question 'How should the engineer relate to society?, Collins gave certain reasons for the dichotomy between the engineer and the administrator. He commented that there was an obligation on engineers to do what they can to bridge the gap and to make their science more comprehensible and meaningful to those outside the profession. To do this, engineers will have in the future to become more involved in economic, sociological and political affairs and in upper management not only of industry but communal affairs.

Collins concluded his presidential address with these words: *'Engineers therefore must individually and collectively participate more deeply in politics and awaken an understanding of the necessity of co-operation between the engineering profession and government.'*

President Lucas Collins presenting the Institution Prize in 1978 to Liam Stephens for a paper (jointly with Edward Dowling) on the Talbot Memorial Bridge, Dublin

Morgan Sheehy addressed the Institution members at length in November 1979 on the subject of Technology and Economic Development. He began by commenting *'The existence of developed and underdeveloped countries suggests to the hopeful citizens of both kinds that the deficits of the latter can be cured by the instant transfer and application of the technology of the former. Development is not a matter of technology alone. Economic development requires a set of institutions, habits, incentives and innovations in order that the inputs necessary to a continuous increase in output are self-generating. The essential inputs are capital, trained manpower, and technology and they are likely to be self-generating only in an environment in which the population seeks to improve its physical wellbeing, and in which the rewards of effort are at least roughly in proportion to the productivity of effort. The availability of modern technology is a matter of great importance.'*

He felt that the precise role played by technology or capital accumulation in economic development had not been agreed. Must the indigenous economics of the developing or underdeveloped nations generate most of the capital required for industrialisation? He felt that the answer was not a simple yes or no. He then attempted to appraise this possibility, weighing the demands of a rapidly increasing population against the supply of natural resources taking into account the relationship between technology and economic development.

He noted that a variety of conflicting opinions existed as to how important to economic development is land, labour or capital. Economists agreed on the central importance in economic development of capital accumulation and technological progress, but they would not necessarily agree on the precise role played by either, for both are simultaneously causes and symptoms of development. Some represent industrialisation as the key to economic development and regard agricultural improvement as incidental; others would reverse the order of priority and emphasise the difficulty of expanding the market for industrial products so long as agricultural incomes are low and food relatively expensive. To some economists the existence of a vast rural surplus of manpower implied the need for a corresponding expansion in industrial capacity, financed, if need be, through drastic taxation. For others, the gains to be expected from taking up any slack in the economy were not very significant so long as the existing technological frontiers were not advanced.

Sheehy said that it was difficult to state the role of land in development without some consideration of capital and technology, but in regard to developed or under-developed countries it could be said that for a developed

country with abundant capital, land is relatively unimportant. However, in the future the developed countries will experience profound changes in values. The relationship between value changes and economic growth is that economic growth must be seen as a means and not as an end. He concluded that the 'value' system will still aspire to full employment, greater material wellbeing and more egalitarian distribution of incomes and distribution. For an underdeveloped country without capital and innovational skills, land is particularly important. Most developing countries need a dynamic agricultural sector to sustain their development process by providing food and employment, raw materials for industrial production, and capital for industrial and urban development.

Thus the limitations to economic growth Sheehy felt were not likely to be caused by a failure of technological innovation. He considered that there were four current technological ventures which would have a profound effect on economic development in the following twenty years:

- Electronics - Teleprocessing and automation will change the face of advanced industrial societies permitting decentralised management of production processes. They will also create new patterns of consumption and employment, though for about ten years the negative effects on employment may outweigh the positive ones;

- Biology - According to some observers biology will have as much impact on industry in the 21st Century as Chemistry and Physics had in the 20th. The possibilities include biofuels, animal feed, ecological pesticides and improvement of animal and vegetable characteristics by genetic engineering;

- Development of new forms of energy.

- The use to be made of oceans and space.

Development consists primarily in employing existing resources in a different way and in doing new things with them, irrespective of whether or not those resources increase. Technology means the systematic application of scientific or other organised knowledge to practical tastes and may be thought of as a primary resource.

Sheehy felt that industrialisation faced three important problems in the developing countries:

- protectionism;

- a bias in the choice of technology; and

- the role of the multi-national companies.

Sheehy commented that *'there is a strong tendency in the developing countries to establish industries using capital equipment from the developed countries. This equipment embodies technologies perfected for conditions where the relative costs of labour and capital are very different from those of the developing countries and which require skills and advanced industrial services not readily available in the Third World. Industrialisation creates fewer jobs than its potential suggests and fails to contribute adequately to income distribution or the growth of domestic demand.'*

Sheehy then traced briefly the development of science and technology in Ireland since the late 1950s. He repeated a reference made in 1896 by Sir Robert Kane, Professor of Natural Philosophy at the Royal Dublin Society, when he wrote in a report of the Recess Committee regarding the establishment of a Department of Agriculture and Industries in Ireland: *"We have in Ireland a poor country , practically without manufacturers - except linen and shipbuilding of the North and the Brewery and distilling of Dublin - dependent upon agriculture, with its soil imperfectly tilled, its area under cultivation decreasing and a diminishing population without industrial habits or technical skill"*. While Ireland had a long scientific and technological tradition it was never considered, or seen as having, a central role in economic development.

Moving forward to December 1957, the then Minister for Finance, whilst considering the desirability of attempting to work out an integrated programme of national development for the next five or ten years, which he believed would be critical years for the country's survival as an economic entity, admitted that he had not a 'plan' in mind. He felt that greater output per head and increased saving were essential conditions of economic improvement. Thus began Ireland's First Programme for Economic Development. The need to instil in the public an expansionist outlook was evident. At the end of the first programme in 1963, the targets set had been achieved. In the Second Programme (1964-1970) the need was expressed to adapt, re-equip, extend and re-organise all sectors of the economy to ensure the greater strength and efficiency needed to prosper in a more acutely competitive world.

Although the aims of the Second Programme were not achieved, Sheehy did not feel that the fault lay with the programme. He continued: *'An aim does not necessarily represent a promise and politicians espouse planning as the preferred development technique; their eloquence rather than the execution of the plan predominates. Programming, after all, involves making the most reasonable estimate of the increase attainable in total production on certain assumptions about major factors such as population, individual output, exports and capacity to finance capital needs. But the setting of over-ambitious targets, when the targets are not attained, have an adverse effect on both the domestic and foreign resources. Failure of a plan is no argument against planning but merely that planning must be effective.'* Because the Second Programme failed to reach its target, initially a mood of despondency, inimical to enterprise and development set in temporarily.

A Report in 1963 on Science and Irish Economic Development stated, on examination of the existing science effort in the country, that "in general, with the exception of physical planning and most agricultural and economic research, the science effort, is piecemeal, scattered thinly, not always directly related to national needs and so uncoordinated that it tends to lead to undue overlap in some subjects and an absence of activities in other important fields. Industrial research is relatively non-existent''.

Sheehy considered that the creation of substantial innovations and new domestic technologies should be a major long-term objective, using Irish science as a basis for economic development. He noted that there were many restrictions on the achievement of technological change in Ireland, despite the very serious and urgent need for it. A comprehensive list of these had been described in the Report on Science and Economic Development, those relating to short-time objectives being:

- Industry has not sufficient highly-qualified technical personnel;
- Industry does not employ sufficient numbers of technologists and technicians;
- Industry has not enough technical advisory services;
- Public Enterprises are not giving sufficient lead;
- Lack of awareness in Industry and Universities of the necessity for technological change;
- Inadequate facilities for technicians and technologists for higher studies or insufficient mobility due to restrictions on secondment; and
- Insufficient research and allied activities to support adequately the types of technological changes required especially regarding the type of "industrial" research, industrial and technical design, building research, certain health, environmental and fundamental research, lack of adequate technical development facilities to implement findings and innovations, including inventions.

The then government, as part of its continuing policy for economic and social development, appointed the National Board for Science and Technology (NBST) to act as the chief advisor to them on policy and planning in the field of science and technology in Ireland. In addition, its tasks included preparation and review of a national programme for science and technology, coordinating activities related to science and technology and promoting

the coordination of public and private investment in science and technology. It had the duty of preparing a science budget, so as to meet the requirements of all Institutions, engaged wholly or partly in science and technology.

Sheehy mentioned that in 1965 the Cumann had produced a report *Technology and Technical Manpower - Aspects of Economic Growth for the Seventies* and a report from the CII in September 1978, which stated that there was evidence that industry would welcome a significant increase in the number of engineering graduates in disciplines such as mechanical, production, industrial and chemical engineering.

Sheehy concluded his address by urging the Institution and its members to endeavour to interpret the events ahead so as to assist in the formulation of national policies and strategies related to science and technology.

In his presidential address to the Institution in October 1980, **Liam O'Brien** chose to deal with some general topics relating to industry in Ireland, with particular reference to the industrial development that had taken place in the West and Mid-Western areas of the country, beginning with a look back at the position that existed when the State was founded. At that time, more than half the population was engaged in agriculture, and only about 8% in manufacturing industry, and virtually all this industry was located in the Dublin and Cork regions. It was evident that prospects for future growth in output and employment in industries that were orientated mainly towards the home market, were very limited . It was obvious that further growth depended on increased industrial exports and from a national viewpoint, this could be most beneficial if promoted on a regional basis.

To achieve development and to increase industrial exports, the government set up three separate semi-state organisations. Two of these, Shannon Free Airport Development Company (SFADCO) and Gaeltarra Eireann catered for Shannon, Mid-West, and Gaeltacht areas and the third, The Industrial Development Authority (IDA), was responsible for all other areas. The success of the developments at and emanating from Shannon Airport, and the uniqueness of some aspects of them, attracted considerable international attention amongst individuals and agencies interested in regional development.

In 1959, the government, conscious of the danger presented to Shannon by new long-range aircraft, set up SFADCO to take action to counter that danger. Shannon developed as a fuelling stop and made excellent use of the opportunities which that presented. It had the first Airport Duty Free Shop in the world. and a total of 1,800 people were employed there. In the depressed West of Ireland, it was a major centre of prosperity and employment. Then, when aircraft would no longer need to land to refuel, SFADCO had to establish other reasons for landing.

Planes land for freight or passengers - the former is generated mainly by manufacturing activity - the latter mainly by tourism. SFADCO's initial manufacturing development was in the newly created Airport Free Zone, the first Industrial Estate with rentable factories in Ireland. In effect, SFADCO provided in a limited area fully supportive industrial infrastructure: buildings, roads and utilities, including a new major water supply scheme. In addition to physical services, it supplied assistance with recruitment, training, labour relations, and general advisory services aimed at minimising the difficulties encountered by industrialists setting up in what was for them a foreign environment.

The Mid-West region consisted of Limerick, Clare and North Tipperary, based on Limerick. The region saw as one of the main obstacles to its successful development, the lack of a university or equivalent at Limerick. NIHE Limerick went a long way towards fulfilling that requirement, its courses being initially specifically related to industrial and business careers, and it had a major effect on attracting engineering and electronic industry to the region.

Aughinish Alumina, county Limerick

The Mid-West region entered the decade with a sound base in advanced technological industry in the fields of electronics, engineering, and health care. O'Brien pointed to some major developments which he felt would undoubtedly have a significant impact on the region: the completion of the Aughinish Alumina project, the building and operation of the ESB Moneypoint Power Station, and the possible building of an oil refinery on the Shannon estuary to process oil brought ashore from the Porcupine Bank, if such was found in commercial quantities.

Historically, manufacturing industry just did not exist to any significant extent in the Gaeltacht areas. In 1958, Gaeltarra Eireann was formed to take over responsibility for the Gaeltacht areas. The objectives were to encourage and expand suitable economic activities and to improve social conditions so that those residing there, who used the Irish language as their normal medium of communication, would have adequate opportunities of securing gainful employment and of enjoying reasonable living standards. In 1965, to further that policy, additional powers were conferred on Gaeltarra Éireann for industrial development throughout the Gaeltacht. The Udaras na Gaeltachta Act of 1979 came into operation in January 1980 when Udaras took over all the powers previously held by Gaeltarra Éireann, with additional powers attached, O'Brien noting that, as a result, some 4,000 additional industrial jobs had been created in the Gaeltacht areas. He felt that it was fair to say that the Gaeltacht areas were not the most suitable for modern industries, and unless an organisation existed with specific responsibility for the development of these areas, little, if any, new industry would locate in them.

In the West region, consisting of the two counties of Galway and Mayo, only 8% of those gainfully employed in 1971 were engaged in manufacturing industry. It was against this background that the IDA opened its West regional office in Galway City in January 1971 and plans and strategies were developed to create new jobs in the manufacturing industry throughout the region. The IDA immediately set about the purchase of sites suitable for industry in each of the 27 towns and villages designated in its plans and a programme of building advance factories in a number of selected locations.

As to tourism in Ireland, the real growth had occurred in the period following WW2, when there had been a significant development in the private motor car, bus and coach travel. Conscious of the importance of tourism for the Irish economy, the Government passed the Tourist Traffic Act in 1955, setting up Bord Failte and empowering it to continue to develop touristic activities within the State. O'Brien mentioned Ireland West Tourism as the organisation responsible for the promotion and development of tourism in counties Galway and Mayo. The Regional Tourism Organisations development programme covered such projects as Golf Courses, National Parks, Forest Development, Environmental Planning Studies, Sub-Aqua Development and Sailing, Angling and Cruising Facilities. Progress had been made since the setting up of Bord Failte, but O'Brien felt that there was potential for further massive growth. In 1956, the total tourism revenue from overseas and out-of-state visitors amounted to £33m; in 1979 this had risen to £335m.

In general, O'Brien said that there was no doubt that great progress had been made in promoting regional development in the undeveloped areas of the country, but that a great deal more needed to be done to ensure that the country would develop and prosper, and that employment would be available for the exceptionally young workforce. He opined that industry was the foundation on which the continuous development of the Irish economy must be built and he was convinced that ample opportunities were there for young entrepreneurs, the majority of whom should come from our engineering graduates, with their education and training.

O'Brien noted that it was interesting that the structure of Irish industry was such that approximately 94% were small firms employing 40% of the persons working in industry. The small firm was at the time a fundamental part of the country's economy and he felt that they contributed to a balanced regional development, to innovation and specialisation. However, he went on to say that the small firm, by virtue of its size and resources,

could not afford to engage in research, and that, without research and development in this technological world, it was difficult to compete with the larger industries.

He noted that they were fortunate in having a very outward-looking university (UCG) and Regional Technical College (RTC) in Galway and industrial firms could utilise the expertise and know-how to their great advantage, and thus promote development. UCG in 1972 became the first university in Ireland to introduce undergraduate and post-graduate courses in Industrial Engineering. Again, the following year, UCG had the foresight to set up an Industrial Liaison Office.

O'Brien was convinced that there were tremendous opportunities open to the young entrepreneurial engineer to initiate and develop his own industrial project, but he warned that to succeed he must be determined to overcome the many difficulties he will encounter: Theodore Roosevelt once said: *"Perhaps there Is no more important component of character than Steadfast Resolution. The man who is to succeed must make up his mind not merely to overcome a thousand obstacles, but to win in spite of a thousand repulses and defeats".* O'Brien also believed that engineers have an obligation towards the development of their country's economy.

In conclusion, O'Brien noted that many changes had taken place in Irish society over the previous two decades, the most noticeable change from the economic viewpoint being the growing industrialisation and urbanisation of society. Industry provided a significantly higher proportion of employment than agriculture and was, at the time, the largest wealth producing sector in the economy. He felt that the importance of the industrial sector in terms of employment and of wealth creation would further increase over the following decade.

He continued *'Ireland faces many challenges as we enter the 1980s. We are a small country with a small home market, and our products face intense competition from the most developed economies of the world on both our home and overseas markets. Ireland has an advantage in having a young and growing population: we have in fact the youngest population of any country of the EEC. We also have the advantage of having a highly-educated population, and our young people have the skills which equip them for employment in the technologically advanced industries.'*

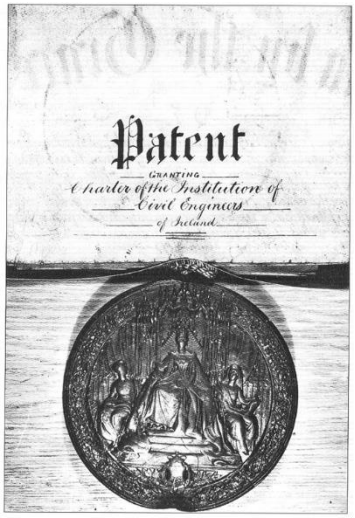
O'Brien concluded that the engineer had been called upon to make a major contribution towards the development of Ireland in the past, but the calls upon the engineer will be far greater in the coming years. The high-technology industries which have been established in Ireland, and which are now in the course of being established, offered very many career opportunities for engineers in production, industrial design, research and development, technical sales, and transportation. Irish industry needed significantly more investment in the research and development of industrial products in order that the industry attracted to this country might become truly Irish in character. He considered that Ireland had also entered a phase of producing goods for the more expensive and sophisticated export markets, and that in these markets it was essential that considerable effort be put into achieving good design, and high quality and finish of our products. In all of these facets, the skills of the engineer were of paramount importance.

Following in the tradition of reading the addresses of former presidents, **Peter O'Keeffe** soon found out that past addresses were real repositories of information on the origin, history and development of the Institution and, most importantly, that they gave one a deep sense of the distinctive attitudes which characterised it as a genuine national professional group.

Delivering his presidential address in 1981, O'Keeffe mentioned that the year marked the centenary of the death of Robert Mallet, who had been largely responsible for the reorganisation of the initial Society of Civil Engineers (1835) and its renaming as The Institution of Civil Engineers of Ireland. He stated that the fruits of Mallet's work live on and were most manifest in the almost unique unity that existed (and still exists) in the engineering profession in Ireland as The Institution of Engineers of Ireland (1969).

O'Keeffe felt that the public tended to be a little suspicious of the operations of all kinds of organisations, including professional institutions. He said: *'If a body is doing its work properly and pursuing its objectives it need*

have no fear of public opinion. It is important, of course, that the public should know about the nature and extent of the activities of national bodies and perhaps the Institution has been a little remiss in this connection by failing to draw sufficient attention to its work.'



Regarding the unity of the engineering profession in Ireland, O'Keeffe commented that professional engineers from abroad were always impressed by the fact that the IEl catered for all the main branches of the engineering profession in Ireland. He noted again that the Charter granted in 1877 (seal pictured on the right) extended the Institution into a society for promoting knowledge which appertains to the professions of both civil and mechanical engineers as well as the advancement of engineering and mechanical science. He considered that The Charter Amendment Act of 1969 was one of the outstanding achievements in the advancement of the engineering profession in Ireland. It had truly unified the profession whilst allowing for specialised areas of engineering and technology to be fully recognised. O'Keeffe stressed that unity had been hard won and that it must be protected vigorously because, it is not alone essential for the profession, but also of vital importance in the advancement of engineering in Ireland.

O'Keeffe had been appointed convenor in 1972 of a small ad-hoc committee to report on the future use of the Institution's Library and, since then had been very interested in the maintenance of its Archives. The committee concluded that the Institution could not continue to maintain an up-to-date library and technical information service from its limited resources. It adverted to the fact that various semi-state bodies and national research institutes had been charged with the provision of such services, covering all branches of the engineering profession and suggested that the role of the Institution should be to ensure that these services were adequate and accessible to all IEI members. The Committee also drew attention to the fact that the Institution Archives were *"not merely a priceless heritage of the Institution but also a part of the national heritage of all Ireland".* It strongly recommended that the Institution retain and maintain its holding as an Archive and Reference Library. [These recommendations were subsequently implemented, the Archive later being transferred to the safe-keeping of the Irish Architectural Archive at 45 Merrion Square, Dublin.]

O'Keeffe had spent most of his career in the public service working on various elements of roads and road transportation, and he singled out a few aspects that were topical at the time of his address.

He said that when he first became involved in road works, engineers were still following Telford's method in the construction of some new main roads and Macadam's method in the reconstruction of county roads, albeit with the addition of bituminous surfacing. However, winds of change were then blowing from the USA, where the construction of road pavements with cheap local gravels had become widespread. In Dublin, the Department of Local Government in 1944 published a classic report entitled *Standards for the Classification and Lay-Out of Roads* leading to a new approach to road development in Ireland. O'Keeffe noted that, while many thousands of miles of less important county roads were improved in the 1950s at very low cost using surface dressing, progress on the improvement of the principal roads was negligible due to short-sighted national economic policies.

O'Keeffe commented: *'As we move into the 1980s we find one significant change in the national approach to road transportation, namely, that road users, industry, the media and others are now demanding that more money be invested in roads to relieve congestion in the cities and principal towns and to raise the level of service on interurban routes. This is a radical change from the 1960s when, with very rare exceptions, the voices of the*

roads engineers were the only ones crying out for more investment in roads. Last year the CII ranked inadequate roads as one of three primary factors restricting industrial development and efficiency.'

O'Keeffe opined that *The Road Development Plan for the 1980s* was the greatest advance made in relation to the development of our road network since the 1920s. The Plan provided for the construction of sixty-two by-passes, many major bridges, hundreds of miles of dual-carriageway roads, and circumferential roads in the principal cities. He felt that there were hopeful signs, but hoped that economic decelerate this important national programme just as it was beginning to get off the ground. He considered that it would be genuinely productive, have very low import content and, most importantly, was one that relative to many other programmes was beginning to generate high levels of direct and indirect employment.

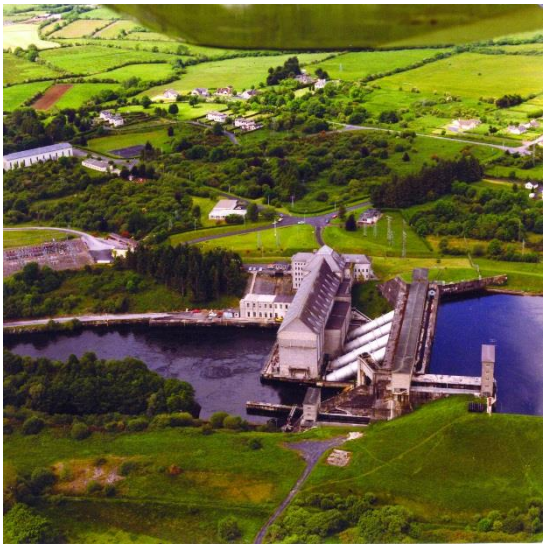
O'Keeffe then made some comments on road safety. He said: *'Traffic accident counter measures can best be looked at under the traditional headings - the three "E"s, engineering, enforcement and education. Traffic engineering for road safety is an ongoing activity in which many members of the Institution have been involved. Despite severe limitations on resources during the 1970, good progress had been made in this field particularly on the provision of road surfaces with high resistance to skidding, the improvement of sight distances, the provisions of hard shoulders, the channelization of junctions and the elimination of black spots. However, due to the continuous increase in traffic volumes, new hazardous locations developed almost as quickly as existing ones were removed and, as a result, the reductions in accidents were not obvious to the public.'*

He also commented on pedestrian safety and speed limits. In 1981, An Foras Forbartha (AFF) held a symposium in Dublin attended by researchers from thirteen countries. Amongst the findings issuing from the symposium were that there was substantial evidence that reductions in mean speeds gave rise to reduced accident rates and lower accident severity. It was noted that, in some cases, the percentage drop in fatal accidents had been as high as four times the drop in mean speeds when speed reductions were achieved. It was accepted that speed limits were still fairly blunt instruments, but with further refinements far greater safety levels could be achieved while maintaining reasonable mobility on the roads.

O'Keeffe noted that many previous presidential addresses had been written during periods of national crisis and were notable for the hope and confidence in the future which they invariably expressed – hopes which were in the main justified subsequently. He believed that there was a wealth of resources and technology available for mankind, and that the engineering profession had contributed enormously to this wealth in harnessing the resources of nature, but that these resources had not always been used for the benefit of man. He felt that the reason was obvious: *'that the spiritual forces of the developed countries, east and west, have been weakened and in many areas almost eliminated. Fortunately, in Ireland we have preserved the great European infrastructure built up with great sacrifices over a period of fifteen centuries but it is not being utilised sufficiently in meeting the challenges created by the infant modern technological society More and more people are awakening to this truth and therefore, I, like my predecessors in their time, am full of hope and confidence for the future of all Ireland.'*

Eoin O Cionna, in his presidential address to the Institution in November 1982, chose to speak on some aspects of engineering in Ireland in the twentieth century. It has only been feasible to provide here brief extracts from O Cionna's wide-ranging look at the development of engineering technology in Ireland during the period 1900 to 1980. Having described the status of engineering technology at the close of the nineteenth century, O Cionna divided his historical account into a number of periods, commencing with 1900 to 1914 and 1915 to 1922 and thereafter by decades.

The period 1900 to 1914 saw the electrification of the Dublin tram system completed by about 1902. Dublin Corporation's English consultant had recommended locating their new power station at the Pigeon House (harbour) and this was completed in 1903 - one of the first three-phase public supply schemes in the world, and the first in these Islands, the station having a total capacity of 3MW from four steam engine-driven alternators served from four Lancashire and four water tube boilers, the latter fitted with automatic stokers. Dublin's new sewage sedimentation plant was completed in 1906. Belfast was benefitting more than Dublin from industrial growth. Harland & Wolff's employment was 18,000 by 1912 when the *Titanic* was launched. Davidson's Sirocco works exported mine fans and tea processing machinery all over the world, as did Mackie's textile machinery works, whilst the Belfast Rope works was the largest in the world.



Hydro-Power Station at Ardnacrusha (The Shannon Scheme)

The next period, 1915 to 1922 was one of unsettlement, turmoil and war. Baldonnel, Tallaght and Gormanstown aerodromes were laid down and the hangars which served the Irish army well in later years were built. Electrical engineering had grown apace, but of the 136 public electricity supply schemes in operation in Ireland at the end of 1922, only twelve had capacities of about 300kW, whilst over one hundred were of less than 100kW capacity. In 1919, John Chaloner Smith of the OPW published his celebrated work on the hydrological data of the river Shannon at Killaloe that proved so essential to the later planning of the Shannon scheme. Post-war planning and construction was very much under discussion and the ICEI Transactions dealt with the development of bogs, coal and waterpower resources, mineral exploration and road development. The industrial uses of turf aroused considerable controversy. Thinking in Ireland at that time was that the development of turf should be funded by a tax on coal. Whilst engineering was still flourishing in Belfast, the Ford Motor Company established a plant in Cork to produce a large portion of their tractor output for Europe. The Atlantic was flown for the first time and radio broadcasting had commenced in the UK.

The period 1922 to 1932 started in national trauma, but was full of significant happenings and of determination by engineers in particular to demonstrate that the new Irish State could initiate and carry through a programme of steady development. The Shannon hydropower scheme moved at a really astonishing speed, work commencing in 1925 and being completed by 1929. The Government set up the Shannon Power Board to act as its engineers in overseeing the works, comprising a small number of senior engineers of experience brought in from abroad, assisted by a number of Irish engineers, most of whom were young. Thus, only three short years after the founding of the State, the dreams of Irish engineers were being realised in what was a big undertaking, even by international standards. The Electricity Supply Board Bill was hurried through in 1927, in effect nationalising electricity supply, and perhaps establishing the first of the Irish State companies. The Electricity Supply Board was given powers to acquire existing supply schemes, including that of Dublin Corporation.

A road maintenance programme got under way, slowly at first, as the roads were in bad condition due to the considerable growth in traffic and the lack of maintenance. Maintenance operations were accelerated in 1926/27 by what was called 'the two million pound scheme', whereby County Surveyors' staffs were augmented and were enabled to purchase much-needed equipment. This was the period of the Depression and of the Economic War that followed shortly after a change of government in 1932. Expansion of the Pigeon House power station in Dublin proceeded and design and construction of the Poulaphuca and Golden Falls hydro stations on the river Liffey went ahead, together with the installation of a Kaplan turbine at Ardnacrusha. Bord na Mona and Comhlucht Siuicre Eireann were set up. Aer Lingus was established in 1936. The OPW began direct labour work

on Shannon Airport in 1936 as part of a programme to provide a combined land/marine airport, but the transatlantic leg was initially serviced by flying boats based at Foynes.

An interesting development was the setting up of Ceimici Teoranta to produce industrial alcohol from potatoes. The ESB resumed detailed planning of its rural electrification scheme and, though limited by finance, started construction in 1948. They commenced work on Portarlington station and expanded their design staff. Shannon Airport commenced land services in 1945 and Dublin Airport got its concrete runways in 1947, the original terminal building having been completed in 1943. Irish Shipping and Aer Lingus expanded their fleets. The IDA was set up as a promotions body, the housing drive picked up again, and the building industry expanded.

In retrospect, the period 1951 to 1960 was disappointing, as industrial growth was not as fast as had been hoped for. It was at the end of this era that the First Economic Plan was produced, and that the first applications involving the transistor arrived in Ireland. The Local Authorities, the ESB, Bord na Mona, and later the Post Office, were major engineering employers, Bord na Mona commencing its milled peat programme and the ESB designed and built thermal power stations at Allenwood, Ferbane, Lanesboro, Marina, Ringsend and Arigna, and brought on stream the Erne and later the Clady hydro stations. SFADCO was set up in 1959 and the IIRS reorganised. CIE started its dieselisation programme, RTE was set up and started to build studios at Montrose, Whitegate oil refinery was built, Busarus opened, and Dublin Port built a new transport terminal. Water supply was augmented, telephone trunk cables were laid, the North Dublin main drainage completed, as well as major water supply works in Limerick and other cities and towns.

The 1960s and early 1970s were periods of cheap energy and of industrial growth in Ireland - the period in which emigration ceased, when Ireland joined the EEC and Irish agriculture expanded rapidly and prospered. The office building boom commenced during this era; Liebherr built their crane factory in Killarney, Cork Airport opened in 1962, Liberty Hall and Ballymun were built, and significant harbour works were carried out in Cork, Waterford, Limerick, Arklow and Foynes. The ESB completed Poolbeg , Rhode, Bellacorrick, Shannonbridge, Great Island and Tarbert power stations; Dublin and Cork Gas converted town gas from coal to naptha feedstock. Tynagh and Silvermines commenced operation, NET was set up and built and operated its Arklow plant; the pharmaceutical industry began arriving and the expansion of the big dairy co-ops began. These types of works required improved design and project management skills and larger and more specialised contractors. An Foras Forbartha was set up as the research arm of the Department dealing with Local Government, and eventually given an independent board. Housing output and demand both increased and the number of road vehicles increased to over half a million, the road improvement programme accelerated, systematic road safety studies began, and cars were delivered with seat belts fitted.

The period 1974 to 1982 commenced with the energy crisis at the end of 1973, accelerated by the Arab-Israeli war. The CII accepted an offer of assistance from a number of engineers experienced in energy usage, formed them into task forces to make one-day visits to selected industries to assess their requirements and problems, to advise them of possible savings and to report. Irish industrial growth continued with notable successes in the pharmaceutical, chemical processing and electronic industries. The coming onstream of the Regional Colleges of Technology led to a significantly increased supply of well-educated technicians and specialist technologists. Natural gas was found and landed. BnaM commissioned two new briquette factories. The ESB commissioned Poolbeg and Turlough Hill stations and converted the Cork Marina station to dual-cycle operation on natural gas.

O Cionna believed that the previous ten years had been a period of very significant progress in Irish technological development, in which horizons widened and skills and experience were significantly improved, so that a markedly greater confidence in our own capabilities was engendered. He continued: *'Because of this, I do not subscribe to the 'severe crisis' talk of today. We have difficulties true, perhaps severe difficulties, but we have far greater resources and skills to deal with them than we had at any time in any of the periods I have touched on. It is up to us to provide the wit and the will and the work.'*

In the period to the end of this century O Cionna considered that the significant developments likely to make the greatest impact would most likely involve Information Technology, Communications, Robotics and Biotechnology. He felt that the first two were likely to have the most immediate impact on our engineering and on our way of life and very much sooner than most of us realise. O Cionna ended by saying that *'we must increase our awareness of the developments and try and plan our training and education and part of our investment to make sure we are not disadvantaged by what others do.'*

Eoin O Cionna passing on the presidential chain of office to Pat Lynch

Pat Lynch, president in 1983, had been involved in one aspect or another of road engineering during most of his career. He felt that it might be appropriate to review the current situation – an audit of our progress and a look forward. He also referred to the splendid work carried out in the development of our railways, our canals and our harbours, heritage that we are still using and enjoying. In the first half of this century, we had celebrated the efforts of that generation of engineers who harnessed our natural resources by initiating the hydro-electric schemes and the bog development which carried us through the difficult period of the 1930s and the war years. This work was the very springboard for the developments of the 1960s and 1970s. Lynch had always considered that the second half of this century should have been the communications age for Ireland and that we should have been making great progress in the expansion and development of our roads, telecommunications, and our ports and airports. Since 1980, investment in the telephone system had been proceeding at twice the level of investment in internal transport, which included both roads and public transport.

Lynch quoted a former president, Ian Bloomer, who in 1951 said: *'' An expenditure of nearly £1OOm. has been incurred on the improvement and maintenance of the road system in the period under review, but the work is far from complete. The ever-increasing weight, speed and intensity of traffic bring forth new problems in design, construction and control. Old surfaces wear and must be renewed. The cost of road work had increased enormously and the problem of adequate financial provision is ever with us. As an offset we have available to us now, new and greatly improved machinery and better methods and materials of construction. The road system of a country must keep pace with the demands made upon it or fail in the purpose which it serves."* Lynch considered that therein lay the challenge. Bloomer's comments were more valid than when they were written and he asked how had we as a profession responded to that challenge?

Lynch reviewed developments following the re-classification of the system in 1969, which was followed by the comprehensive inventory of the physical characteristics of the newly designated National Route System, provided comprehensive data for the information of engineers and others engaged on the planning, design and maintenance of the National roads. For the National Primary Routes, the study indicated that 10% of the system was in very poor condition, 8% was in poor condition and 25% was in fair condition. A feature of this work was the introduction of the concept of level of service, and a forward projection of traffic flows. This enabled the year of obsolescence to be determined for each road section of the system and for the first time, gave the element of choice to the decision makers in defining the costs associated with the development of the network to a particular standard. This work paved the way for the first real attempt by Government to define a roads policy for the country. In 1979, the *Road Development Plan for the 1980s* was published and even though it was modest in its proposals, it was a giant step forward for all involved or interested in roads in Ireland. Lynch added

that *'for the first time it gave official recognition to the cost of congestion - a theme that had been exercising my mind for years - but one which I found difficult to quantify on a national scale'.*

The overall strategy of the plan was sound in that it set as its first objective the preservation of the existing road network which represented a most valuable asset to the nation. It then proposed to continue, at an accelerated rate, the improvement of the inter-urban network to at least a two-lane standard as a first step. Lynch commented *'On the first question, regarding the choices of first phase projects, one has only to look at the map in the plan to appreciate the good sense and judgement applied to the task. The major bottlenecks have been identified and when they are eliminated and the new proposed river crossings have been constructed, the network will be freed up considerably.'* He noted that Ireland spent less on its road system than any other developed country. Whilst road taxation in Ireland as a percentage of State revenue was the second highest in the EEC, expenditure on road maintenance and improvements was the second lowest. He felt that the low level of funding for roads was the more surprising in view of the potential employment which road building afforded. Maintenance works were even more labour intensive. He welcomed the statement from the then Minister of State at the Department of the Environment that the Road Development Plan was currently under review and that a capital investment programme of £3,000m was to be provided by the government over the following ten years. However, he noted that the Minister had not stated whether or not this represented the combined inputs of State and private sector.

Lynch felt that if the accelerated programme was to be brought to a satisfactory conclusion within a reasonable time scale, a need existed for a group of people separate from, but reporting to the Dept. of the Environment to provide the additional and much needed focus for this work. It might be called a National Roads Task Force, a Road Construction Unit, a National Roads Agency or some other title. He added that the name was not really important, it was the functions assigned to such a body that would make the difference. The primary responsibility of such an organisation would be to draw up the detailed programme of work, to raise and receive al! the necessary finances from the various sources to fund the programme. It would also impose the standards set by the Dept. of the Environment and allocate the functional responsibilities for the execution of the programme. It would also allocate the necessary funds for the works and monitor performance.

Lynch considered that another area for serious review was that of pavement design. *'With the increase in number, weight and extensive movement of heavy commercial vehicles, much closer attention must now be paid to structural design of road pavements. It is most important that the adequate design life be henceforth built into pavements'*. He also suggested that with the removal of bottlenecks and the construction of by-passes, much of the pressure points in the system would be relieved. He added *'The approach, in my view, for the second phase of the plan should be that of route development, starting in Dublin and the other major centres and working outward. This strategy would improve the roads in decreasing order of traffic density, and maximise the total relief to the road user. It would also ensure more uniformity in the routes themselves'*. He felt that it was critical that adequate levels of funding for maintenance be provided as it was generally accepted that provisions had dropped by at least one third in real terms over the previous four years. The inevitable result of this trend would be the disintegration of the network.

Lynch said that *'In this country, the need is no less than in other countries. The increase in the application of technology to the work involves new maintenance processes and specialised treatments that are now becoming available and also involves the more extensive management of maintenance through more formal structuring of the work. Another aspect is that of training which is more critical now than ever before with developments in standards, materials and equipment. In the area of structuring of the work, more attention must be given to measurement and condition assessment in order to establish the priority needs in a situation of diminishing resources. Decisions on when to repair or replace a pavement may well be based on results of measurement of pavement deformation or deflection. Methods of measuring these properties are well developed and must be used more extensively in the future, in order to get the best value for money.'*

Commenting on R&D in the roads area, Lynch considered that the country needed a National Inland Transport Policy where Road Transportation fitted in as a major element - and had resources applied to it in proportion to its contribution to the inland movement of goods and people. He continued: *'Unfortunately, we do not have the time to wait for it, but must press on with the Plan in its revised state. It essentially will be the road transportation element of the National Policy'. In conclusion, I would say that 'we have established the need for the maintenance and development of our road network. We must now get down to the task as expeditiously as possible'.*

Oliver Feighan opened his presidential address in 1984 by thanking the members of the Institution's Council and Executive for their deep and sustained commitment. He said that *'my period as Vice-President and President has given me a unique opportunity of observing at first hand, the degree of dedication of our members to the nation's advancement. The Council and Executive members, in particular, have a deep and sustained commitment in the shaping and formulation of concepts which will develop the professional standards and work ethos of present and future generations of engineering graduates'*. *'Acknowledgement of this commitment and involvement by the Institution's elected officers over the generations has not always been expressed. I have great pleasure in now paying tribute to those engineers who have gone before us and those who now control the destinies of the Institution of Engineers of Ireland. They sought from the finest motives to lay down guidelines of engineering practice and professional ethics. I know that they will always work to preserve the proud tradition of engineering service to this nation that we love so well'.*

Oliver's career background had been mainly with Local Authorities. He continued: *'It is rarely appreciated that the Local Authorities, as defined under the Local Government Acts, are a major employer in Ireland today. The total employment under all headings amounts to 37,500 persons, of which 30,000 persons are in the skilled, semi-skilled and other outdoor and manual grades. The remaining 7,500 are employed as professional, managerial, engineering, clerical and administrative staffs'.* Feighan then outlined briefly the development and progression of the identifiable elements leading up to the formation of the modern Local Authority system.

The first organised attempt to construct and maintain the embryo road system of the country was in 1613. This enactment required the choosing of two honest persons of each parish to be surveyors of the road repair works and their arrangement. The emphasis then, as today, was that the surveyor be an honest person. So was set in train, the reputation and standards of honesty and integrity which are synonymous with the engineer of today.

The modern Local Authority Engineering Service traces its formation to legislation in 1833 and 1836, when it was stipulated that the County Surveyor must be a qualified engineer. The legislation went on to outline duties in the supervision and maintenance of roads and other public works, with the additional empowerment to employ Assistant County Surveyors and Clerks. Further legislation in 1898 saw the establishment of County Councils in Ireland, and the County Surveyors and their staff transferred to a new Local Authority System. The Local Government Act of 1925 provided for the division of roads into Main, County and Urban Roads, while Sanitary Services were transferred for discharge through a Board of Health.

The County (Management) Act 1940 vested power in the Manager to appoint such officers and employees as are necessary for the performance of the functions of each Local Authority. The introduction of County management changed the title of County Surveyor to that of County Engineer and established him as head of the Engineering Services of the county, with responsibility for services and supervision and direction of the engineering staff. The position at that time was thus reached where the County/City Engineer, in his particular area, had responsibility for a diversity of engineering tasks ranging from Roads, Sanitary Services, Housing, Fire Services, Environmental Protection, and Physical Planning. Feighan then provided a brief overview of the engineering involvement under the headings: Expenditure, Roads, Housing, Sanitary Services, and Planning.

He stated that the extent of local authority services could be deduced from noting the financial returns over the years, the return for 1983, for example, amounting to £931m. At the time, the public road lengths of the nation

amounted to 92,284 km, 73,975 km being county roads. Feighan said that it was clear that increased investment in road improvement programmes must be basic and essential to the development and betterment of the country's prosperity. He commented that it was evident that while road expenditure had increased, it had not kept pace with the need to remedy the damaging effects of greatly increased traffic and loading. The Institution had been concerned over the position and had in 1983 made a submission to the inter-departmental working group on Inland Transport. This outlined weaknesses "such as inadequacy of funding for roads, haphazard nature of route development in the National Road System arising from the present planned system, lack of clear definition of the role for rail / road and private / public transport in the system."

Feighan considered that the need for road development funds was great and advance planning and design of road and bridge projects an essential factor for all local authorities. The level of expertise and design background had grown substantially in the local authorities over the previous twenty years. Development and progress have been accompanied by a high input of engineering design and technology. He felt that the introduction of computer-aided design to all local authorities would develop and foster that design background. The construction and maintenance of local authority housing had always been a basic part of engineering. Engineering involvement had ranged from layout and house design to preparation of documentation and supervision of construction.

Feighan felt that the essential contribution of sanitary services developments to the life and development of the nation had been underestimated by succeeding generations. The availability of water and sewerage systems determined the progression of industrial development, housing development, agricultural production and building programmes of schools, hospitals and commercial expansion. He continued: *'The work of the sanitary services engineer had made an invaluable contribution over the years, when one considers that the number of houses without piped water has fallen from 289,000 in 1961 to 46,000 in 1981. This is an eloquent tribute to the work undertaken by regional water schemes, and the supportive work of the Group Water Development Schemes'.*

The Vartry reservoir, county Wicklow

The local authorities had come a long way from the advent of the Local Government Planning and Development Act of 1963, which emphasised the new and positive role of local authorities. They were encouraged to see themselves as development corporations, with a high degree of emphasis on initiative and self-reliance. The concept of freedom and corporate development was dealt a body blow in 1978 by the limitation of rate increases by departmental directives. The limits fell far short of inflation and there was a consequent deterioration in the ability to provide improvement and services to the public. He added: *'There are however hopeful signs that local authorities are now being afforded the right to replacement revenue for funding of essential local development'.*

Feighan noted that the industrial and domestic development of the nation had undergone a dramatic change for the good over the preceding twenty-five years. Industrial employment had increased and had been accompanied by better housing and educational standards. There had been, he noted, a dramatic increase in the population and, with it, must inevitably come the problems of coping and providing for the future and continued prosperity of the people.

He considered that the role of the local authority engineer must continue to maintain and develop the high standards of engineering expertise and design that had already been attained. He said *'It is an indisputable fact that the skills of engineering technology will always be an outlet and contribute to the work satisfaction of local*

authority engineers for decades to come. The role, too, of engineering technicians in all aspects of local authority works is understood and appreciated by the engineering profession'.

Feighan posed the question: What then is the role of engineering in the local authorities now and in the period to 2000? He felt that training and experience fitted the engineer to stimulate ideas and concepts and provided for efficient management of community and national services. He added: *'Management of resources, management of people, management and control of systems are fundamental to the work of all engineers. The recurring theme is management and yet, engineers have often seemed reluctant to see themselves cast in the managerial role'.* Feighan was convinced that the future role of the engineer must embrace a strong bias towards management. He added: *'the public will not thank us, if public projects are not subjected to a logical and just form of assessment before commitment of scarce financial resources'.*

Feighan continued:

The present and future generations of engineers must therefore develop the following aspects:

- Development of the process of systematic analysis of management, project appraisal and its predictable effects on the community;
- Greater understanding and appreciation of financial control and expenditure;
- Public speaking must be appreciated as the clear asset it is, in reaching the public mind and imagination. Too often, the art of illustrating and defining the technical content and implications of a public project is not fully utilised. Communication skills are vital. Engineers must and will come to terms with this essential requirement;
- The future of local authority development will rest on the attraction and retention of young graduates within the service. This in turn will depend on the willingness of the engineer to embrace the introduction of training and development schemes for graduates in the best modern practice;
- It must be recognised that all the techniques of modern management are an essential adjunct to the technological experience of any engineer.

As the topic for his presidential address in 1985, **Robert (Bob) Hayes** chose an overview of the transport industry in Ireland. He noted that, from pre-historic times until approximately the time of the foundation of our Institution, there was little change or development in the form of transport available to man, solely because the sources of power did not vary during that period. The only power available was that of man power, of animal power and wind power. The foundation of this Institution coincided in general terms with man's harnessing of the power of steam which led to the development of the railways. Various other sources of power transport became available in rapid succession, the internal combustion engine, the diesel engine and the electric motor. Steam locomotives grew rapidly in reliability and increased their maximum speed progressively and ushered in an era in which the steam locomotive was the king of transport for the following hundred years or so. It has, however, been overtaken by road transport during the past fifty years.

The concept that each distinct community should be, in the main, self-sufficient and be in a position to rely upon its own resources for its day-to-day needs was no longer true. Depending upon their special resources and their aptitudes, individual communities grew rapidly around large manufacturing units, specialising in the production of one particular article or commodity. The self -sufficiency of each community was achieved through trade, by selling its particular product on more widespread markets, using the revenue thus gained to purchase, in relatively remote places, the goods they required for their everyday activity. Thus, the pattern and volume of trade changed virtually overnight and the transport industry, which dispersed the mass-produced goods to remote markets on the one hand and brought back the raw materials and the necessities of life on the other hand, was cast overnight into the dominant role which it plays to this day.

Transport is a service industry. It does not produce goods, nor does it add to the value of goods already produced. It does, however, take goods from their place of production to the point of sale where the goods can command high prices, thus paying for their cost of production and for their cost of transport. Hayes saw the challenge of the transport industry in Ireland as being to deliver its export goods to Britain, to Europe and to the rest of the world and to deliver them safely, efficiently and reliably. They must, of course, be delivered in the right quantity, in the right time and at the right price. The decline of the railways had been related to the growth in car ownership, the growth in road freight vehicles, and the development of excellent road networks. The number of goods vehicles in Ireland doubled between 1960 and 1984 when the number was 83,000. The number of light vans had in the same period almost doubled, as did the number of trucks, which grew from 12,500 to 24,000. Not alone did the number of trucks double, but the individual size also grew. In 1960, only 1% of the truck fleet exceeded 8 tons unladen weight, but in 1984 almost 40 % of the number exceeded that weight.

Hayes then commented *'The quality of the road network, however, leaves much to be desired and it lags behind the standards set in other countries.'* It was only since 1980 that a major investment programme had been designed to upgrade these routes and was undertaken based upon the Road Development Plan of 1979. Only one short section of motorway had been opened in the last few years and this served to by-pass the town of Naas.

The transport industry found itself carrying large truckloads, by road and rail, to the quaysides, and found that it was necessary to unload these vehicles in order to have their contents stowed on board ships. It was not long before experimental vessels were built which were capable of carrying these large trucks without their tractor, but complete with their load, to overseas destinations and so, the Roll On/Roll Off method of sea transport was born. It soon became clear that where longer journeys were concerned, it was a great waste of space to carry the full chassis and wheels of the trailer and so detachable bodies were made which could be lifted off their chassis at the quayside. In this way, the Lift On / Lift Off or Lo-Lo mode was born. The adoption worldwide of standard-sized containers gave the final impetus to the accelerated move into large articulated trucks which were required to accommodate the containers. Hayes considered that Ireland must face the consequences of having a large fleet of container vehicles and that we must also face the possibility that their weight and number, and possibly their length, would grow in future years. He stressed that the planning and design of our national primary road network must be adjusted accordingly.

Hayes continued: *'Environmental safety must also be considered as it is upon these types of trailers and tractors that we transport the raw materials and fuel for industry. In the past twenty years, Ireland has moved into the forefront of sophisticated industries, many of which are chemical related or chemical based. These require the transport in tankers of such materials as petroleum, acids, alkalis, solvents, LPG, ammonia and acrylonitrile, to mention but a few of the products that are classified as Dangerous Substances.* The introduction by Government of bye- laws regulating the transport of dangerous substances was eagerly awaited and it was to be hoped that it would not require a major incident or tragedy before such bye-laws were introduced.

Public opinion supported by economic analysis now accepted that major capital expenditure on national primary roads was good for the economy and the national wellbeing. The success of the East Link toll bridge indicated the way to new sources of money for investment in roads and clearly demonstrated that the road user is prepared to pay a toll for the use of an additional convenient facility. Motorways were considered to be the only class of road upon which tolls could be conveniently collected. Hayes felt that recent events and experience warranted a review of the Road Development Plan, including consideration of a single road authority to control the national primary routes. Plans should also be based on a higher level of service requiring that the more obvious routes be re-constructed to motorway standard.

Hayes considered that we must have three things:

- A National Roads Authority to administer the national network;

- Extended lengths of motorways on certain roads;
- The facility to collect tolls on these routes if that is deemed to be appropriate.

He added *'The introduction of the container and the trailer as a standard unit of transport, has caused revolutionary changes in cargo handling in ports. Sophisticated and expensive equipment is required to handle containers in port terminals and even more expensive cranes are required to load and unload container vessels.'*

Container traffic

Hayes said that the introduction of containers and the increased speed of delivery had reduced the inventory charges associated with transport. These included the cost of wrapping and packaging, security from pilferage and the cost of insurance. Speed of transport enabled the manufacturer to bill the receiver earlier, thus benefitting his cash flow. Speedier and more reliable deliveries enabled stock levels to be maintained at a lower level and the need for warehousing was often eliminated. *'It can be seen, therefore, that the indirect benefits of good transport are both real and widespread.'*

Hayes noted that the design, configuration and size of vessels had also changed in the past twenty years, particularly in relation to unitised cargo. Specialised vessels had taken over from the general break-bulk vessels of the past. Today's ships were represented by a new generations of car ferries, Ro/Ro and Lo/Lo vessels. As the vessels had changed, so also had their operation and their routing, particularly between Ireland and the UK and from both, to mainland Europe. Car ferries, in particular, tended to seek the short sea route, so as to provide a scheduled service in which at least one round trip, and preferably two or more round trips, could be completed in each 24-hour period.

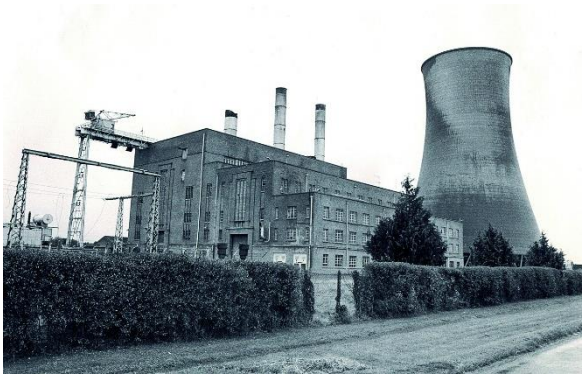
In conclusion, Hayes introduced another project which he felt might well lead to even greater changes in the future of the transport industry in Ireland. This was the proposed fixed link across the English Channel connecting England and France. Hayes warned that the changes caused by such a project would be far-reaching and could, almost overnight *'cause a much more dramatic change in our transport industry than we have witnessed in the past twenty years'*. Hayes ended by saying that *'it was appropriate to emphasise that the only thing that is certain about transport is its continuing uncertainty.'*

John Lang, noting that a former president, Stephen Farrington in 1955, had *"castigated the dead hand which bureaucrats can lay on the innovative ideas of engineers and architects",* found himself in full agreement with most of what Farrington had to say and attempted in his own address in 1986 to prove, by way of the experience of his own career in the ESB that it was nevertheless possible to have a challenging and fulfilling career in the public service.

Lang had joined the ESB shortly after graduation and where he was to make his career. He said that it was interesting to remember that at the time the ESB had only two power stations, Ardnacrusha near Limerick and Pigeon House in Dublin. The performance of Ardnacrusha depended primarily on the amount of rainfall while, in the case of Pigeon House, the availability of suitable coal was the main problem. Lang said: *'As a young engineer I found out things about combustion of a low calorific fuel which came in very useful in later years when the development of the technology for burning peat became important*. *Such was the ethos of the organisation*

of the ESB at the time that if you had anything to contribute in any particular field you were given great freedom to do so'.

At the end of the 1940s came the development of peat-fired power stations. Portarlington (24MW) was commissioned in 1950 and Allenwood (40MW) in 1951. While sod peat had been used in a small power station in Germany twenty years previously very little was known about the technique of firing this fuel and Lang commented that he had spent several happy years testing and experimenting in these two stations.



Peat-fired power station at Portarlington

Towards the end of 1953 Lang was appointed Station Manager of the new Marina Generating Station in Cork. Marina consisted of two 30MW turbo-alternators, the largest yet to be commissioned on the system. The station could operate on either oil or coal, but ran for most its life on oil rather than coal. Lang continued: *'In Marina we introduced a programme of further training in physics, chemistry, thermodynamics and plant operation. We prepared many of our operators for City & Guilds of London examinations in Boiler and Turbine operation and Combustion Engineering. They rewarded us by winning many first places and gold medals. Having shown that these men could be trained to a higher level we persuaded the authorities to let us create supervisory shift jobs at the sub-professional level. Eventually in many of the ESB's smaller stations these men, with some extra internal management training, took over the duties of Shift Charge Engineers and in some cases progressed to even higher levels. The unclimbable wall between worker and staff was eliminated'.*

In 1973, the energy crisis arrived and the price of oil quadrupled overnight. This made peat highly competitive and the ESB and Bord na Mona quickly got together and agreed on a large extension of the peat development programme. Bord na Mona's competitive advantage lasted until 1980 when the Government made what seemed to Lang an incomprehensible decision. It ruled that the price of peat to the ESB should be related to the price of oil rather than the cost of production. This put a tax on the electricity consumer and created a strong disincentive for the ESB to burn peat. In 1985 Bord na Mona and the ESB reached agreement on a new pricing system related to the Consumer Price Index. This was just in time to prevent the disastrous drop in earnings which Bord na Mona would have suffered when the price of oil plummeted in 1986 to one third of its previous value. This incident underlined finally the fallacy of an oil-related pricing policy.

New oil-fired power stations were built at Great Island in Waterford, Tarbert in Kerry and Poolbeg in Dublin. Set unit sizes grew from 60MW to 120MW and then to 270MW. It was the era of cheap oil all over the world and the ESB took full advantage of it to the extent that in 1972 the cost of electricity in Ireland was among the lowest in Europe. Lang explained that the ESB was well aware that this cheap oil bonanza could not last for ever and plans were well advanced for the construction of a nuclear station. In fact, the commissioning date of 1978 was already set. Then in 1972 natural gas was discovered off Kinsale and the urgent need to diversify away from oil was relieved. The sudden oil shock in late 1973 made the gas find commercially viable. It was then decided that the procurement of fuels, with special reference to secure coal supplies for the projected Moneypoint station, was critical to the future of the ESB.

Lang noted that coal reserves were spread world-wide over all the continents. The fact of the matter was that coal was competing not with oil but with coal from other sources. To date coal had been bought from the United States, Colombia, Poland, Australia and the United Kingdom. South Africa was one of the largest exporters of steam coal and its prices were the lowest in the market place, but it was decided that the people of Ireland did not at the time wish to be involved in major trade with South Africa.

Lang considered that Ireland had long suffered from the total lack of a national energy policy. The various energy industries had operated under the handicap of having no national framework in which to set their individual plans. The effective use of natural resources combined with the protection of the environment were dependent on having an overall national policy. The companies set up by the State within the energy industry were, starting with the youngest, the Irish National Petroleum Corporation, Irish Gas, Bord na Mona and the ESB.

In an attempt to obtain secure oil supplies for this country the Irish National Petroleum Corporation was set up after the second oil shock of 1979, when there were long queues at the petrol stations. Initially an oil procurement agency, it soon acquired Whitegate Refinery when its owners decided to depart. Lang continued: *'As there has not been an actual oil crisis since the establishment of the Corporation it is difficult to evaluate how effective it would be in securing supplies for Ireland. In the absence of indigenous crude oil it would seem prudent that the Government should invest in a stockpile of crude oil, which could be conveniently accommodated at the Whiddy oil terminal. Otherwise the justification for running our own refinery might be weakened. This is just one of the many anomalies which results from the absence of a national energy policy'.* Irish Gas was given the job of marketing Kinsale gas and building a transmission network to bring supplies to as many customers as possible.

Lang noted that Bord na Mona had suffered less than most of the other energy industries from the lack of a national energy policy. From the beginning its role had been fairly clear as the producer of an indigenous fuel and the provider of good employment in some of the poorest areas of the country. Coal had been the traditional form of heating in Irish homes, particularly in urban areas. It was burned at very low efficiency in open fireplaces. In the 1960s and 1970s, coal began to lose out to oil-fired central heating. With the advent of high oil prices, and consequent high electricity prices, the government undertook a scheme of grants to householders to build fire-places and chimneys. This, added to a price advantage for coal, led to a big increase in the use of coal for heating. The result in Dublin and Cork was a serious increase in air pollution. This again underlined the need for a co-ordinated energy and environmental policy.

Lang felt strongly that it was essential that the freedom of state companies to operate on a commercial basis would not be further eroded by the imposition of external bureaucratic control. He added that, above all, the dead hand of the then Department of the Public Service must be removed from the state companies. He continued: *'Not that I believe that public salaries should be allowed to run out of control, but rather that market forces should prevail instead of a system of uniform pay rates for all. The present system is a recipe for widespread mediocrity and it is a minor miracle that state companies operate as well as they do. Any system that rewards all people on the same level equally, irrespective of performance, has to be unproductive. The rewards system in state companies would appear to be designed to discourage initiative and emphasise the merits of conservatism. Under present rules the only way to reward a high flyer is to promote him. This produces organisation structures which are top-heavy with chiefs and very short of Indians. It is my long-held belief that the best way to revitalise the state companies is to change the rewards system so that performance, and not service, is the main determinant for increased pay'.* Lang said that he was satisfied that there was really no option but to change the system, otherwise the best of our highly educated and well-motivated manpower will turn its back on the public service in favour of private enterprise or the emigrant plane.

In conclusion, Lang noted that the ESB, like all other energy companies, had to perform without a national energy policy. It responded by producing its own policies which became progressively more sophisticated. Nevertheless, they were energy policies for the ESB and not necessarily for the nation. Lang thought that most people would agree that a national energy policy must now be an important priority for any government. Lang ended by saying: *'Energy consumes an important percentage of the national wealth. In the absence of a policy co-ordinating the use of fuel for electricity generation, the role of natural gas in the economy and the impact of energy decisions on the environment, sub-optimisation by the various agencies will continue to waste resources'*.

Michael O'Donnell, in introductory remarks prefacing his presidential address in 1987 said that he had been greatly impressed by the variety of important issues that had been raised in former presidential addresses and the scholarly nature of many of them, ranging over historical perspectives, philosophical treatises and critical reviews of important issues at the time they were prepared. He decided to focus on some contemporary issues that he felt were important, not only for the profession, but for the future well-being of the economy and society.

Michael noted that it is widely accepted internationally that the current world recession and unemployment problems had been caused in large part by the slowness to respond to technological change. Ireland had experienced profound social changes in our lifetime. There had been a rapid decline in the numbers employed in agriculture from some 700,000 in the 1930s to less than one quarter of that number today. The employment level in industry had gradually increased from 260,000 in 1961 to over 360,000 in 1981 but it had declined since then to about 300,000. Services sector employment had grown more rapidly from 416,000 in 1961 to over 600,000, but is likely to be halted or reversed with government cutbacks in the public sector and the increasing use of modern technology.

Having reviewed past decades of emigration and unemployment, O'Donnell focussed mainly on manufacturing industry in the remainder of his address, because that was where he saw the greatest potential for wealth creation and for advance in the Irish economy. He said that *'It is also the sector where most of our young engineers and technicians are finding employment and where, I believe, our Institution has a very important future role. I am less confident about suggesting a solution for our general unemployment problem unless there is a radical change in our work patterns including working hours, job sharing, retirement age and even the very definition or concept of employment itself'.* Irish manufacturing industry had made rather spectacular progress over the past thirty years, having an output today four times higher than it was in 1960 and taking over from agriculture as the main source of export revenue.

O'Donnell noted that the Telesis Report of 1982 had pointed out that the foreign firms that had been mainly responsible for much of the increased volume of exports drew their development expertise from their parent firms back home. Many of them appear to have seen the Irish plants as production bases located here to take advantage of generous grants and tax concessions and relatively low labour costs when compared with those prevailing in the more industrialised countries. The indigenous Irish manufacturing firms were also making little use of domestic R&D and were finding it increasingly difficult to keep abreast of developments in the market place. The Report recommended that Ireland should be more selective in developing a limited number of firms to serve home and European markets.

The problems facing Irish industry were further highlighted by the European Management Forum Report published in 1986, which dealt with competitiveness in 22 OECD countries. This ranked Ireland in the rather low position of seventeenth in terms of overall competitiveness, just ahead of countries such as Portugal and Greece. The government had published a long-awaited White Paper on Industrial Policy in 1984 and generally this endorsed the findings and recommendations of the Telesis Report. O'Donnell considered that, since the then government had taken up office, it seemed to be following similar policy but, with the curtailment of public expenditure in many sectors, less funding was available to support industrial development. It had, however, taken a number of important Initiatives by establishing Ministers for State with responsibilities in Science and Technology, Food and Marine. The Minister for Science and Technology had been given the task of developing and implementing a coherent strategy in areas such as microelectronics, information technology, biotechnology, telecommunications and satellite broadcasting, chemicals and healthcare, product development, and the establishment of enterprise centres in third-level institutions linked to local industry.

A recent OECD report on Innovation Policy in Ireland had pointed out that modern economic development was very dependent on brain power and that advanced high-technology firms should invest as much in research and development, marketing, training and software as they do on buildings, equipment and machinery. Reflecting

on the main theme of this report, O'Donnell felt that one cannot but agree that indigenous Irish industry generally had a rather low technological capability. Yet, he noted, at least one third of our young engineering graduates were emigrating, either because they found it difficult to obtain employment at home without initial work experience or firms could not afford to employ them.

O'Donnell noted that Irish third-level colleges employed up to 20% of the more highly-trained and experienced technological personnel in the country. These colleges also had a wide range of sophisticated laboratory and workshop facilities, elaborate computing, library and other resources, all of which were essential to support their academic programmes. Yet, relatively little use was made of this expertise, and the resources at their disposal, by Irish Industry. Research and development work undertaken in colleges often had immediate application and could be of vital importance to those responsible for product development, involving areas such as advanced manufacturing, microelectronics, biotechnology, and new materials.

Turning to the provision of engineering manpower, O'Donnell noted that towards the end of the 1970s, with the development of the Irish economy and the success of the IDA's industrial development programme, a number of prominent industrialists and other spokespersons began to express concern about the shortages of engineering manpower, especially for electronic and production engineers and computer specialists. A Manpower Consultative Committee was established by the Minister for Labour in 1978 and having examined the situation it concluded that there were serious shortages that could in the main be met by expanding the output from the existing engineering schools. In 1979, the Higher Education Authority, working closely with the Manpower Consultative Committee, developed an engineering manpower programme in co-operation with the Irish universities, NIHEs, Colleges of Technology and Regional Technical Colleges and this was approved by the Minister for Education for immediate implementation. The overall effect of this programme was a step input, increasing enrolments in engineering and related disciplines that resulted in a considerable increase in the outputs from degree and technician programmes. A report in 1986 of the distribution of engineering graduates showed that 38 % were in Electrical/Electronic Engineering, 43% in Mechanical /Process and other Engineering, and only 19% in Civil Engineering, which contrasted with a figure of nearly 50% in this discipline less than a decade earlier.

O'Donnell noted that the passing of the Single European Act earlier in the year marked a further important milestone in the unification of Europe as a single economic market catering for some 350 million people. He said that *'This presents Ireland with both challenges and opportunities. The challenges relate to how effectively we can compete in providing products and services of the required quality, market them, and respond to the demands as they occur. The opportunities relate to the size of the market, its sophistication and purchasing power'.* It was widely acknowledged at the time that there was a European shortage of engineering graduates, especially those with microelectronics, computing and manufacturing experience.

O'Donnell felt that the success of Irish industry in the future would become increasingly dependent on its ability to apply and utilise new technology, allied of course to good marketing and management. He offered the hope that in the Ireland of the 1990s we would see the type of vision outlined by the authors of the OECD Innovation report becoming a reality with our manufacturing industry playing a leading role in wealth creation and providing much high level employment. He concluded by saying *'If this is to be achieved it will, in my view, call for the proper deployment of many more engineers, technicians and other scientific personnel in the industrial and related sectors of the economy. The promotion of this objective must remain one of priority for our profession in the years ahead'*.

Pierce Pigott chose as the title of his presidential address in November 1988 *"Irish Construction – Looking Ahead",* in which he reviewed some salient features of Irish construction and pointed to some likely developments.

Pigott began by saying that *'the provision of buildings and civil engineering works has a particular fascination and provides the engineering profession with a degree of satisfaction which I believe exceeds that of many other professions. It is an enormously complicated process involving many disciplines and skills, it is shrouded in convention and legal precedent and the outcome of this endeavour affects virtually everyone in society. The physical nature of the product, its diversity and complexity as well as the wide geographical spread of demand , have together moulded a structure on the construction industry significantly different from that of any other industry. Yet the fascination of contributing to the built environment enthrals most of those engaged in this work'.*

Construction of West Link Bridge on M50

Construction work probably combines a wider range of technologies than virtually any other industry. Pigott's definition of the construction industry included builders, contractors and direct labour organisations (as in local authorities) covering all civil engineering and building including house-building and building services. Also included were those concerned with the planning, design, erection and maintenance of buildings and works as well as with the production of materials and components.

He noted that the construction industry in Ireland had changed fundamentally and dramatically over recent decades from a traditional industry based on craft skills to a partially technological-based industry and that the industry was now a large and important sector of the economy. It produces mainly investment rather than consumer goods. As a consequence it is subject to the uncertainties that characterise investment decisions; it operates, almost by definition, in an unstable environment and its structure responds to this economic climate.

Pigott noted that the then current recession was the longest and steepest experienced since 1950. He observed: *'A curious feature is that after each recession output increased progressively for a period of seven years before the next slump began. I am not aware of any economic theory which would explain this phenomenon but it does emphasise the cyclic nature of construction activity'.* It was generally agreed that prospects for the industry were almost wholly dependent on the scale of economic turnaround, along with the degree of success with which the imbalance in public finances was being tackled. In general, however, he felt that future growth of the industry at least to the end of the century was more likely to parallel growth of the economy rather than benefit from sudden upsurges fuelled by government and private sector demand.

He felt that, as in most European countries, the upgrading of buildings and the renewal of infrastructure would of necessity absorb an increasing proportion of construction output in future years. He saw the renewal and upgrading of the infrastructure as an urgent problem, particularly in our major urban centres. He concluded that failure to act now would lead to a significant reduction in the level of service enjoyed by the community and to substantial economic loss.

He noted that in Ireland the role of government in the affairs of the industry was substantial and that the public sector was the principal client of the industry. The government affected demand indirectly by acting on the level of overall demand in the economy, which in turn influenced taxation, interest rates and the supply of credit. The Construction Industry Development Board, established by the government in 1987, had played a useful role in identifying issues which could stimulate demand and encourage development.

Pigott opined that any consideration of construction activity must address the problem of quality and performance in use. At the time, the industry had a poor reputation for quality. Problems arose mainly because of poor design, bad organisation by the contractor, inadequate project information or even carelessness. There was little difference between public and private sector work. The very blunt message which emerged was that the construction industry could no longer rely on traditional procedures to achieve satisfactory quality. Fundamental changes in the technology and structure of the industry meant that a more systematic approach was required.

Pigott noted that many experienced clients considered that the then method of procuring construction work combined with the disparate structure of the industry provided little incentive for builders and professionals to produce good quality work. The increasing rate of introduction of new construction products into an industry with practices based on "learning by doing" further exacerbated this problem. He considered that the absence of legally enforceable building regulations in Ireland did not help the situation. He felt that some change in roles and responsibilities was required and believed that in future many experienced clients, despairing of the industry putting its own house in order would dictate what was built and the terms and conditions on which they would do business with the industry. The State as the principal client of the industry was most likely to lead the field. He considered that planners, builders, architects and engineers must combine to ensure that in the case of mass housing the potential for communities to develop is fostered rather than sacrificed to utility and that one-off housing does not do irreparable damage to sensitive landscapes.

Pigott then considered the principal changes in construction that could be anticipated over the next decade or so. Irish involvement in the U.K. had arisen out of necessity and generally not in any planned way. It did serve to highlight the value placed on Irish skills and products in other markets and provided a good foothold for exporting. Pigott felt that *'it is surely time to realise that construction is something we should be exporting on a regular basis as many other countries do and that we should set up the structures both within the industry and at government level to fully realise this potential. In this way the adverse effect of the fluctuations of the Irish market can be minimised'.*

A preliminary assessment of the situation suggested that in all three sectors - design, construction and manufacturing - the size of the organisations might limit the ability to compete abroad. Pigott felt that some mechanism was required whereby amalgamations of firms, particularly consulting engineering practices, could be facilitated to increase their marketing power and provide resistance to inroads from foreign competitors.

Pigott reminded his audience that the advent of 1992, then some fifty months away, when completion of the internal market was envisaged by the European Community, could pose a further threat to the existence of many Irish firms unless they prepare for change now. Much had been said of this prospect but little had been done to assess its impact. The technical aspects bore consideration although there could also be important fiscal implications. The technical matters related to the free movement of products and harmonised codes of practice (Eurocodes), standards and other instruments. The significance of this harmonisation was that we will no longer be in sole control of such technical matters for application in Ireland. Some structures were in place to influence European decisions in these matters but it remained to be seen how effectively these structures would operate and how effectively the Irish construction industry would influence decisions made in Brussels.

Pigott believed that two specific actions in relation to 1992 were necessary. Firstly, negotiations on proposed EC directives relating to the construction industry must be informed by the best professional expertise available and this should be willingly provided by the professional bodies. Secondly, detailed action plans for the sectors of the industry, design, construction and manufacturing, must be prepared jointly by the industry and government to ensure that the optimum benefits are derived for the Irish construction industry. He continued *'However, it is unlikely that much will survive unless we maintain a healthy investment in education, training and research across the industry. Firstly, we must ensure that the current output of engineering graduates is at least maintained, with a strong likelihood that some increase will be required into the next decade. Secondly, we must*

in the accreditation of degree courses, examine the overall balance between civil engineering and building construction. Thirdly, continuing engineering education must be available on a wider scale if we are to compete effectively in new circumstances and markets. Fourthly, research and development, should not be seen as a luxury but as a necessity for industry in general and for the construction industry in particular. Prior to recent cutbacks in government funding we did not compare favourably with other countries and with increased competition it is unlikely that we can succeed without this sharp edge. Furthermore without good research capability we will be ill-equipped to benefit from research undertaken elsewhere. The industry clearly must increase its investment in research'.

Pigott then presented his views of the future shape of the Irish construction industry. In summary these were:

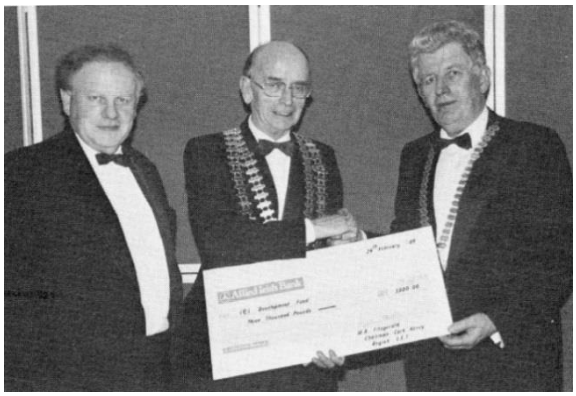
- Growth will return in 1989 or early in 1990 and this will extend well into the next decade;
- Private funding will replace some government funding to an increasing extent;
- Rehabilitation and maintenance of our building stock and infrastructure will constitute an increasing proportion of total construction output;
- The mould of the past will be broken with the amalgamation of firms to form larger units in face of competition from abroad;
- Exports of construction and professional services will be necessary for survival;
- Public and private sector clients will demand quality-assured buildings and works;
- Materials technology will not change dramatically;
- New materials and construction techniques must be subject to more rigorous testing and assessment before use;
- Buildings and civil engineering works have always had some defects, but better construction will follow from the wider adoption of good practice and the use of up-to-date technological information in design offices and on site; and
- Outmoded communication techniques between clients, designers and construction teams cannot be sustained. To date the industry had barely begun to think about harnessing new information technology.

In conclusion, Piggott believed that *'the Irish construction industry must recognise the need for good design and quality construction with projects completed within budget and on time. This is what the client expects and he will be more insistent on getting it in future. If that expectation is satisfied, there is an assured future for the industry in Irish and overseas markets'*.

As a result of construction work being carried out at the Institution's HQ at 22 Clyde Road to complete a new Engineering Education Centre, the then president, **Brian Sweeney** opted to delay his presidential address until the conclusion of his year in office in 1990.

Brian said he looked back on his year in office as one of the most rewarding experiences of his professional career. In common with many of his predecessors in office, he took the opportunity to say how much he appreciated the commitment demanded of officers of the Institution in the performance of their duties and even more the outstanding commitment of the members of the profession who devote so much of their valuable free time to the service of engineering. He said '*It has never failed to amaze me that there is such a well of devotion and loyalty from our Profession to the Institution - right across the country'*. It had been a very busy year - one which saw the completion of a new education centre at Clyde Road, a project commenced under the presidency of Pierce Pigott, which was pursued with great diligence throughout his year of office. Sweeney considered that *'We now possess a headquarters which bears comparison with many larger institutions. I am pleased to consider that our profession had sufficient confidence in its future to pursue this enterprise to a conclusion and to provide a facility at headquarters which had been signally lacking in recent decades. In this connection there is of course the potential pitfall of central versus peripheral attitudes. Suffice to say that without*

the infrastructure at 22 Clyde Road the resources necessary to service our members simply cannot be put in place'.



Presentation of cheque for £3,000 to the IEI Development Fund on the occasion of the Cork/Kerry Region Dinner in February 1989

The year also saw the pursuance of the Development Fund Appeal which had reached 40% of the target of £500,000. Sweeney reminded the members that it was necessary at all times for members to remember that the Development Fund was not just a fund for building at headquarters, however necessary that may be. Rather it was a fund set up to provide a secure financial backing for the Institution in fulfilling the objectives enshrined in the Charter. Sweeney noted that the progress this relatively small Institution had made in recent years had been outstanding and, through the activities of the Institution, Irish engineering could hold its head as high in the international scene as any other comparable body of engineers. In an era when internationalism and globalisation was the key to future success, The Institution of Engineers of Ireland had paved the way, through its international agreements for the mutual recognition of Irish engineering qualifications throughout the major countries of the world, thereby facilitating trans-national employment of Irish engineering graduates.
He continued: *'We have succeeded with a small Institution's resources in maintaining pace with far larger bodies. The opportunities for greater advance must not be hindered in the future by the lack of resources to fulfil them. In many instances we have been at the forefront in initiating international reciprocal agreements, and Irish engineers have responded well. It is a source of great pride for me that we in Ireland have the greatest number of successful applicants for Eur Ing per head of population in Europe. This denotes the deep interest Irish engineers have in the internationalisation of the profession and their commitment to the concept of an united Europe'.*

Sweeney remarked that a feature of recent years had been the difficulty of retention of our members. The very active and successful recruitment of the early 1980s at a period when our profession was growing dramatically, was severely inhibited in the latter part of the decade by gross cutbacks in public and private sector expenditure, cutbacks in staffing and a rate of emigration of our engineering graduates which in numbers exceeded anything ever experienced in the history of the State. The Institution in recent years had managed in spite of such difficulties to maintain its membership at a consistent level, but this was not enough to support a body with the objectives it had set itself for the furtherance of engineering in Ireland.

Sweeney believed that the works of the Institution for the profession could be exemplified by a number of its activities. The accreditation of engineering courses, which was a task entered into in the early 1950s, had, he believed, been of tremendous value not only to the colleges that received the accreditation of the Institution, but also to the Institution itself. A number of new courses were accredited and the Institution had already received the appreciation of the colleges in question. These high-level engineering courses of a variety of disciplines were accredited or re-accredited as fulfilling the Institution's requirement for Corporate Membership and also fulfilled the requirements of other engineering Institutions throughout the world with whom the Institution had signed agreements.

Sweeney noted that there was a further aspect of accreditation in that it afforded the Institution an insight to our educational system - a unique insight - which was invaluable when the Institution, in contact with policy makers and educationalists, could draw on a corpus of knowledge which was hardly available from any other source. This undoubtedly strengthened the hand of the Institution in such representations as it makes. It strengthened the hand of the Institution also in supporting the efforts of our engineering schools in maintaining

themselves at that level where graduates qualifying from those courses could be considered the equal of the best, and were fully qualified to meet the many faceted demands of modern industry.

Sweeney perceived that, if there had been a central theme to his presidency, it had been that of emphasising the business aspect of engineering, the competence and capacity that engineers possess by virtue of their education and formation to make a greater contribution to the economy than had been recognised heretofore. He said that *'It is my dearest wish that this consciousness of our potential be realised and applied in a well-considered professional manner to the economy as a whole'*.

He noted that every president carried on tasks initiated by their predecessors and that he was no exception to that rule. Much of the work now being carried out is a follow-on to projects initiated during Michael O'Donnell's presidency when the Commission on Engineering did so much excellent work - work which was continued during Pierce Pigott's presidency. Sweeney felt that there were two aspects of the work initiated in those years that he considered needed to be finalised: 'Employ an Engineering Graduate' and 'Engineering Aid'. Sweeney was rather disappointed that there had not been more progress with either of these two worthy enterprises. However, at the year's end, further initiatives were taken which he hoped would see both enterprises launched within a few months.

Sweeney considered that the principal objective of an engineering Institution must be to make good engineers better. The development of the Continuing Education Programmes in recent years had been one of the Institution's success stories and Sweeney was very glad to see in the year just gone by the very high number of courses being organised by the Institution on a variety of topics and in a variety of disciplines. The emphasis had been on introducing course content at the cutting edge of new and significant technologies.

The development of the facilities in Clyde Road had of course been of considerable significance. However it was also encouraging to note the success of courses and seminars organised throughout the Regions. Sweeney felt that this was something that must be encouraged for the future. It is a service that the Institution could provide for its members and he believed it was also a service of national importance.

As many recent holders of the office of president had found, it had given them great pleasure to work with the committees of the lnstitution. Sweeney said that he had been more than impressed by the dedication of individuals who had served on committees at HQ, on Regional committees, Divisional Boards, and in the Sections and Vocational Groups. He continued: *'We now see an Institution which has grown considerably during the last decade and we can face the 1990s with every confidence that the Irish profession will grow in strength. Sweeney stressed that the Institution needed new members and that it needed the funding to achieve its objectives. The Development Fund had yielded significant results, but more was needed'*. He reminded those present that the Institution had asked that every member seek to invest in his or her own Institution for a period of two to three years. *'This investment need not be great and if everybody in the Institution contributed something, our debt for construction and reconstruction would be eliminated and would provide a sound financial base to the Institution's activities for the future'.*

"*The Development of Ireland through Civil Engineering*" was the title of **John Wallace's** presidential address, delivered in 1990 in the recently opened Engineering Education Centre at Clyde Road. Wallace took a look back at the development of Ireland through the eyes of a civil engineer and, particularly through the eyes of a contractor.

In Ireland in the mid-eighteenth century, the development of agriculture required transport arrangements and hence, in 1757, began the construction of the Grand Canal under the direction of a Dutch engineer, Thomas Omer. This was to connect the Shannon, which was also to be made navigable, to Dublin, the central market for the sale of agricultural goods. Wallace noted that there were many errors made, both in the engineering and construction of this canal. Quoting from Mullins's presidential address of 1859 he noted that "Mr Trail executed

the works without any contract having been entered into, receiving 5 per cent on the expenditure, a mode of proceeding which turned out to be so unsatisfactory that the original capital was expended before the canal was made navigable to the point of partition near Robertstown" and Philip's work on Irish navigation: "The failure of this great work, which at first might have been so easily completed at a moderate expense, may justly be attributed to the want of an accurate and well-digested plan and survey, for it does not appear that there were any material difficulties in the whole line". Further canals were constructed by making the Upper and Lower Shannon, the Barrow and the Boyne all navigable over certain lengths and in 1817 the Royal Canal was completed from Dublin to Tarmonbarry on the Shannon. The Grand and Royal Canals ran in parallel much of the way across Ireland, an example of bad planning, as there was really not the economic necessity for two canals.

Contemporaneous with the construction of the canals went the construction of the main Irish harbours at Dublin, Howth and Dun Laoghaire in the Dublin Area - and Belfast, Cork, Drogheda and Wexford in the provinces. The Harbour of Dublin began in 1707 with the establishment of the Ballast Office Board and work went on for many years right up to 1832 and from 1850 to the end of the century many quay walls were built by both contractors and direct labour under the Chief Engineers of Dublin Port. Even to this very day, Dublin Port is still developing and moving seaward. Kingstown (Dun Laoghaire) Harbour was commenced in 1817. It was completed as far as the entrance in 1833. Cork Harbour did not need any engineering works to protect it as it was a sheltered deep-water port with good channels. Passage also had deep water and in the late eighteenth century parliament made a grant available to remedy the defects of navigation from Passage to Cork. In 1820, Cork Harbour Commissioners were appointed and in 1826, when steam dredging was adopted, a channel from Passage to the quays of Cork was opened.

Dublin Port

Turning to roads and bridges, Wallace noted that as early as 1766 a report by a British Military Officer reported that "No country had more or better roads and bridges than Ireland". Roads were built in those early days in a very simple manner "by throwing up a foundation of earth in the middle of the space from the outside upon which they formed a layer of lime stones, broken to the size of a turkeys egg; on that again, a thin scattering of earth to bind the stones together, and over all a coat of gravel". In 1806, Telford was the first engineer in the UK to give attention to the design of roads and in 1813, McAdam developed a design of his own which still carries his name in various Macadams.

Masonry bridges were built all over Ireland throughout the 18th and 19th centuries on county and smaller roads and many of them are still in use today. During the construction of the railways in the second half of the 19th and early 20th century, many major river crossing bridges, mostly in iron and steel, were built. These also stand to this day as a monument to civil engineering expertise and contracting ability in the days before modern equipment.

Wallace then turned to the next major civil engineering development – the railways. A Railway Commission was set up under Thomas Drummond to lay down a system of railways in Ireland with a view to gaining the greatest advantage for the smallest outlay. Charles Vignoles surveyed the Southern routes and John Macneill the Northern routes. However, following the death of Drummond, the government held that enterprise should regulate itself. This caused a well-devised system to give way to a principle which presupposed that speculators should know the best means of attaining what they want, in matters with which they were unacquainted, and that "professional advisors were the most skilful and disinterested guides that can be found; whereas all experience in cases of rival schemes goes to prove the contrary". Railways were then built by private companies. In 1861, it was reported that, the new railway system brought Dublin within eleven hours of London by post.

Wallace quoted again from Mullins (1859) regarding contracts as follows:

“A notable result of the construction of railways has been the development of the contract system, which while on the one hand it has had a beneficial effect in aiding engineers, by dividing the labour with practical and responsible sub-ordinates, has on the other hand by means of liberal banking accommodation afforded to the holders of large contracts, tended to create a monopoly of the execution of works in the hands of a few, who having eventually become influential capitalists, were in a position to make combinations unfavourable to economical construction, more particularly in cases where part payment was agreed to be received in shares by the Contractor; but with an engineer of skill and integrity, and sufficient funds at the command of the company, the competitive contract system, based on details, quantities and prices has been found a safe course to pursue".

Wallace then looked at developments in Ireland following independence. He began by giving details of the Shannon Hydroelectric Scheme and Rural Electrification, the brainchild of Thomas McLaughlin, an electrical engineering graduate from UCG in 1922, and Patrick McGilligan, Minister of Industry and Commerce in the Free State government at the time. 4,000 German and Irish engineers and labourers worked for four years on this amazing project. Leading engineers associated with the work were: Professor F. S. Rishworth (Chief Civil Engineer), J. T. Prendergast (Resident Engineer), Joe MacDonald (Design and Measurement Engineer) and J. A. O'Riordan (Hydrometric Survey Office), all past-presidents of the ICEI.

Turlough Hill Pumped-Storage, county Wicklow

Further hydro-electric schemes were constructed by the Electricity Supply Board on the River Liffey at Golden Falls (1937), Pollaphuca (1937) and Leixlip (1945), Ballyshannon hydro-electric scheme at Cliff and Cathleen Falls on the Erne (1946) and Carrigadrohid on the Lee (1953). During the late 1940s, 1950s and 1960s, peat bogs were developed by Bord na Mona and peat was used in power stations built at various locations around the bogs to burn the peat in the form of milled peat and in smaller stations as sod peat, to generate more electricity. Power stations to burn coal were built at Ringsend, Arigna and Marina in Cork in the early 1950s. Later in the 1960s and 1970s oil burning stations were constructed at Great Island, Wexford, Tarbert on the Shannon estuary and Poolbeg in Dublin. The Turlough Hill Pumped Storage Scheme was built in the Wicklow Mountains in the early 1970s. In the late 1970s natural gas burning stations were built at Aghada and Marina in Cork and at the North Wall in Dublin. Rural electrification which went on right through the 1950s 1960s and 1970s brought the electricity from these many power plants to the people and industry of the nation. The last major development by the ESB was the coal burning station at Moneypoint on the Shannon estuary.

Ireland's ports and harbours continued to develop after independence, particularly post-1950. Dun Laoghaire, Howth, Cork, Drogheda, Foynes, New Ross and Waterford have all developed into modern ports with major civil engineering works. Ireland's sanitary services have had a large civil engineering input into the many sewage treatment and water treatment works serving every city and town in Ireland. This work has been ongoing right from 1922 to date and will continue right into the next century.

Wallace considered that the quality of life of every Irish family will be effected by the way civil engineers help in the development of Ireland in the future. He perceived the following areas where developments were essential: Transportation, Sanitary Services and Maintenance of Infrastructure. He also mentioned the challenge of rising sea levels and the need for innovative methods of funding of developments.

Wallace concluded *‘… civil engineering will continue to be at the forefront of daily living in local authorities, consultant engineering, construction, and at our academic institutions where our civil engineers will be helping*

to keep the development of Ireland on the move upwards by their contributions to their various fields of endeavour'.

Michael Higgins in 1991 elected to speak about the education of engineers in Ireland. He commenced by reviewing the entry requirements to the engineering profession. He noted that the basic requirement for entry to a recognised Engineering degree course was Grade C or better in Higher Level Mathematics. Michael then gave some statistics regarding the number of students who sat for Mathematics as a subject in the Leaving Certificate in 1991. He pointed out that a mere 8% obtained a Grade C or better at Higher Level and were therefore eligible for direct entry into engineering courses. At least half of the school leavers embarking on full-time third-level engineering courses did so through Certificate and Diploma courses. All of these courses had as their basic entry requirement a Pass Level Leaving Certificate, including Pass Mathematics. Higgins commented that *'Clearly some very able students embark on these courses in the expectation that on completing them successfully, they may be able to transfer to degree courses at an advanced level. Transfer arrangements are not uniform but some Colleges are prepared to admit those who have successfully completed a Diploma to a high level after three years of study, to the third year of a four-year degree programme. Thus the pursuit of an engineering degree for these students takes a minimum of five years'.*

Higgins considered that the generally accepted supporting arguments for choosing engineering were:

- Engineering is a challenging and potentially creative area of study;
- Engineering is an international discipline offering significant employment opportunities at home and abroad;
- Engineering is in the vanguard of modern technology and few other disciplines will provide the same appreciation and understanding of the world of technology in which we live;
- Engineering is an excellent formation for many career paths;
- Engineering provides a high proportion of our leading industrialists and outstanding managers.

The number of students suitably qualified for entry to the engineering schools was low, the essential problem being that too few candidates took Higher Level Mathematics as a proportion of the total, only 8% compared with 41% in physics and 47% in chemistry. Higgins felt that teaching standards in mathematics needed to be raised. In particular more girls must be encouraged to study mathematics at the higher level and thus be eligible for entry to Engineering and Science courses. He said that *'Mathematics is the second language of communication. We must not permit wastage of the intellectual capacity of so many bright children, particularly girls'.*

In the colleges of engineering, there were at the time 1,100 places available - just over 40% of them in Electronics, almost 30% in Mechanical and Industrial combined, less than 20% in Civil and the remaining 10% in the other areas. All thirty-one degree courses were accredited by the Institution of Engineers of Ireland as fulfilling the academic requirements for Corporate Membership and subsequent Chartered Membership of the Institution.

Regarding the funding of higher education, Higgins said that *'The whole basis for the education of engineers and therefore the future of the profession rests ultimately with national education policy. In other words, it is a political issue. Policy and funding depend to a considerable degree on the Minister for Education of the day. The outgoing Minister contributed to positive progress in a number of important areas; we must hope that the incoming Minister will take an enlightened view of the resource needs of third-level education, particularly in the technology area'.*

The Higher Education Authority (HEA), set up in 1968, acts as a general planning agency for higher education as well as being the distribution medium of the funds provided by the State. Traditionally the university colleges

enjoyed a large degree of academic freedom. This was now being challenged by a combination of financial pressures and government policy, which puts priority on the promotion of courses of study which have a direct employment relationship. A further significant cause for concern was the proposal to introduce a unit-cost system for university education.

Higgins said that *'surely third-level educational policy cannot be determined by cost considerations alone. In this debate I hear echoes of the man who knew the price of everything and the value of nothing'.* He continued: *'While public servants and their political masters may well be attracted to performance indicators, I cannot see how their use will give us two of the fundamental elements of university education, namely teaching quality and a balanced representation of subjects'*.

Higgins commented that *'Irish engineers do not fear change. Indeed, we welcome change, but demand that it may be progressive. We do not fear analysis of our professional contribution to the development of Irish society. We will not apologise for the cost of our professional training. A balanced society and a balanced university needs its engineering school and its professional engineers. Both must be as good as it is possible to make them'.*

The Institution's two principal activities in the area of education nationally are the accreditation of courses of study in engineering in the third-level colleges and the stewardship of the route to Chartered Membership of the Institution. The IEI's Committee for International Affairs is involved in activities both in Europe and in the United States. In Europe its principal role is concerned with FEANI and the common European title of Eur Ing. The IEI's objective is to work with the other EC countries within FEANI in seeking a Directive for professional engineers.

Higgins noted that, as far as other associations were concerned, agreements had been reached under the Washington Accord in relation to the mutual acceptance of the accreditation of professional engineering courses with the Accreditation Board for Engineering and Technology of the United States, the Canadian Engineering Accreditation Board of the Canadian Council of Professional Engineers, the Institution of Engineers Australia, the Institution of Professional Engineers New Zealand and the Engineering Council of the United Kingdom.

In attempting to assess the future of engineering, the initial focus must inevitably fall on the mode of entry to the profession. Clearly the current basic requirement of Grade C or better in Higher Mathematics should be maintained. Higgins felt strongly that the members of the Institution must encourage schools and career guidance teachers to persuade more second-level students to take Higher Level Mathematics as well as other scientific subjects such as Physics, Chemistry and Biology.

Higgins observed that there was some confusion in the current system in relation to choice of course and in particular the stage at which that should be made. *'My personal preference is for a period of general engineering studies following entry. Some schools insist on choice of course prior to or at time of entry. This policy is leading to a lowering of the standards of entry and this should never be acceptable'*.

At the time, the Institution believed that Irish Engineering education was not being given adequate resources. Higgins said *'Our academic colleagues can point to high student/staff ratios, inadequacy of numbers of support staff, and shortage of funds for staff development, for updating of equipment and refurbishment or replacement of buildings and other facilities. While some significant capital investments have been made, especially over the past decade, we insist that there is a lot of leeway to be made up'.*

Higgins concluded with these words: *'It is necessary to face reality. There must be adequate investment in facilities and teachers. It's an investment in the future. Progress must be steady and not a cycle of famine /feast/famine. Once you lose ground you don't recover easily'.*

Richard Grainger accepting the presidential chain of office from outgoing president Michael Higgins

In 1992, **Richard (Dick) Grainger** became president of the Institution of Engineers of Ireland. Railway engineering figured very prominently in the work of many past presidents and Grainger was no exception. His involvement with railway engineering was with Córas Iompair Éireann (CIE) at their Inchicore railway works in Dublin, first as a post-graduate apprentice and later as Chief Mechanical Engineer. The following are extracts from Grainger's full address which, like others were published in the Transactions of the Institution of Engineers of Ireland or in the Annual Reports of the Institution.

Around 1950 a major replacement programme of the railway fleet got under way, and diesel motive power had begun to challenge the supremacy of steam locomotives as the main railway motive power. The greater efficiency of the diesel units was already well recognised in terms of lower fuel consumption, easier servicing in use, and longer periods of operation between servicing. Grainger's professional career as a railway mechanical engineer developed in parallel with this modernisation of the Irish railways.

The first major modernisation began in the early 1950s when CIE introduced a fleet of 64 diesel railcars for main line and suburban passenger services. The introduction of these diesel railcars eased the pressure on steam locomotives for passenger trains and most of the latter were assigned to freight services and shunting duties. Replacement of the ageing steam locomotive fleet commenced in 1955 with the delivery of the first of 94 diesel-electric locomotives ordered from Metropolitan Vickers, Manchester - 60 for main line service and 34 for operation on branch lines. The process of modernisation of the railway fleet continued and the complete elimination of steam traction had been decided as the strategy for the future. However, this process took almost ten years to complete. While the introduction of the first group of diesel locomotives resulted in very significant economies in operating costs, due to lower costs for fuel and the reduction of driving staff and depot servicing staff, the operating performance of the locomotives, particularly the diesel engines, was disappointing and as a result, their reliability fell short of expectations. The next batch of main line diesel locomotives were purchased from General Motors in the U.S.A.

Diesel locomotive power in the 1950s

Grainger noted that the continued poor performance of the original diesel locomotive fleet led to lengthy negotiations with General Motors resulting in a scheme in the late 1960s to replace the original diesel engines with General Motors engines. The 60 mainline locomotives were re-engined at their original rating of 1200 horse power. In the meantime, motive power requirements had changed due to developments in traffic patterns and branch line closures, with the result that the 34 branch line locomotives were under-powered for the traffic needs that were emerging. At the time of re-engining these units their power was increased from 550 HP to 1000 horse power, thereby making them suitable for a wider range of duties. Thanks to the co-operation of the original electric equipment manufacturers a very satisfactory conversion was achieved on all 94 units. The performance of the re-engined locomotives improved

considerably and with the completion of the programme, CIE had standardised on the General Motors diesel engine in the diesel locomotive fleet. CIE was one of the first railways in Europe to convert fully to diesel operation and already replacement of some of the original diesel units had commenced.

Grainger then turned to the railway carriage fleet which had deteriorated to a very considerable degree during WW2 and was substantially replaced in the 1950s. The new carriages were of bogie design some 20 metres long with 64 seats each. They were completely designed and built at Inchicore and a number of special vehicles such as catering cars were included in the programme to provide meal services on the trains. As on the motive power side, railway carriage designs also developed and in the early 1960s monocoque carriage design developed, in which bodies of metal construction are assembled to metal underframes to form an integrated load bearing structure.

He noted that *'the market demand for greater passenger comfort and amenity in travel led CIE, many years ago, into the provision of air-conditioning on all new passenger carriages, so that practically all of our mainline trains are now air-conditioned. While air-conditioning is hardly necessary in our climate, the improvement in passenger comfort through a more consistent environment and the dramatic suppression of travel noise due to high levels of insulation and fully sealed double-glazed windows, has fully justified the use of air-conditioning'*. The latest fleet of mainline inter-city carriages, which were also of monocoque design, were built in Inchicore in the 1980s and were of all-steel welded construction. The need for a drivers cab on a small number of these carriages developed in response to a market and operating requirement for quick train tum-around at terminal stations. The train comprising the locomotive at one end and the control car at the other end remains as a fixed consist with the locomotive pulling in one direction of travel and pushing in the other direction - hence the name "push-pull train".

Grainger described the movement of freight on the railway as having seen dramatic changes, particularly in more recent times. Traditionally, all freight had been carried in three basic types of wagon - flat, open top and covered. The movement of freight in and out of the wagons involved a lot of manual handling, with the requirement of attendant staff. Increasing use of road transport on long-haul freight traffic, giving the customer door-to -door service, produced its own challenge to the systems of freight handling in use on the railways. The railways responded by developing specialised systems of freight handling based on the extensive use of flat wagons and various types of containers.

Referring to the Dublin Area Rapid Transit system (DART), Grainger felt that it was appropriate to draw together the strands of the overall design concept and the management of the project. The option of a Turnkey Contract with a single contractor was not adopted for the DART Project and instead, a multi-disciplinary team of C.I.E. engineers was established to guide the project to completion. There were many critical interface decisions to be addressed, particularly between the rolling stock, the signalling system and the power supply system. It was decided to use 1500 Volt DC overhead supply, principally due to the many level crossings along the line.

There had been, over the years, increasing operating speeds on the railway for both passenger and freight trains. This increase in speed was not just a matter of speed for its own sake. In addition to improving the competitive position of the railways, it was consciously directed to increasing the productivity and utilisation of the rolling stock equipment by increasing the number of round trips that are possible each day. Increased operating speed, however, increases the dynamic forces at the wheel/track interface and these forces transfer as disturbing forces into the running gear and suspension of the vehicles. Vehicle dynamics is the subject of continual technical evaluation to help optimise running gear suspension systems and develop parameters to minimise wear and tear.

Grainger commented that *'There has been the constant striving and adaptation to the needs of the moment and the projected future, recognising the inevitability of change and espousing the developments in technology relevant to our situation at any given time'*. He quoted from the 1876 presidential address of one of his

predecessors at Inchicore, Alexander McDonnell, who had this advice for young engineers commencing their duties.

"…it is of course necessary to become well-grounded in mathematics, mechanics, and chemistry, which are now so necessary for all well-educated engineers. The better your knowledge of these, the more you will use your knowledge - I might almost say without your knowing it. Pay particular attention to geometry of all kinds, to the geometry of three dimensions and geometrical mechanics. It will assist you in designing, and in mental calculations, to which I would advise you to become habituated. Learn French and, if possible, German. Learn a little book-keeping and become well acquainted with accounts, and the use they can be put to when properly kept. Without a knowledge of accounts, you will never be able to carry out large works with economy, or even become thoroughly acquainted with the cost of work, which is of the first importance to an engineer. As soon as you have an opportunity, learn the cost of materials of all kinds, and the uses different qualities of materials can be put to with advantage. If you undertake the management of workmen, study their peculiarities. The workmen of no nation work hard if left to themselves. You will get better results by organising their work well than by trying to force them to work hard by unnecessary severity."

Grainger felt that these words were still relevant even now as then, education for the engineering profession must also anticipate the learning of the art of engineering early in the young engineer's career. He wondered how an engineering education of 40 years ago would still be relevant and that this same question is facing today's graduates as they look into their future in the practising profession. Of course, the basics are still the same. There are more powerful means for calculation and iteration to support decision making, but the need for experience which develops a mature sense of judgement, is still essential. There will always be a need for practising engineers to keep their skills up-to-date and to deepen their knowledge of their own field of practice and a considerable onus falls on the older members of the profession to coach young engineers through their learning-by-doing period.

In particular, he felt that the engineering institution had a special duty to organise lectures, meetings, seminars and courses to help keep engineering skills up to date. The engineers in practice owe it to themselves to be associated with the Institution so that they may be aware of developments in the profession and take full advantage of them for their own personal career development.

As Grainger reflected on his career in engineering, he was struck by the extent to which the future was in focus at every stage. He concluded: *'I believe that it is the future which really dominates our every present moment. It is the wish to improve on the present that is the driving force of our profession and it is only in the future that we find fulfilment of our every present labour*'.

In 1993 **Liam Fitzgerald** entitled his address *Engineering - An Ingredient of Urban Revitalisation and Economic Activity.* As City Engineer of Cork, Liam had been associated with the Cork Land Use and Transportation Study (CLUTS) since its inception in the late 1970s. He dealt firstly with the historical development of Cork City to set the background for reviewing the strategy adopted in the plan, and its achievements to date. He emphasised elements which contributed to the revitalisation of Cork city and which gave rise to economic activity. The built environment of the past, particularly in the urban context is subject to change either by natural obsolescence, decay or adaptation to cater for present and future needs. Liam felt that *'It is, therefore, necessary for the engineering profession to be at all times conscious of the need to preserve what is good from the past, that any adaptation or refurbishment is done sensitively, and that redevelopments or new developments are complementary to the environment in which they are placed'.*

Fitzgerald began by considering aspects of the physical environment of Cork city, followed by a look at the demographic, social and economic environment of the city. The city goes back to the Viking settlements at the upper reaches of the tidal waters of the river Lee in or about A.D. 820. This was followed by an Anglo-Norman takeover up to about A.D. 1176. Cork then became occupied by descendants of both the Norse and the Anglo-Norman settlers and was granted its first charter in 1185 and remained as a colonial outpost up to about 1600.

In the 17th century, Cork consisted of a fortified, walled city, built on an island with a central north/south spinal street layout between the bifurcated river Lee over which bridges connected it to the mainland. This medieval street plan is retained more-or-less today as North Main and South Main streets and bridges, together with many of the laneways and alleys. Remnants of the old city walls still exist today.

From about 1660 to 1920 Cork became an important world trading link between the South West of Ireland, Europe and America. In the 17th and 18th centuries it was the principal port in Ireland for the transhipment of provisions to the Americas. This gave rise to a period of unprecedented economic growth and urban expansion. The ancient city survived due to the gradual extension of the urban area downstream towards the east. This trend was facilitated by the reclamation of the marshes and swamps, the culverting of the waterways, and the development of a street network in the form of today's Grand Parade and St.Patrick's Street, which now form the centre of the present urban area. A dramatic population increase had occurred in the suburbs and surrounding satellite towns. Doubts were being expressed regarding the continued sustainability of traditional heavy industry in the area. Fitzgerald noted that unemployment in Cork had increased from 4% in 1966 to 8% in 1976.

It was against this background that CLUTS was commissioned in 1976 to deal specifically with such diverse aspects as land use, transportation, sanitary and demographic issues. Amongst its objectives were the accommodation of the future population of the Greater Cork Area, the optimisation of the effective use of available resources, the realistic setting of investment targets, the provision of an acceptable and equitable level of mobility and accessibility, the minimisation and amelioration of detrimental impacts, the retention of the city at a convenient size, and the preservation of the character and fabric of the city. In a nut-shell what was proposed was the development of a set of separate coherent and inter-dependent strategic recommendations designed to make the Cork area a better place in which to live and work. In relation to land use, the greatest potential for industrial development was centered around Cork Harbour.

The Plan provided an inter-related and inter-dependent set of proposals for improved public transport, traffic management, new and improved roads and bridges (including a tunnel under the river Lee), parking restrictions etc., all aimed at providing an achievable investment policy to alleviate and control congestion and to provide an acceptable level of mobility. The Plan also recognised the need to make provision for an adequate water supply to cater for the reasonable demands of industrial as well as domestic consumption. Similarly, it catered for the collection and treatment of waste water and solid waste. The development needs of the port and the airport were identified. Fifteen years after the publishing of the Plan, much had been achieved and the Plan for the most part remained firmly on the rails. A respite from chronic traffic congestion was given to the city centre by the construction of new inner city bridges and by the introduction of traffic management schemes, including a co-ordinated area traffic control system. In relation to the city centre, Fitzgerald reported that considerable progress had been made in improving the surroundings in which people can live, work or shop, thus stimulating urban renewal and economic activity. In a predominantly industrial area with a significant number of high-density small artisan dwellings, an obsolete gas works yard had been converted into an attractive scenic public park named appropriately Shalom Park. The result had transformed a drab industrial area into an attractive residential enclave.

Fitzgerald noted that there was a certain nostalgic attachment in us all to bridges, and probably more than any other element of the built environment, their creation was attributed to the engineering profession. Cork city had more than its share of river bridges for a city of its size. Many of these bridges are of the historic masonry arch type and remain vital to the economic activity of the city. Their replacement by modern structures was never an option, and so a programme of strengthening was undertaken. Such strengthening obviously had to be undertaken in a sensitive manner in order to preserve the original aesthetic character of the bridges. Foundations were underpinned, defective masonry renewed, and a lightweight reinforced concrete saddle constructed over the stone arches.

Fitzgerald reported that, for over a decade, Cork Corporation had invested upwards of £17m. in providing interceptor sewers to collect the numerous outfalls to the river as it passes through the city and the stage had now been reached where there are only two outfalls at the eastern tip of the Island. He said that this limited exercise had dramatically improved the water quality of the river in the city centre, with a significant reduction in offensive odours, and the re-appearance of fish life.

He noted that there was an inter-dependence between cities, their suburbs, their hinterlands and their satellite towns, and acceptable mobility and accessibility within each element and between each element is fundamental to their well-being, their expansion or re-generation, and their economic activity. Accordingly, the Plan contained proposals for ring roads around the city to cater for the high percentage of through traffic wishing to bypass the city. The most important of these roads was the Southern Ring, then at an advanced stage of completion, incorporating eleven new road bridges, two pedestrian bridges and one pedestrian/cyclist over-bridge.

The most publicised road scheme originating from the Study was the proposed river Lee tunnel for which tenders on a design/construct basis were then being invited by Cork Corporation. The cost of the tunnel was estimated at the order of £65m. It was to be the first of its kind in the country of the immersed tube type. The tunnel was selected as the mode of crossing because of its engineering feasibility, its negligible environmental impact, its comparable costs with other traditional modes of crossing, and its negligible impediment to shipping movements.

Southern approach to river Lee road tunnel

Fitzgerald was convinced that the completion of the CLUTS Plan within the ensuing five years would allow Cork Corporation to concentrate on the further enhancement of the city in general, and in particular the inner city and the old medieval walled city. He concluded with these words:

'Without the foresight, dedication, diplomacy and commitment of the Cork City Manager of the day and his successor, in chairing the various meetings of the Steering and Monitoring Committees, and guiding their deliberations, the Study would not have received the unanimous acceptance which was so vital for its success. Nevertheless I feel that it is not unreasonable to record the major contribution of the engineering profession to what has been, and continues to be, achieved.

Pat Jennings, in his address in 1994, took the opportunity to remind his audience of the engineering and architectural heritage of Irish railways, before reflecting on the modern infrastructure, the responsibility of Iarnród Éireann. Irish railway heritage has been extensively described over the years in many publications and only some brief extracts are offered here as a background to more recent developments.

The first railway in the country was the Dublin-Kingstown Railway (DKR) opened in 1834, one year before the founding of this Institution. William Dargan, who built the DKR was also the main contractor for the construction of the Dublin to Cork line with a branch to Carlow for the Great Southern & Western Railway (GS&WR). Work commenced in 1845 and was completed in 1849 to a temporary station at Blackpool, just north of Cork City. Even by today's standards, this was an amazing achievement in four years. Over six years were to elapse before the 1240m long tunnel needed to extend the railway into Glanmire Road Station was completed. The Midland

Great Western Railway (MGWR) was incorporated in 1845 to construct a railway from Dublin to Mullingar, Longford, Athlone and Galway.

The Ulster Railway (UR) from Belfast to Portadown Railway was completed in 1842, while the Dublin to Drogheda Railway (D&DR) was completed in 1844. Services from Drogheda to Dundalk commenced in 1849 from a temporary station at Newfoundwell, on the north bank of the river Boyne. The railway between Dundalk and Portadown was completed in 1852. The scene was now set for one of the great engineering achievements of the age, the construction of the Boyne Viaduct, which Jennings then described in some detail.

The bridge section of the viaduct was the first large-scale wrought-iron latticed girder bridge to be built. Designed by Sir John Macneill, Consulting Engineer, and James Barton, Engineer with the Dublin and Belfast Junction Railway, work commenced in 1851 and was completed by 1855. The condition of the river spans later deteriorated due to corrosion and lamination of the wrought iron and they were replaced in 1932 with N-girders in mild steel. Prior to the reconstruction, the track was singled and the new N-girders were erected inside the original wrought-iron latticed girders, thus enabling rail traffic to run uninterrupted throughout the duration of the bridge renewal.

On the Cork Line, masonry arch bridges of all shapes and sizes proliferated. The viaduct at Monasterevan carries the railway over the river Barrow. A major viaduct at Mallow spans the river Blackwater and the Monard Viaduct near Cork is a fine masonry arch construction. The MGWR line to Galway was completed in 1851. With the exception of the Shannon Bridge at Athlone, the only major engineering feature was the construction of the railway across extensive areas of bog. Jennings retold the story of how the railway was built across deep bogs. The main experience was to be got from the engineers who had built the roads and canals and this pointed to a need for adequate pre-drainage. Today's problems of maintaining good railway running conditions on the tracks in bogs relate to differential settlement, vibration of the track under trains, and formation failure.

Bray Head rail tunnels, county Wicklow

The building of the Dublin to Wexford line posed many engineering problems in its construction and in its subsequent maintenance. On Bray Head with the passage of time, and arising from extensive coastal erosion and the wave action of the very heavy seas, it became necessary to carry out major diversions of the line, the abandonment of the wooden and steel trestles, the construction of permanent sea defence works, and a new one-mile long tunnel constructed in 1917. Extensive maintenance works are carried out on an annual basis to maintain them in in this location. These have extended to ramparting and buttressing the very high cliff face on the landward side of the railway, regular inspection of the cliff face, removal of loose rock, and the provision of steel netting and rockfall protection structures. On the seaward side of the railway, very substantial retaining walls were provided at many locations, high stepped ramparts, heavy gabion structures and slope stabilising systems were employed in the continuous battle against the heavy seas. Meanwhile in Dublin, despite severe opposition from Dublin Corporation a Bill was passed in 1884 approving a double-track railway between Westland Row and Amiens Street crossing the river Liffey and the works were completed in 1891.

The ongoing development of Rosslare Harbour at the turn of the 19th century led to the construction of the Waterford/Rosslare line so that the railway could provide quick and easy direct access direct from Cork to London via Rosslare and Fishguard. The most significant engineering feature was the 650m long Barrow Bridge west of Campile, the longest railway bridge across water in Ireland, consisting of thirteen fixed spans and a centrally-pivoted swing span.

It was in the period shortly following the establishment of the State in 1922 that the railways began to experience difficulties mainly due to demands for pay and better conditions by their staff, but also due to the costly materials for maintenance renewals and the very high cost of renewing the infrastructure at a time of diminishing revenue and intense competition from bus transport. In 1924 the GS&WR amalgamated with the MGWR and other smaller railways to form Great Southern Railways (GSR), who embarked on a major rationalisation and cost-cutting plan that saw the singling of lines and the closure of many branch lines. The economic depression of the 1930s meant little or no new investment in the railways, while the onset of WW2 aggravated the situation.

Córas Iompair Éireann (CIE) came into existence in 1945 with the amalgamation of all the transport modes and as far the railway was concerned, it inherited all the problems of the GSR. In effect it acquired a run-down railway starved of financial investment. The government policy at the time was that "Railways must pay" and deficit accounting and an annual subsidy was introduced. Dieselisation was financed in the 1950s, but it was not until well into the 1960s that serious investment occurred in developing the freight and traffic businesses.

While these developments were taking place in the 1960s and early 1970s the basic railway infrastructure had not changed to any extent. Signalling was still of the semaphore type and operation of points and crossings was by lever frame and rodding from signal cabins at each location. The track structure still consisted of a wide variety of flat-bottomed rails and jointed bullhead rails, timber sleepers generally creosoted, numerous types of fastening systems, with ballast depth and grading depending on the capacity of line involved. The rail adopted by Iarnród Éireann (IR) on a system-wide basis was the 54kg/m rail, a standard European section. In the middle to late 1970s the company began to phase out the use of timber sleepers. Concrete sleepers, having an inherent high lateral resistance, being less subject to the ageing process, combined with their ability by virtue of the manufacturing process to maintain precise gauge, were henceforth widely used on IR mainline track. The most important development in recent years in railway track technology has been the elimination of the jointed rail and the introduction of continuous welded rail (CWR). The technical advantages of welded over jointed track are prevention of rail creep, elimination of rail fracture arising from joints, prevention of dipped joints and rail end batter, smooth, pleasant and comfortable vehicle ride, and the economic advantages due to reduced maintenance costs and extension of rail life.

Cahir Rail Viaduct, county Tipperary

Virtually all bridges on the railway system needed to be renewed with minimum interference with train traffic and were usually carried out in a well-planned, well-programmed arrangement over weekends. Accordingly, bridge renewals in the IR system involved pre-casting in concrete, pre-assembly or pre-fabrication in steel with in-situ works being kept to the minimum. An interesting type of reinforced concrete portal bridge was developed to improve railway clearance for container traffic as a replacement for a masonry arch. Jennings reported that in recent years reinforced concrete had largely given way to precast prestressed bridge beams for longer-span bridges. Inverted "T" beams were used up to 17m span on overbridges, generally laid individually and finished off with an in-situ slab. In underbridge construction, inverted “T” units were used up to 10m span, generally cast in groups with an in-situ joint, while a similar form of construction was employed using “M” beams for spans up to 20 m.

Up to the early 1970s, the railway signalling on the system for the most part consisted of mechanical semaphore-type signals controlled from individual signal cabins at station areas. Traffic between stations operated under the “block” system with only one train being allowed in a “block” or section at any one time. Centralised Traffic Control (CTC) was introduced in the mid-1970s. This is a means of controlling long sections of track from a central

control point, and employs colour light signals, track circuits, and motor operated points. Relay logic replaced the mechanical interlocking of points and signal levers in the signal cabins. The CTC system has been further developed and refined in line with technological developments.

The case for investment in Ireland's transport industry has been widely and generally acknowledged within the European Community. The availability of the various European Community Support Funds in the operational programme on peripherality, the cohesion, and structural funds encouraged IR to overcome the long-standing lack of investment in the railways. Accordingly, IR made a comprehensive submission for grant assistance, the main components of which amounted in total to £450m, related to upgrading track work and replacement of life-expired locomotives and rolling stock. Other elements were improved signalling, freight wagons and handling equipment, engineering equipment and upgrading of stations throughout the system.

Jennings felt that the jewel in the crown of IR enterprises was the immensely successful and profitable port of Rosslare Harbour. Irelands first roll on/roll off (Ro/Ro) facility was built by John Paul & Co. in Rosslare in 1968 when Normandy Ferries introduced a new direct service to France. A second Ro/Ro berth was provided in the 1979/1980 period with the construction of a new pier carried out by Irishenco. Rosslare Harbour was then the largest ferry port in the Irish Republic. On completion of the development project, Rosslare Harbour was to have four fully-functional shipping berths capable of handling a wide range of ships and high technology craft. Jennings felt that the development would secure Rosslare Harbour's position as Ireland's gateway to Europe.

In conclusion, Jennings considered that a new era had dawned for the railways. With the completion of the Channel Tunnel and the railway developments in continental Europe, giving high quality, fast and efficient services, and competitive journey times, the future of the railway internationally was assured. In Ireland, Iarnród Éireann was already carrying higher passenger numbers than at any other time in the history of the railways and ridership was increasing annually. By the end of the millennium, with the completion of the infrastructure upgrading, the consolidation in service of the new locomotives and the high-quality rolling stock, together with the planned reconstruction and refurbishment of the main line termini at Heuston and Connolly, and the upgrading of station facilities throughout the system, Jennings was sure that the railway would truly be offering customer satisfaction, and an environmentally friendly service capable of being more competitive than any other mode of transport.

In 1995, **John Killeen** took as the theme of his presidential address *A History of Irish Roads – A Pavement Perspective.* This extensive address provided an illustrated history of roads in Ireland together with a review of developments in pavement engineering.

A means to an end, roads were never a requirement, but rather a necessity of mobility and therein lies their lack of priority even to this day. The need for mobility varied throughout the centuries - travel for military purposes, commercial/barter/leisure and communications being the necessary requirements. Evidence of our earlier roads have been found in our midland bogs leading to the fording points on the Shannon in particular, from the Tara/Dublin area. The period of early Irish roads extended for at least 2,000 years, probably from 1000 BC to 1100 AD, during which period roads were 'constructed' and abandoned at different times.

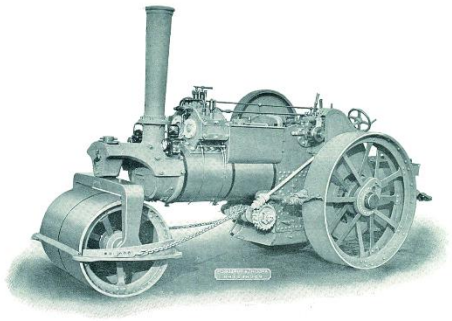
In 1615, the parliament of Ireland passed the "Highways Act" introducing the notorious ‘statute labour' system to Ireland. It deemed that each parish would provide two surveyors for one year to be in charge of the roads and that farmers must send two men and carts for six days each spring. Roads were maintained by placing available stone into the clay or mud forming a matrix with it, and finished with a thin layer of gravel, which created a stable surface, except in times of bad weather. The Grand Jury Act of 1710 was the first Act to make a lasting impression on the Irish roads network. It increased the powers of the Grand Jury in the counties (which had already been set up by the Normans). The Grand Juries were composed mainly of wealthy landlords. The Presentment system of maintaining roads required setting out of work to be agreed at Barony level. This was

carried out by 'statute labour' and had to be approved by the Grand Jury and Judges of the Assizes. The presentment system was modified in 1765 to have the work done by contract. This gave rise to a new era in road construction and the system lasted until 1898.

The composition of the pavements appears to have consisted of stones embedded in mud or exposed gravel, where this occurred below the clay layer. Some haulage of gravel evidently took place during this era to provide a gravel finish to the surface. Turnpike or toll roads started in Ireland in 1729 and became popular in Leinster until about 1780. These were built by trustees who collected tolls for their cost and maintenance. Their construction quality, width and upkeep varied substantially from one toll road to another. Mail coach roads were introduced to Ireland in the late 1790s and an Act passed in 1805 changed the laws for improving and upgrading of mail coach routes. This Act provided for the first alignment standards for roads and allowed postmasters to appoint surveyors. In 1822, an Act of Parliament gave powers of grant making to Central Government and in 1831 the Board of Works took over management of grants and funds for roads, providing some control over Grand Juries at the time.

While roads may have been affected by the completion of the main railway system in 1859, the desire to create employment resulted in 350,000 people being employed on roads through the Board of Works and an estimated £4M was spent by the Board during the Famine period, during which it was estimated that 30,000 miles of road were built. Most of the walls and ditches of the roads of Ireland were constructed during this period.

An 1857 Act empowered County Surveyors to employ direct labour to do 'works in charge of the County Surveyor'. This was slow to start because of objections of contractors, but by 1913, after a long and often bitter struggle, it became the more popular method of carrying out construction and repair of roads. The important Act of Local Government of 1898 brought about many changes in organisation and management, power to declare main roads, proportional surcharge to district or county at large for repairs or new works.



There were many changes in the mode of transport towards the end of the 19th century with the development of the bicycle, motor car and the steam traction engine. The focus shifted from provision of additional routes to creating even dust-free roads. From an engineering point of view, this saw the introduction of rolling to create a level and stronger road. Generally, broken stone blended with a fine gravel was the normal material used and then rolled by a heavy-duty roller. The steam-driven heavy rollers were the first self-propelled rollers and began appearing from the late 1890s to 1910 and were the normal heavy-duty rollers used up to the 1930s and occasionally in the 1940s.

The early part of the 20th century up to 1925 saw the beginning of the sealing of roads by tar - an idea derived in France, but later developed and used more widely in the UK in the mid-19th century. Its good ability to adhere to stone was recognised as a means of binding chipping onto the surface. The use of bitumen - a residue in the production of gasoline - also became available in the 1920s. This was normally softened by a 'cutting oil' or solvent which allowed it to be sprayed and pumped at lower temperatures. These materials had good sealing qualities and were generally used to 'grout' the larger broken stone - 2" down to about ¾". This was then gritted with smaller chippings roughly ½" in size to prevent pickup and close the matrix. The process was often referred to as 'road metalling'.

The Local Government Act of 1925 identified national roads - a network of over 1,600 miles and 9,000 miles of main road being so designated. Gravel, where naturally available, was the principal road material laid up to this time - generally being water-bound and compacted by steam roller. Blinding with chippings between ½" and ¾" was the most common practice. This process produced very good road bases, which were generally level and

did not 'pothole' easily. Many of the roads were sprayed with tar and chippings, to seal and render them dust free.

The 1930s saw a major improvement in both the miles of road that were sealed by tar spraying - up to 3,500 by 1936 and some 150 miles of tar-bound macadam was used. This latter material was usually an open-graded stone mix with a more viscous tar added than that used for spraying, using small mobile batch plants. The 1950s saw a period of the extension of the tar and chipping of main and country roads, as the priority of government. By now, bitumen was replacing tar as the binder for both surface dressing and in making 'tar macadams'. Cationic bitumen emulsion was replacing refined tar as the main surface dressing binder, with the demise of the production of town gas.

The Arterial Road grant introduced in 1963, led to the designation of National Primary and Secondary roads. Speed limits were also introduced at this time, which had an impact on the design standards of roads. During the period a new concept evolved for pavement design and construction. It was realised from work done, particularly by An Foras Forbartha, that open-graded-large single-sized stone would not provide adequate foundation strength given the traffic volumes and axle weight projected in the future. This resulted in the use of denser materials - a gradation of crushed rock or graded gravel.

The use of 'wet-mix' macadam as a road base material gained widespread acceptance in the 1970s and 1980s. This material - a dense gradation within a grading envelope, was easily attained by most quarries in the country with minimal crushing and screening abilities. The material was laid and compacted at an optimum water content, which allowed maximum density to be attained. This material was an excellent base material when adequately sealed, drained and when kept below the optimum moisture content, otherwise high levels of saturation reduced its strength to the extent that failure occurred within a very short period of time (often days). With increasing axle loads and frequency of heavy goods vehicles, this material on its own as the structure of the pavement, gave very short life expectancy. However, when overlaid with bound structural layers, it was found to provide an economic structural layer, particularly when the drainage of the pavement was good. The sealing of these materials was critical to their survival, as only occasionally in the regions around Dublin were the roads paved with a bitumen macadam overlay. The use of hot-mixed macadam and its more dense variety hot-rolled asphalt became the normal pavement material in the larger towns and cities during this period.

The greatest impact on pavement design and construction arose from the change in axle loading from the 1960s to the 1990s, the average commercial axle load increasing from about 5-6 tonnes to 11 tonnes. Killeen noted that the ‘recipe’ method of pavement design was then being challenged by a rational design approach – a structural engineering method. This latter method sets out to evaluate all the loading stress over the total design life of the road and, together with the constraints of ground conditions and materials of the pavement construction, seeks to optimise the pavement details. The use of computer-aided design programmes for the vertical and horizontal alignment design of road pavements had enabled better and more economic improvements to be made. Pavements, of course, are basically the structure of the road, but they are expected to have many other attributes, including skid resistance, surface water dispersal, delineation, profile – super-elevation, and low noise generation.

Killleen felt that surface dressing still continued to provide a very high skid resistance to all our main and country roads, together with a large section of our National Primary and Secondary Roads. It also sealed the roads, which mainly (over 90%) consisted of gravel or crushed rock structures. The usual mechanism of failure for these roads was the 'out of shape' mode. This would not necessarily result in short-term failure unless the seal breaks and the base becomes saturated. However when the seal is retained, this out-of-shape pavement becomes uncomfortable for travelling and also makes the road less safe, due to waterlogging and uneven surface.

Killeen concluded by saying that *‘It is necessary for the Road Engineer to be conscious of the need to learn from the past and from developments in other parts of the world, as pavement engineering is a life-long learning*

process, as it responds to the changing world around us. The need for improving quality, life cycle value and the promotion of safety for the road user is an on-going challenge'.

The Presidential year 1996-1997 was dedicated by the Institution as the year of a *Celebration of Irish Engineering*. The objective of the year was to make the public and government more aware of the contribution which engineers have made to the development of the nation and to indicate what the profession could achieve in the future. In his presidential address, **Phil Callery** looked back to the early days, made some comments on the present and peered somewhat into the future. The following extracts may not do justice to Callery's comprehensive address, but the full text may be found in Volume 120 of the IEI Transactions.

In the year of celebration a number of engineers and their achievements were honoured by the erection of commemorative plaques. These included the Shannon Navigation at Athlone, the Birr telescope, the Ballinamore-Ballyconnell canal, the Chetwynd Viaduct in Cork, and Dun Laoghaire Harbour. The Roadstone Calendar for 1996 featured the work of some eminent engineers of the past in Ireland. These men contributed immensely to the economic development of this country in the 19th and 20th centuries. Included were Alexander Nimmo, Robert Mallet, Bindon Blood Stoney, Thomas McLaughlin, and Harry Ferguson.

Vice President, Phil Callery with the President, John Killeen and Vice President, Gordon Millington with the portrait of Finbar Callanan, which was hung at HQ in Clyde Road.

Callery saw the 1990s as the golden age of infrastructure in Ireland. Ireland had been a major beneficiary of EU aid. Structural fund receipts from the European Regional Development Fund (ERDF), the European Social Fund (ESF), FEOGA Guidance Fund and the Cohesion Fund had increased substantially since the end of the 1980s. The average value of these contributions had been £900 million per annum in recent years. He then referred to some sectors which were receiving major assistance.

The telecommunications network had been greatly improved in recent years, but in spite of a massive development programme of £1.5 billion in the 1980s, Callery said that Ireland had lagged behind other European countries in this area. He felt that, if the country was to hold its status as an attractive location for tele-services, the high level of investment in our telecommunication services must be maintained. Knowledge-based industry has located in this country, providing top quality employment for our graduate engineers.

Callery noted that the Irish electricity supply industry was entering a period of great change. EU regulations would allow other suppliers to provide electrical power within Ireland. A new Electricity Act, which was expected early in 1997, was to change the present supply system within the country. Callery noted that generating capacity required expansion. Demand for electricity in Ireland exceeded the EU average demand and currently stood at 5% per annum. Demand was to be met by the introduction of additional suppliers, new electricity generation facilities, including a new peat-fired station and inter-connection with the Northern Ireland system.

Natural gas then supplied one fifth of the country's energy demand. The gas interconnector between North County Dublin and South West Scotland was completed in 1993 and Ireland was now linked into the British and European gas grids. This interconnection provides for continuity of a valuable low-cost energy source for Ireland for many decades to come. The gas distribution network extended to the major centres of population.

It was estimated that 130 million tonnes of peat could be harvested from the holdings of Bord na Mona. The life of this resource was thirty years and was capable of making a substantial contribution to the energy needs of Ireland. Peat then provided 13% of the primary energy requirement. It was expected that EU Structural Funds would assist in the provision of a new peat-fired power station, which would use the most up-to-date technology, and would be 50% more efficient than current peat-fired establishments.

Harvesting milled peat

Road transportation continued to be a major beneficiary of EU Structural Fund investment in Ireland. Callery noted that major improvements to the National Road System had been undertaken in recent years, resulting in significant reductions in journey times and increased levels of safety. The National Roads Authority (NRA) administers the funding for the National Primary and Secondary Road System. The emphasis was to be on strategic corridors which form part of the Trans-European Road Network. Callery commented that *'Since the removal of rates on domestic dwellings in 1978, local authorities have had to rely on exchequer rate support grants. These grants did not match the previous funding capabilities of local authorities with the result that funding for local roads has significantly reduced. The fabric of the non-national road system has deteriorated to such an extent that huge investment is necessary to retrieve the situation'.* In 1997 the Minister for the Environment announced a ten-year rescue package for non-national roads, a major step towards the rehabilitation of the network. Structural Funds were also to be used to improve the non-national road network. As a result of the cutbacks that had taken place since 1978, the surface dressing cycle had been greatly increased. Many county councils now surface-dress roads on a cycle greater than 25 years and this had been happening for at least fifteen years. Skid resistance had been severely reduced across the network. This, together with reduced hedge cutting, signing, delineators and white lining, had affected road safety.
Substantial investment in the rail network was then under way and would result in track renewal, new signalling systems and modern rolling stock. As a result, journey times between the major population centres were to be significantly reduced. During the National Plan 1994/1999, £185m was to be spent on the rail development programme. The major emphasis was to be on the Belfast-Dublin-Cork line which forms the central axis of the national rail system. Other lines to benefit included Dublin-Sligo, Dublin-Limerick-Cork-Tralee, Dublin-Galway and Dublin-Waterford. The proposed Light Rail System for Dublin City (LUAS) was at the time generating much debate and the government had indicated that the project would proceed with EU grant assistance.

Callery said: *'All engineers have a key role to play in the maintenance of Ireland's environment. Many aspects of our environment are the envy of our European neighbours. Our clean air, water, landscape and seascape are a heritage which must be jealously guarded'*. He felt however, that there were some areas which must be a cause of concern to the profession. Inland waters, while showing a decrease in levels of serious pollution, were showing increased levels of slight and moderate pollution. The main polluters were identified as Industry 49%, Agriculture 31%, Sewage 20%.

The Waste Management Act, 1996 had major implications for local authorities. In future, landfills were to be operated by local authorities under licence from the Environmental Protection Agency (EPA). The standards of landfill design now included lining of excavations, recovery and treatment of leachate, methane recovery and a high quality of environmental design. Charges for disposal of waste on public landfills were expected to rise to five times their then level. Callery felt that the cost for each local authority to provide disposal facilities for its own municipal waste and sludges to the standards then required would be more than could be reasonably

afforded and regional disposal of waste must be investigated. Callery concluded that *'technology is constantly reducing emission levels from combustion and engineers must be prepared to defend the introduction of safe new technology to provide cost effective waste disposal'.*

Regarding coastal erosion, Callery noted that climate- change predictions and a projected rise in sea levels had serious implications for Ireland. An increase in the frequency and severity of storms, together with a rise of sea levels of 18cm by 2030, would cause massive coastal erosion in Ireland. The sandy coastline of the East of Ireland would suffer most. Extensive flooding of coastal cities and towns, loss of amenity beaches, destruction of sand-dune systems and natural heritage areas were to be expected. Callery concluded that there was an urgent need for the establishment of a National Coastal Authority to co-ordinate all the agencies with coastal responsibilities and to allocate funding for priority projects.

One of the environmental landmarks of the decade was the establishment of the EPA in July, 1993. It is an independent body, charged with (i) the licensing and regulation of large industries; (ii) monitoring environmental quality; (iii) advising public authorities; (iv) promotion of sound environmental practices; (v) co-ordinating environmental research; vi) regulation of waste recovery activities; and (vii) overseeing the environmental performance of local authorities. Callery said *'It is to be hoped that the EPA, in partnership with the local authorities, will ensure that Ireland's environment will be protected for the generations to come*'.

On education, Callery said that the engineering schools in our universities could be justly proud of their contribution. Irish engineers throughout the world are recognised as being of the highest quality. The location of so much high-technology industry in this country in recent years was, he felt, directly related to the availability of well-educated graduates. The Regional Technical Colleges have also been a spectacular success. The Culliton Report – *Industrial Policy for the 90s*, had made a strong plea for increasing the numbers of engineers and scientists in the country. Between 1971 and 1986 the number of accountants more than trebled, the number of auctioneers and lawyers doubled, but the number of engineers increased by less than 50%.

Callery noted that the engineering profession in Ireland had always been male dominated, but that the situation was gradually changing. He considered that it was important for the future of the profession that the best minds should enter engineering (male and female). This year, for the first time in the history of the Institution, three women were members of the Executive Committee of the Institution. Callery opined that '*The day cannot be far away when we have, for the first time, a woman as President of the IEI. It will also be a major breakthrough when a woman is County Engineer. I look forward to both of these occasions'*. [Jane Grimson became president in 1999].

Callery felt that the Institution was in a particularly strong position as the Millenium approached. The Institution had 13,000 members and growth was steady. The greatest region of growth was Northern Ireland. The overall objective was to achieve a membership of 20,000 for the whole of the island. Callery felt that in the past, the headquarters at Clyde Road may have been perceived as a facility for members in the Dublin Area. This perception must change. The headquarters is a facility available for all members from every part of the country.

Turning to engineering qualifications, he noted that the Institution had introduced new procedures for the achievement of status of chartered engineer, bringing the IEI standards into line with the Institutions of other countries. Callery stressed that CEng status was the cornerstone of our Institution and we must promote its usage and recognition. It should be recognised as a guarantee of engineering excellence and a mark of quality assurance. Callery said that *'In the future we must, to a much greater extent, take on the mantle of leadership. The engineer by his education and training has the ability to analyse complex problems and provide workable solutions. Too often, we have stood back, remained as technical advisors and allowed others to lead. This was not accepted by the great engineering figures of the past'.*

Callery noted that Ireland's economic performance over the past ten years had been superb. G.N.P. was 75% of the EU average, but this meant that Ireland would no longer have Objective I status and be fully eligible for

structural funds. The predictions for the Irish economy, however, were good. Inflation was currently below 2%, interest rates were low, and the economy was expected to grow by 5% per annum to the turn of the century. This growth rate was expected to sustain the Irish economy into the next century so that we would be less dependent on structural funds. It seemed unlikely that there would be a sudden withdrawal of funding from Europe after 1999. Such a withdrawal would likely be gradual. Therefore, the prospects for the building industry and the engineering profession were good and we could look forward to our economic future with confidence.

In his opening remarks in 1997, **Gordon Millington** said he was determined that the Institution would continue to ensure that engineers from Ireland made a major contribution to the benefit of mankind's future in Ireland and around the world. Gordon wondered how many others with Belfast connections had been in high office of the Institution. He continued: *'I could not believe my eyes when I read that the first Honorary Secretary, 1835 to 1837, was Charles Lanyon then living in Kildare. He subsequently became the first county surveyor of Antrim and according to Brett "the greatest single name in the development of Belfast". He was the great architect of the rapid development of the city in the second half of the 19th century'.* Gordon said that his first memories of being an engineer were as a child constructing go-carts and that this had been a true design, build and operate contract. The Erne hydro-electric scheme of the 1950's was a prime example of the great gains to be made by considering engineering on a geographical basis rather than by political divisions and a classic example of the meaning of *Engineering an Island*, the theme of that year's annual conference. Gordon recollected that on his first day at Queen's University (Belfast) he had been asked what sort of engineer he wished to be i.e. Civil, Electrical or Mechanical. *'I did not know the difference. Not that it mattered as we all did the same course for the first two years'*. Four years later he left Queen's with a degree in Civil Engineering, but was also taught to weld, to use a lathe, do metal work and design electric circuits and electric motors, a great background for a fulfilling career.

By 1845, Ireland had four colleges teaching engineering. At that time there were only two other universities on these islands with engineering departments, Glasgow and London. Millington wondered *'What was wrong with a society that ignored higher education for those who were the backbone of the transformation of Europe into a progressive and healthy society?'* He continued: *'Against that background it is clear why our Institution started up as an organisations to pass on knowledge from one person to another particularly amongst the younger Engineers. The universities were showing little interest.*' The output of engineering graduates was now quite different. There were (1997) about 325 engineering graduates per million of the population in Ireland.

Millington recounted that he had spent most of his career in Belfast, but a very important stage was two or so years spent with the design team for a thermal-electric power station to be built in Buenos Aires, with dual fuelling from coal or oil. *'This experience left me with a fascination in power generation and an appreciation of the complex and exciting nature of the Civil Engineering challenges associated with the generation of electrical energy'.* Millington said that, despite that, most of his work had been connected with more general structural engineering. Recently his involvement with the continuing development of Belfast had led him to write a paper on the changing face of Belfast entitled *"Turning to Face the River".*

His thoughts turned to making a contrast in the developments of Belfast, Dublin and Cork. He felt that they had developed as very different cities at different speeds and at different times. He wondered had this anything to do with the development of the engineering infrastructure or was the development of the engineering infrastructure a consequence of the different types of growth? The effects of the Famine and of the mechanisation of agriculture depopulated the countryside but left the cities unscathed or even growing.

Millington commented: *'The key to life as it is now lived in the western world is engineering in all its forms. The tiger economies of the far east are following at such speed they will probably match our standards soon and then surpass them, making some of the mistakes we did and avoiding others. Life now is however much more complex, the individual is seldom the creator of project great or small, the team is now supreme. This follows the increasing*

democracy of our decision making. With the management of diverse knowledge now needed to bring to conclusion the results of our ability'. Bertram Russell stated that "Almost everything that distinguishes the modem world from earlier centuries is attributable to science." Engineering is the key to applying that science. So what is this key, what is engineering? Millington concluded that engineering is the application of scientific knowledge to create wealth, protect health, and to sustain the environment. He continued: '*Is any one of these more important than the other? I do not know, but I do know they are interdependent upon each other and constantly changing in detail and context depending upon what stage of development a society has reached'*.

Millington said that it was worth remembering that it was only now that we who live in Europe have got to the stage where we clean up sewage before disposal into the sea. So the creation of wealth is needed to carry out the work to protect our health. The improvement of our environment is the result of our work to protect our health. The accumulation of wealth leads us to the desire to have a pleasant environment that is sustainable. Engineering is the key to the achievement of all those aims.

Improvement in conditions would have been impossible without the creation of wealth and its efficient use. The contribution of engineering has been immense. It has been the linchpin of so much of industry. The design of goods, the setting up of manufacturing process, the transport of the products. All of these have major engineering inputs. Millington noted that *'the application of science by engineers has continued to accelerate in my lifetime. I can see no reason why that should not continue to be the case for the foreseeable future. I am not inclined to the view that a shortage of basic raw materials will be a serious threat to mankind. Scientific knowledge and financial adjustment will see to that'.*

The passing on of knowledge from one generation to the next is the basis of education and the development of new knowledge via research advances mankind. The encouragement and auditing of these two functions are the primary work of the Institution through its Membership and Qualifications Board. The provision of third-level education has been increasing at a substantial rate in the last few decades. This is increasing the numbers and diversity of graduates available to industry and Millington believed this was essential to the future development of engineering and the engineer's contribution to society.

On the question of entry standards to engineering courses, Millington commented: *'I am not convinced that entry standards are the key to the problem. Why are we not measuring the entry into our profession instead of the entry into the Universities? I am far from convinced that all of those leaving University match the requirements for our profession even if they did have a satisfactory entry standard. We should be auditing the exit standard'.* It seemed to him that the traditional universities had missed this point of remaining the outstanding centres of excellence and had been drawn down the mass-market path. He felt that they were in danger of becoming the supermarkets of education rather than the leaders of highest standards and quality.

Today we have expanded third-level education as our driving force into the New World, the fuel of which is knowledge. Millington said: '*That is a sound route to follow, but we have too few paths and have ignored the advantage of a path to the top of the mountain for a few who have the ability to reach the peaks of knowledge. This must change; our senior learned universities must take the bull by the horns, turning away from the mass market. They must develop their institutions into providers of third-level education for the genius that can reach the peaks. Others will cater for the able that can gain advantage of a high standard of third-level education, and others may be better at providing that level of knowledge'.*

He was convinced that the Institution had a part to play in such a change. He said: *'We have fallen into the same lethargy. The Institution must set up a system of recognition that will encourage some universities to set up suitable courses and that will encourage students to accept the challenge, that will provide an increasing band of high-flying students coming into the profession. Professor Patrick Dowling had recently expressed concern about our inability to give appropriate recognition to student investment in post-graduate education'.*

Ireland is no longer a provider of cheap labour or knowledge. Millington commented: *'We must build our future upon high standards and high technology and high return. Our future contribution to the world will be a resource of high ability, fed by engineers the equal to the best in the world. The aim of the Institution is to qualify our members to be leaders of the profession in the world'.* Education of an engineer does not stop upon graduation and the Institution ensures that by its process of development leading to the various grades of professional membership. This was currently going through a process of upgrading and clarification.

Millington felt that the Institution had a duty to set up systems that would enable its members to prove duty of care. It was also the duty of the institution to ensure that only those of its members who have acquired the necessary knowledge are entitled to use its qualifications. He said that he would like to see the Institution taking an imaginative line for CPD and setting an achievable and effective system that could become the benchmark by which other systems could be judged.

He believed that the leaders of the profession should not reflect social attitude but play an active role in changing them for the common good. The establishment of the Irish Academy of Engineering was seen as a very welcome move in that direction. Ireland's engineers have been leaders and continue to be leaders in the creation of the world's infrastructure and industrial base and improvement of our environment.

Ireland is now able through its modern development to give the opportunities once again for engineers to make a major contribution to the island's as well as the world's economy, a challenge being grasped successfully by many of our members at the present time. Millington concluded: *'The future for engineering will surpass the past. This Institution will be the key to open that future to those who wish to meet the exciting challenges ahead'.*

"Engineers are the only professionals who can deliver the future" (BBC 1997). So, **Jack Kavanagh** began his presidential address in 1998. He observed that *'Certainly engineering is one of the great pillars on which civilisation is based. Modern society and the living standards it enjoys have been made possible by engineers in all our various disciplines. The odds are that most of us would not even be alive today but for the work of engineers. We would have died when young from contaminated water, spoiled food and insanitary conditions'.* Today, engineering had ensured that society could take for granted telecommunications systems, skyscrapers and long-span suspension bridges, safe airline travel, dependable motor cars, electrical power on tap, and computers which are changing the very fundamentals of health services as well as business and communication.

Kavanagh quoted Kieran McGowan (IDA) as saying that "Ireland is on an irreversible move higher up the value chain as a skills economy. This brings with it an unrelenting demand for ongoing enhancement of the physical and technological infrastructure and the need to expand the range and level of skills in the labour force". The evidence is everywhere around us. Companies with household names throughout the world have established operations in Ireland and continue to expand those operations. These companies are world-class players in such areas as information technology, software development, high-value electronics, instrumentation, pharmaceuticals, medical devices, and chemicals. These in turn have given rise to world-class indigenous companies that now confidently seek new global markets.

Kavanagh believed that one of the most prominent contributors to Ireland's success was its 70,000 highly-qualified engineers and engineering technicians. The rapid growth of the new multi-national industries had been matched by an equally remarkable increase in the numbers of engineer and technician graduates from our colleges. *'The capability and engineering know-how of well qualified, skilled and competent professional engineers and engineering technicians are, I believe, at the very core of Ireland's success to date'.* Kavanagh said that much public debate now centred on two issues. The first is how will Ireland manage to keep its competitive edge as we move more and more to a knowledge-based economy? And the second is how will we continue to attract world-class companies to our shores?

Gaps have already been identified in our national infrastructure and will increasingly militate against companies locating in regional areas and will increase pressures on infrastructure in urban areas. Another national concern is Ireland's preparedness to take advantage of the information age. Government's responsiveness and initiatives here have been impressive. However, today's success is threatened by a growing shortage of engineering professionals. Kavanagh noted that we needed to ensure that we would have an adequate supply of high-calibre professional engineers and technicians into the future. Equally important, in his opinion, was investment in the continuing development of the competence and skills of our present engineers and technicians.

What of our plans for tomorrow? How will we ensure our continued professionalism? What are the factors for our continuing success as key contributors to our society's well-being? And how can our Institution help? To this purpose our Institution, in common with many other engineering Institutions round the world, has been critically examining itself and its activities. The Institution's strategic plan was adopted in June 1998 as *The Corporate Plan 1998-2003*.

The new guiding vision within the Corporate Plan for the Irish engineering profession was defined as: "Professional engineering shaping modern society through the pursuit of world class standards of safety, performance, quality and environmental awareness". Out of this vision came the five goals of the Corporate Plan, namely:

- Promoting excellence in Irish engineers;
- Setting and maintaining professional standards;
- Raising external awareness of engineering issues;
- Enhancing services to members; and
- Management of resources.

Under the first goal a submission had been made to the Irish Council for Science, Technology and Innovation in which a case was made for a new national vision of research and innovation to be developed and shared by government, industry, educationalists, scientists, the engineering profession and the public. This submission stated that one of the reasons for the low prioritisation of research in our country was that it was seen as a discrete academic and mainly scientific activity, rather than as a continuum in an innovative chain that, in many cases, links directly to the application of engineering technology through to cost-effective production processes, products and services. This chain could be described generally as commencing with scientific research, leading to pilot-plant production, process design, implementation, and finally feedback. Most of these activities drew on engineering technology and involved the engineering profession in researching, designing and managing the delivery of new products and services. The bottom line was that the importance of having talented professional engineers and engineering technicians working throughout this national innovation and development chain could not be overstated.

Kavanagh considered that as a knowledge-based economy Ireland must develop a pervasive ethos of excellence in research and innovation. To do this we must capture the imagination and the hearts of our young citizens. He strongly advocated the building of a new National Science and Engineering Centre - as a bold statement of our confidence as a nation in exploring the discovery of knowledge and innovation. It would impart to children a sense of the potential of Science and Engineering to serve society and to change the world. The second goal identified the crucial issue of developing and maintaining the competence and relevancy of skills of both present and future engineers and technicians, the development of a planned framework of CPD being a key national issue. The Institution for its part was at present developing a new and more pro-active CPD policy and framework.

Kavanagh said that possibly the most innovative aspect of the Corporate Plan was the third goal - raising external awareness of engineering issues, i.e. marketing the profession. Regarding the remaining goals, he felt that *'services to the membership must always be relevant, timely, and delivered efficiently. In order to ensure that*

engineering continues to be "the key profession" we must ensure that the range and depth of our skills beyond core competencies meet the demands of today's world'.

Modern business structures were increasingly dependent on information and communications technology. It had always been the case that management was an integral part of the engineer's function - management of the processes of manufacturing/construction/producing, including human resource management. It was still the case that engineering training begets good managers. Engineering graduates are attractive to management and banking companies on account of their problem-solving techniques and their numeracy. It was also the case that more colleges were increasingly responding to demand by offering engineering courses in marketing, corporate finance, and communications skills and, when this was combined with a strong argument for incorporating a liberal arts content into the education of professional engineers, the case for a five-year degree programme, as had been argued for some time by Finbar Callanan and others, had become even stronger.

Kavanagh said that *'Another skill area that we as a profession need to develop and mature our relationship with is software engineering'.* Professor Kevin Ryan had argued cogently that, subject to the development of a core curriculum and the definition of an agreed body of professional knowledge, software engineering should be a fully acceptable branch of professional engineering. In that context a Memorandum of Understanding had recently be signed between the Institution and the Irish Computer Society. On a general point, Kavanagh believed that as engineers we needed to be increasingly conscious of the societal responsibilities attaching to our actions. Professional engineers will need to have skills which include stronger interpersonal skills and more in-depth knowledge of politics, economics, history and geography in order to deal effectively with the huge range of issues confronting a world increasingly dependent on engineering.

Kavanagh then commented on the growing tendency, which he found disturbing, for the word "engineering" to be discarded in favour of "technology". He said *'You may well say that what is meant by technology is basic engineering. But if that is the case, why do we stand by as our work is rechristened? It is belittling of professional engineers and engineering and it undermines the drive to create for professional engineers a stronger sense of identity. It is a serious mistake to believe that words and definitions do not matter. A major problem for the profession is the lack of public understanding of what professional engineers do, and, even, of who we are: it's not that we have a bad image - we simply have no public profile at all. Most importantly, the very future of our profession - on which our society depends - itself depends crucially on the issue of young people's perceptions of professional engineering'.*

The third goal of the Corporate Plan was a vitally important objective, i.e. to create the circumstances whereby the work of professional engineers and technicians was better understood and appreciated by the public, by government, by first and second-level educators and parents, and by others. Kavanagh continued*: 'I know that many of us look on the term "branding", and indeed "marketing", as inappropriate for applying to the providers of professional services. I do not like them very much myself, but branding is a sine qua non of marketing and while we may not like the terminology, I believe we must deal with the concept of branding whether we call it that or something else. The problem as I see it is simply put as follows: 'It is pointless presenting the accomplishments of our profession as the work of engineers when the very word engineer does not mean the same thing to us as it does to the public. As identifiers/labels the words "engineer" and "engineering" are unfortunately too generic and too broadly defined for us to recapture and tame them to mean Professional Engineers and their work. Each of us subconsciously acknowledges this when we are describing what we do, we qualify "engineer" with "civil" or "mechanical" or "chemical" or "consulting". But this surfeit of adjectives confuses rather than enlightens'.*

Kavanagh believed that there needed *to* be an effective, restricted brand name before any effort to promote us or our work would succeed in the public arena. He continued: *'In Ireland we already have a statutorily protected brand name in the title "Chartered Engineer". It is not appreciated widely enough, even amongst our own members, that "Chartered Engineer" is a legally protected title and may not be used in the Republic of Ireland by*

anyone unless registered with the Institution of Engineers of Ireland. To have such a legally protected title and not use it forcefully as a brand name is simply nonsensical'. [The Institution in 2000 adopted the marketing brand name of *Engineers Ireland*]. He noted that the Institution had adopted the policy of persuading its chartered members to consistently use their full title of Chartered Engineer, not the abbreviation CEng. The aim was to use the title to create an awareness that Chartered Engineer is the definitive, autonomous , internationally recognised, title in Ireland for the registered professional engineer.

Kavanagh concluded:

'We need to create a climate where all engineering professionals want to be registered as such, where their professional title (not just letters after their name) becomes relevant to them in their everyday work and they wear it with pride. And we need to create a climate where employers and others know that "Chartered Engineer" and our other registered professional titles are the quality-assured brands of engineering competence and reliability'.

In 1999, **Jane Grimson**, the first female president of the Institution, brought us rapidly from the stone age to the information age in her address entitled *"To engineer is human".* She opened by saying that engineers had played a key role in getting us from an agrarian and craft-based economy to one that is increasingly dominated by digital machines, but it was becoming clear that the role of engineers in society was changing and that we as a profession must adapt to and, where appropriate, drive that change.

Prior to the Industrial Revolution in the 19th century, engineering was largely craft-based, relying on common-sense, skill and experience, rather than the application of scientific principles. While engineering is often loosely defined as applied science, it was not one-way traffic. Scientific discovery lead to engineering applications which in turn lead to further scientific advancements. In engineering science one is given well-defined technical specifications and uses basic engineering and scientific principles to produce a result. This result will be the same regardless of the context in which it is done. Grimson noted that we all recognise the importance now more so than ever before of giving students a good solid foundation on which to build in the context of an ever-more rapidly changing world. She then asked '*What then are the challenges which we face as a profession as we try to realise this future?*'

Jane said that she chose the title of her address to highlight what she saw as one of the major challenges facing the engineering profession at the end of the 20th century - namely the need to increase the focus from the scientific and technical to the human, societal, environmental and business side of engineering. She saw engineering lying at the interface between science on the one hand, and society on the other. It was concerned with the systematic application of scientific and mathematical principles towards practical ends for the benefit of people.

During what some regard as the Golden Age of Engineering (1850-1950), the contribution of engineers to economic prosperity, improved public health, mass transportation, and quality of life generally was widely recognised. It has been said that through the provision of clean water and improved sanitation the civil engineering profession contributed more to the promotion of public health and increased life expectancy in the last century than the medical profession.

Grimson felt that there was no doubt that engineering suffered from an image problem. It was not that engineers had a bad image, but rather that they had no image at all. There were obviously many reasons for this but in some measure it could be attributed to the fact that until the advent of electronics, most technology was mechanical. It was possible for users to have some understanding and appreciation of how things worked. Today, however, technology had become increasingly complex and virtually inaccessible. It could be argued that the essence of good engineering design - something that is "well-engineered" - is that the technology, the mechanics

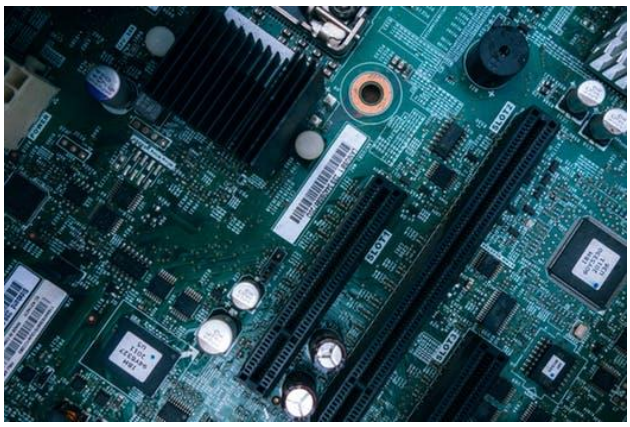
of how the device works, is invisible to the user. Compared to engineers, scientists are much more acutely aware of the importance of the public promotion of their work.

On education, Grimson commented: *'Having overcome the problem of getting bright young people to consider engineering as a career, it is important to ensure that they have made appropriate subject choices at school and here there is a major cause for concern. Science - apart from what might broadly be termed Nature Study - does not form part of the standard primary school curriculum.'* At the secondary level, there had been a dramatic drop in the number of secondary school students studying Physics and Chemistry to Leaving Certificate level. The perception appeared to be that these subjects were hard. Apart from a good understanding of the physical sciences, the aspiring engineer needed to have an opportunity to question and to explore different solutions and approaches - to learn by doing.

Ireland was currently enjoying unprecedented economic prosperity accompanied by improved quality of life for the majority and falling unemployment. This was due in large measure to the strength of the engineering and technical workforce. There were many forces at work which threatened to slow down growth. These included the accelerating speed of technological change, globalisation, little or no research infrastructure to support innovation, and, arguably the most critical issue of all, the threat of a severe shortage of qualified engineers.

To remain competitive organisations, Grimson felt they would have to adopt a new style: collaborative, team-based, multi-disciplinary, and less hierarchical, with more employee involvement, in an attempt to maximise profitability and reduce costs. Employees and leaders, particularly the engineering and technical staff will require new, more people-oriented skills in order to adapt to these new working practices. Hence the ability to communicate effectively and to work with others - both technical and non-technical - is increasingly highly valued in our profession. As engineers are encouraged to take more responsibility there is a need for them to develop business, financial, marketing and management expertise.

Grimson continued: *'In the knowledge-based economies of the future, competitiveness will depend on ensuring that engineering and technical staff in particular keep updating their skills to exploit the latest developments in science and technology. It is, therefore, very timely that the Institution has recently launched a new Continuing Professional Development (CPD) policy'.*



She felt that in such a rapidly changing global environment, the ability to innovate and to exploit the latest scientific and technical knowledge, was critical. This required an industry culture in which Research and Development were seen as an integral part of securing their competitiveness, profitability and indeed survival into the future. Government support for research in the universities and third-level sector generally had also been inadequate and significantly below other countries in the OECD. However, she considered that it was encouraging to see that this was changing. The recently published National Development Plan stated clearly that "there is a strong link between investment in the research and innovation base of the economy and sustained economic growth". The Plan proposed to meet these objectives, including increased support for R&D in educational and research institutes, incentives for industry to engage in R&D, and the establishment of a major Technology Foresight Fund. The fund was initially to be targeted at the two key areas identified by the Foresight report - namely Biotechnology and Information and Communications Technology.

Turning to the issue of women in engineering, Jane commented that, compared to other professions such as medicine and law, where women and men were fairly equally represented, engineering in Ireland as elsewhere

lagged a long way behind. She said that there was evidence to suggest that girls were still not considering engineering as a career. Grimson continued: *'It is not that girls view engineering as a male profession and positively reject it, but rather that they do not consider it in the first place. This further reinforces the view that society has little understanding or appreciation of what engineers do. The absence of a significant number of young women in the profession to act as role models exacerbates the problem'.*

The initial solution therefore is to raise the profile of engineering among society at large. The second problem is concerned with access. Even if they are interested in pursuing a career in engineering, girls have to be able to study the appropriate subjects at secondary school - honours mathematics, physics and chemistry - to be eligible. Jane felt that it was alarming that even today 25% of pupils in all-girls schools leave without ever having studied a science subject. Engineering is arguably one of the most creative professions, and research from across the world has shown that teams are at their most creative and innovative when they are composed of people from diverse backgrounds, skills and experience. *'Like the gene pool, we need diversity to ensure that a community is vigorous and thrives. Men and women bring different perspectives to engineering design and problem-solving'.*

In conclusion, Grimson quoted from the Institution's Corporate Plan 1998-2003: "The engineering profession has a long and proud tradition in Ireland. For more than 200 years, Irish engineers have played a major part in developing our country and giving practical shape to the visions and plans of our leaders and entrepreneurs together with their own". In order to ensure that engineers continue to play a key role in shaping and sustaining the future we need, as a profession, to pay more attention to the human, societal and environmental issues by:

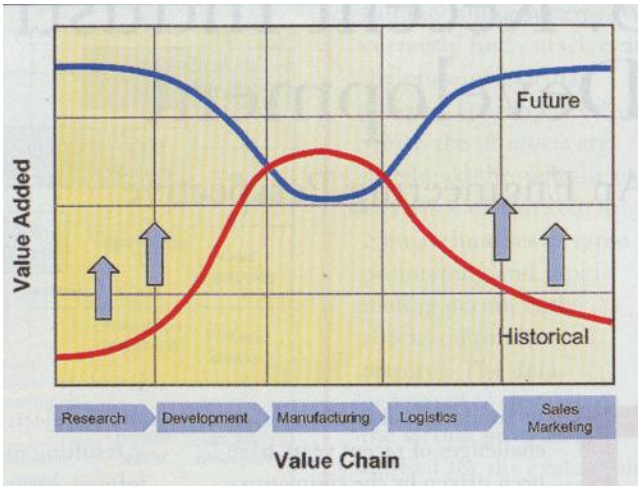
- becoming more visible by participating more actively in discussions about technology, the environment and the development of our infrastructure;
- raising the profile of engineering in society and increasing awareness generally about what engineering is about;
- promoting engineering as a career among both girls and boys in primary and secondary schools,
- and developing a commitment to professionalism, life-long learning and continuing professional development.

Grimson noted that plans were underway for the Institution to take a leading role in a comprehensive campaign to promote engineering as a career. The raising of public awareness of engineering and the active involvement of engineers in public debate were longer-term goals, but she felt that a start had been made. She ended by saying:

'We must be proud of our contribution to society and not sit back and allow others to take the credit. We have reason to be optimistic (certainly not complacent) about our future. How effective we are in providing a quality service depends primarily on ourselves. So as a profession, we are all charged with contributing to the debate as to how to carry engineering into the new millennium - and then acting on our own advice'.

In 2000, **Gerald Byrne** delivered his presidential address entitled *New Challenges through Technological Development - A Vision for the Future of the Engineering Profession*. Byrne began by saying that the profession of engineering had developed significantly in recent years. The rate at which new products were developed had never been as great and life-cycle times were continually reducing. There were now many examples of companies setting up in the new technology areas and growing into multimillion euro organisations over a short number of years. One common feature of many of these successful companies had been the significant input of engineers and technicians and the shift from manual operations towards the knowledge-driven organisation. Areas such as bioengineering, medical devices and microsystems technology were rapidly emerging. The implications of such development for the engineering profession were wide-ranging.

He next considered the historical development of engineering and reviewed more recent technologies. He noted that tremendous strides had been made in the development of engineering materials and that the advantages of the application of newer materials to our engineering systems could be most significant. As a result of the accuracy of microsystems in parallel with the increasing speeds of our engineering systems, significant development had taken place in the capability of our systems to produce very accurate components. An increasing number of companies in Ireland make use of technologies operating in the micron and nanometre range of accuracy. Another important trend in engineering had been towards micro-systems and miniaturisation. Byrne reasoned that surface engineering had become a central issue and the understanding of surfaces and their topographical and physical properties had become vital. A gradual shift had taken place towards computer-aided solid modelling and computer-aided systems had moved from being an aid to 2D drafting to finding use as full modelling systems.



Byrne believed that the fundamental structural challenges of recent years had been driven by the competitive necessity to accelerate the pace of technological development and innovation. It had become essential to implement engineering processes which enhanced quality, reduced costs and improved the quality and range of services offered. This was being achieved by reorganising management structures and working procedures within company operations. Historically, we had not been adding value at the R&D end of the value chain to any significant extent. Considerable emphasis was placed on the manufacturing element. At the other end of the chain, the value added in logistics, in sales and marketing and in customer service was also limited. The scenario for the future showed an almost inverse trend whereby the concentration of added value is greater at either end of the chain. Byrne said that, in such a development, our future would be secured with the knowledge base residing within our country.

Byrne felt that one of the most important issues in relation to engineering development was the partnership aspect for equipment design. The equipment supplier no longer works in an isolated manner independent of the end user, but rather has very close collaborative ties. The impact at each stage of production contributed to the overall environmental impact and, as engineers we must be aware of the impact engineering systems have on the environment. Each of the stages from R&D through to design, construction, utilisation, recycling and waste management, represented a data block. The data is generated by knowledge transformation. When viewed in this manner the role of the engineer could be perceived to be one of adding value through knowledge of the fundamental and applied aspects of engineering technology. He noted that ownership of data and security of IT systems and company-specific data had become issues of significance.

He commented that it was evident that the engineering profession in Ireland had changed dramatically in recent years. In addition to technological developments, many other factors had contributed to the change in Irish industrial development including:

• The strong financial EU support for infra-structural development over the previous ten-year period;

• The impact of the multi-national companies in Ireland;

• The more widespread capability in the achievement of world-class standards in engineering and business in Ireland;

• The strong educational system for engineers and technicians which was deemed to be at top international level.

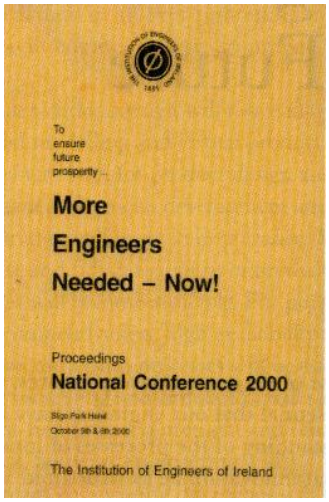
Byrne felt that considerable development was required in our research and development capability in support of ongoing technological development. The Irish economy is critically dependent on the availability of engineers and technicians. He noted that the unprecedented economic development of Ireland in recent years had resulted in a sharp increase in the demand for professional engineers and technicians. A serious supply shortage currently existed and would become even more acute in the coming years if remedial action was not taken. Byrne felt that achievement of the targets set out in a recent National Development Plan for Ireland would critically depend on the ability of engineering faculties and departments in universities and institutes of technology to ensure that there were adequate student places and, perhaps even more importantly, that the places available were filled with top-quality students.

Byrne saw the then shortage of engineering professionals in Ireland as being partly filled by immigrant engineers working on short-term contracts. This supply was also seen as a short-term solution and did not meet requirements across the engineering disciplines and all industrial sectors. In summary, Byrne concluded that one of the most significant challenges facing the profession was the attraction of top quality students into our undergraduate programmes in engineering.

Byrne continued: *'There are very many factors to be taken into account when considering the future development of the engineering profession in Ireland. It is important not just that we respond to change but that in certain technologies we ourselves become the drivers of change. It is vital that we closely monitor international developments and trends. In this regard, benchmarking studies and technology monitoring exercises in engineering to identify new developments and to compare standards are essential. Some very important information concerning the future direction of technology and the changing competencies of engineers can result from such studies. Skills in technology forecasting will thus become essential. Because of the competitive pressures, it is also essential that our engineers have an understanding of the processes of innovation and that innovation be as structured as possible without negatively impacting on creativity. We are still at an early stage in our understanding of the processes of innovation in the engineering context. Focussed research programmes with ongoing monitoring strategies to ensure highest chance of success must be achieved.'*

Byrne considered that the definition of engineering in the future would include "The addition of value to data and or the transformation of data into physical systems through the controlled flow of energy". Communications technology would permit the transfer of engineering data universally. As a result, autonomous engineering systems with local self-analysis and global communication would become commonplace. Diagnostic systems would increase in significance for effective maintenance management. Asset management techniques and systems would become more IT intensive. There would be increasing demands placed on the engineer's competency in the use of communication technologies as well as on his/her own personal communication skills. Byrne also felt that there would be an on-going thrust towards higher precision and towards the application of micro-systems. The engineer would be required to operate in a more open, less defined, multicultural environment where the traditional boundaries both within the organisation and between organisations would shift.

The IEI revised Code of Ethics will take on increasing importance. Each engineer has the responsibility to familiarise himself/herself with the Code of Ethics and to practise in accordance with this code. The lEI has a key role to play in support of the engineering profession in a changing environment. Never before has the engineer and technician required such a responsive, well-developed and focused support infrastructure. The high level of mobility and the trend to shorter-term contract employment demands responsive and new services for the membership from their professional institution. Support for career development in conjunction, with Life Long Learning and Continuing Professional Development (CPD) is growing in importance. The five-year Corporate



Development Plan currently being implemented by the lEI is addressing these issues. The STEPS programme of the lEI, formally launched in November 2000 represents a major step forward in attracting top students into engineering schools. The Government, Forfas and a wide range of industries are actively involved with the Institution in supporting this initiative. Given the critical supply shortage, a major expansion of this initiative was deemed to be required.

Byrne felt that new and highly challenging demands were being placed on the capabilities of engineers and technicians who work to retain the technological competitive edge in the global economy. These demands were a direct consequence of the radical improvement in the rate of scientific findings attributable to focused and results-oriented R&D programmes. The technological challenge facing Ireland was a result of many factors including the serious situation in relation to the available technological skills pool and the perceived lack of attractiveness of the engineering profession both nationally and internationally. The expectations placed on the professional engineer were thus significantly different as compared to five years previously.

Byrne considered that the competencies required by the engineer included:

• Specialist engineering competence with a solid basic mathematically and scientifically oriented technical knowledge and an appreciation of engineering application, sustainable development, environmental considerations, and of project and technology management;

• Methodical competence to implement the specialist knowledge in a constructive and solution-oriented manner with high-quality business process skills;

• System competence giving an ability to identify and think beyond the correlation's which exist outside the limits of one's own particular engineering discipline;

• Social competence with the ability to work and interact effectively with teams in a multicultural environment; and

• Personality to handle the complex issues and the management of others in a competent manner.

Coupled with these, the engineer required competence in information technology, a multidisciplinary approach, mobility, foreign country experience and language. A full competency in the English language was also a fundamental requirement. Finally, the engineer must recognise the importance of and be willing to embrace life-long learning (CPD).

Byrne said that the competencies and skills required of Irish engineers would become more complex and that it was the responsibility of our engineering schools to identify the competency requirements and to equip future engineers with these core competencies. He concluded: *'The challenge we face in the engineering profession is great, the rewards enormous. We can look forward with confidence knowing that the foundations as laid down by our many excellent predecessors are solid and lasting and that our engineers are of the highest international calibre. Engineering is the wealth creator in our economy and will continue to be so into the future*.'

The 2001 presidential address, entitled *Engineering Europe's Fastest Growing Economy - From Industrial Revolution to Spatial Development* was delivered by **Liam Connellan**. He began by noting that engineers had a long tradition of contributing to the development of the Irish economy. This contribution had been channelled through the establishment and operation of manufacturing and service industries and of essential infrastructure on the island.

When what is now the Republic of Ireland achieved independence in 1922, its industry was very underdeveloped and based mainly on agricultural raw materials. The first major policy change was the imposition of tariff barriers in 1932 partly in response to the Great Depression following the Wall Street crash, but also as a means of building up its infant manufacturing base. The imposition of tariff barriers was quite common in small European countries at the time. The protectionist policy was moderately successful and Irish industry achieved a rate of expansion of about 3% per annum until the early 1950s.

The Federation of Irish Industries, later to become the Confederation of Irish Industry, was established in 1932 to represent the interests of the growing manufacturing sector. To ensure that industry remained in Irish control, the Control of Manufactures Act prohibited the setting up of new manufacturing firms with majority foreign ownership. Irish industry did not participate in the strong growth experienced elsewhere in Europe during the post-war expansion. The country's trade balance deteriorated and cash deposits equal to the value of six months imports had to be lodged in advance by importers in addition to customs duty so as to slow down the flow of imports. Some commentators even began to question the economic viability of the State.

Nevertheless, some major initiatives had been taken. As early as 1925, the government had awarded the contract to construct an 80 MW hydroelectric power station at Ardnacrusha on the river Shannon to Siemens Schuckert. Bord na Mona was established to harvest the country's peat resources on a commercial scale for electricity generation. The Irish Sugar Company was established to produce sugar from beet grown on farms and Aer Lingus was established as the national airline. The Irish Cement Company was set up with assistance from FLSchmidt, a Danish engineering company. An Foras Tionscal, later to become the Industrial Development Authority (IDA) was established and was to play an exceptionally important role in attracting inward investment.

It was a happy coincidence that in 1957, when the Irish economy was at its lowest ebb, that the original six member states were deciding to set up the European Economic Communities, or Common Market, by signing the Treaty of Rome. The phoenix of Irish enterprise was to rise from the ashes of despair of the mid-fifties. The publication of the First Programme for Economic Expansion in 1958 set a modest target of 2% growth in the national economy over the following five years and the foundations of modern Irish industry were put in place. The Anglo-Irish Free Trade Area Agreement was negotiated, whereby Ireland would retain Commonwealth Preference for its exports to Britain, and the 40% Irish customs duties on competing British imports would be eliminated in equal steps over a ten-year period. The Agreement came into operation in 1964. During this period the output of industry in Ireland increased by 6% per annum, the highest rate achieved since independence.

In 1973 Ireland joined the European Economic Communities. As part of the entry negotiations, all customs duties on competing products from other Member States were to be eliminated by the end of 1977, and goods from the rest of the world were to be subject to the Common External Tariff, which averaged about 8%. The first year of membership was a boom year for the economy. Then disaster struck late in the year with the restrictions on oil output by the oil producing states led by Saudi Arabia, and a substantial increase in oil prices causing an economic slowdown which would last for three years. The overall result of the first five years of EEC membership was an average annual increase in manufacturing output of 5% per annum. Reflecting this new investment, the output of the modern high-technology sectors increased by 15% p.a.; the food processing and drink sector grew by 3% p.a. In contrast the output of the traditional sectors, which included textiles, clothing and footwear, fell by some 3% p.a. By the end of 1977 Ireland was in a customs-free zone with the other eight member states. Since many barriers remained in the form of different national product

standards, trading and fiscal regulations there was still some distance to go in creating a Single European Market. Nevertheless, the first major hurdle had been overcome with the elimination of customs barriers. Many of the firms from abroad setting up in Ireland created a demand for professional engineers. Shortages of graduate engineers were experienced and the Institution led a campaign to increase the capacity of the third-level institutions to ensure that supply matched demand.

The impact of operating in a customs-free zone of 280 million people took some time to take effect. New industries from abroad were attracted to Ireland in increasing numbers. And there were now over 800 overseas-owned companies in Ireland, of which over one third were US owned. High-technology industries such as computers, micro-electronics,and pharmaceutical and organic chemicals industries, sustained a 15% annual rate of expansion and by 1986 accounted for over 40% of total manufacturing output.

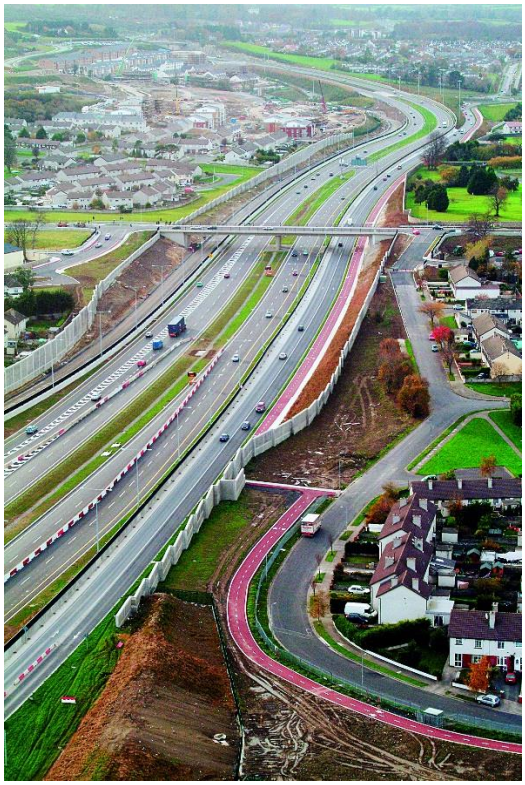
The expansion phase 1987-1992 commenced with the passage of the Single European Act which would create a genuine Single Internal Market. The structure of the Irish industrial base was now sound and a continuation of the previous broad policies seemed the best way forward. In addition, the innovative establishment of the International Financial Services Centre in the Dublin Docklands, with a favourable corporate tax regime agreed with the European Commission, was making a significant impact towards the end of this phase.

The Maastricht Treaty in 1992 set the wheels in motion for economic and monetary union throughout what was now called the European Union. A common currency, the Euro, would be introduced and exchange rate parities with the Euro would be set irrevocably at the end of 1998. Irish industry had consistently welcomed the expansion of the European Union. The excellence of the Irish education system was fundamental to success.

By 2001, the high-technology industries had accelerated their average annual rate of increase in output and accounted for almost 60% of the value of manufacturing output; the food and drink processing and the traditional industries continued to grow at a moderate pace. The total output of manufacturing industry had increased by 12% per annum over the period. The enlargement of the Union in 1995 brought the total population to 340 million. Trade was now likely to develop more rapidly with the Euroland member states as there was no longer a currency risk.

Irish manufacturing production was concentrated in four broad product groups: Organic Chemicals and Pharmaceuticals; Computers; Electrical Machinery and Scientific Apparatus, which together accounted for 72% of Irish exports. These sectors were (and still are) dominated by engineering professionals. Many of the chief executives in these sectors are engineers. In addition, there was a strong reliance on information technology in the international and financial traded sector.

The rapid rate of industrial expansion during the 1990s resulted in a doubling of the total output of the economy during the decade. There were now some 1200 overseas-owned companies operating in the Republic; income per capita had exceeded the EU average; unemployment had fallen to 3.5%; and the population was growing at more than 1% per annum with considerable assistance from immigration. However infrastructural constraints began to emerge in areas such as transport, energy and housing.



Within the context of a spatial strategy for the island, Connellan then commented on some elements of infrastructural development related to present and future needs. He noted that a programme to build 900km of motorways/high-quality dual-carriageways between Dublin and the five main urban centres was scheduled for completion by the end of 2006. These urban highways were in response to projected needs based on the extrapolation of historic traffic volumes. Major projects such as the 6km Dublin Port Tunnel, and the final leg of the M50 C Ring around Dublin had commenced construction.

On the railways, there was a substantial programme of line and stock upgrading underway. Speeds of 150kph were now being achieved on improved sections of the Belfast to Dublin, and Dublin to Cork routes where double lines were in operation. Connellan also noted that a proposed new Metro for Dublin City was scheduled for possible completion by 2010, comprising about 60km of rail [plans not proceeded with at time of publication].

He noted that air travel had been growing at the rate of 10% per annum over the previous decade. Traffic to and from regional airports was increasing more rapidly, and was then at a record level. He felt that there was need for substantial investment in the development of Dublin Airport which was currently at its limit of capacity. He observed that over eight million passengers were travelling by sea annually, and that more than 57 million tonnes of freight were transported annually. Freight traffic through Dublin Port had trebled over the previous eight years.

There was at the time 300km of natural gas pipeline on the island. Demand was expected to double by the end of the decade. There was an urgent need to increase the transmission capacity of the electricity network to eliminate the deficits arising from the doubling in the output of the economy over the past decade. The time had come for security, competitiveness, and trading reasons to give serious consideration to an East-West interconnector from the Republic to Wales. This interconnector would complete a loop from Scotland to Northern Ireland via the North/South interconnector to Wales. In this way Ireland would become part of a larger European grid and would have the capacity to buy or sell competitively-produced power to and from this grid.

With regard to the environment, it was suggested that an integrated approach to national waste management was required. A comprehensive programme of waste minimisation, recycling, recovery, treatment and disposal of waste materials was planned for implementation. Some 80% of the effort would be on prevention, recycling and recovery.

Connellan noted that information technology had transformed society over the previous decade. It had meant the death of distance, and reduced the disadvantages of our island location. Some of the largest companies in the world, such as Microsoft, Hewlett-Packard, IBM and Intel, had production operations in Ireland. A universally accessible broadband network was required together with very high-speed international links for users. Already the penetration of mobile phones amounted to 65 per

hundred of population, one of the highest in Europe. The next big step was to install and operate a 3G network which would enable voice, data and visual images to be transmitted to the next generation of mobile phones.

Connellan concluded his address with these words:
'The pace of change continues to accelerate. The need for engineers is greater than ever. A high-income economy needs to produce higher added-value products and services. Our aspiration must be to continue our climb up the international value-added ladder, and to play an ever-increasing role in the global industrial community'.

Brian Kearney, in 2002, took as his theme *The Engineer as an Entrepreneur and Manager*. With his extensive experience gained in a long career in project management, Brian was eminently placed to deliver his thoughts on what makes a successful project engineer. The following is a brief synopsis of Brian's presidential address and, in common with the other addresses, cannot begin to do justice to the full address, which may be found in the Transactions or Annual Reports of the Institution.

Having spent twelve years with Irish Cement, in 1974 Brian co-founded the Project Management Group (PM), which had by then grown to be Ireland's largest engineering design and project management company. Kearney said: *'I firmly believe that every entrepreneur is driven by a mixture of motivating forces, and that the mix is different for each person. I also believe that many of these forces are not apparent at the time of starting a new business, and it is only in retrospect that I can describe those forces which motivated me and Jim Walsh (Project Manager of Irish Cement's Platin Project) to set up a project management business'*. Ireland in the 1970's was experiencing the first period of significant inward investment and economic growth since the foundation of the State, and the potential for new business in the construction sector seemed limitless.

Kearney recalled: *'We believed also that, because we had, as clients, engaged the services of consultants to carry out engineering design, and contractors to build the facilities, we knew all about the inner workings of the businesses. We had thought, in our ignorance, that we could mirror the large international companies and work as consultant and contractor, but in the narrow Irish market of the time it became clear that we could be only one or the other. Since our skills leaned more towards project management and design rather than contracting, we opted for the more suitable role and shed our contracting ambitions'.*

He recollected: '*Prior to the establishment of PM, I worked for a company which was a client and which used the services of professional organisations. The needs of the client have always been paramount to us, because we could not understand why it should be any other way. From the start the service culture of PM had the goal of building long-term personal relationships with our clients'*.

He continued: *'From the start there has been an ethic of hard work by all, and of getting the job done no matter what time it takes. There can be no such thing as all work and no play and I was very heartened to hear one of our younger engineers, on a CD made to encourage graduate recruitment, describe PM as a company that "works hard and plays hard". We set out to hire and retain the best people, and set high standards for everything that we did'.*

In 1991 the company initiated an intensive campaign on Total Quality Management (TQM) and in the course of the TQM process developed a Company Mission Statement which was prominently displayed in its offices. One of their senior executives produced a True Mission Statement, which he felt gave a more accurate view of the company culture some fifteen years after the Company's foundation.

Kearney saw PM as having gone through four phases of growth, which he called

- Early Entrepreneurial

- Hitting the Wall
- Back on the Tracks
- Riding the Tiger

Kinsale Gas Field

PM's first big break came in 1976. Marathon Petroleum, who had been drilling offshore Ireland for some years, discovered the Kinsale Gas Field and in 1976 began the engineering and project management work to bring the field into production. Marathon were under no legal obligation to use any Irish goods and services. PM formed an alliance with John Brown and were given three of the 114 positions on the project management team for the first of two gas platforms. Their relationship with Marathon grew, and when the centre for the project management of the second platform shifted from London to Cork, Marathon decided to perform the work themselves.

Because of the strong rapport with Marathon, PM selected the support engineering and project management personnel exclusively from their own staff. Staff numbers grew in that period from six to fifty.

1978 saw a shift of focus towards the pharmaceutical sector and the establishment of a Cork Office. By the end of 1987, the Irish market had begun to recover, and PM's numbers had grown to 120. Three senior managers from Foster Wheeler, the international engineering contractor, visited the Cork office to form a joint venture with PM. The volume of business grew in both Dublin and Cork through pharmaceutical projects in both locations, and through the design of the Ireland- UK gas interconnector pipeline. The increased design work quickly indicated that PM's systems were not adequate to ensure best quality work. Accordingly, in 1992 an ISO 9000 initiative was launched, and ISO 9000 certification achieved in June 1993. "Riding the Tiger" (1994-2000) resulted in the management of many other projects, notably the design of the IBM Technology Campus at Mulhuddart. Major healthcare projects for Boston Scientific and Johnson & Johnson followed, together with many other pharmaceutical projects.

Kearney commented: *'It is rare for a small company to grow without forming alliances along the way. PM started as a minuscule company without any track record, and it was inevitable that we would have to work with others in a sub-contracting role, or where we each had separate contracts with the client. In all cases the client expected us to co-operate with our partner to achieve the client's objectives, and did not want to hear about any rows between the parties'*.

'In working in alliance with companies one hundred times our size, there was a great risk of being side-lined, but our people skills and client focus meant that we invariably developed a good rapport with the client's local management. This usually meant that our position was secure for future work. We were often invited to join with a foreign contractor at tender stage to provide the token Irish presence, but we always tried hard to make our input meaningful. In working with these partners, our people learned many specialist skills, and we absorbed the best of our partners technical and administrative systems'.

'In approaching all agreements it is critical to write down the services each party will provide. I believe that each party should be rewarded on a similar basis, e.g., an hourly rate for the time and skill level provided. To avoid conflict later, there should be no global overhead charge in the alliance from either party, and performance bonuses, where relevant, should be shared in proportion to the man-hours put in by each party. We usually nominate a PM senior manager as our sponsor for each alliance relationship, and we have helped to anticipate and minimise any problems through regular sponsor meetings with our partner and jointly with our client'.

On the question of leadership and management, Kearney said that creating the culture of an organisation was a very complex task. He strongly believed that the major duty of the leader of any business organisation was to influence the key elements of company culture, and to guard these elements. He added that the core values of PM were to deliver quality Irish services, to give excellent customer service, to have respect for all our people, and to mix hard work with some play. The greatest threat to these core values came in the form of short-term thinking, sometimes triggered by client demands, which encouraged people to cut corners.

Kearney stressed that *'A chief executive who says one thing and does another will persuade no intelligent group. It is absolutely vital that a leader believes in what he says on all major issues and is seen to practise what he preaches. It is also important to be consistent, although not to the point of inflexibility. I believe that people take comfort from knowing where the boss stands, and this knowledge gives a greater sense of purpose and direction to people in all organisations'. 'A smart chief executive should realise that he is heavily reliant on others to achieve any result. In the first instance, it is important to build a good relationship with all direct reports. It is important to get a fix on their personal skills and interests, their sphere of knowledge, and on the time that they have currently available to carry out anything asked of them'.*

Kearney said: *'I strongly believe that in a people business, Management by Walking About is as relevant now as when the concept was first expounded. People need to see the chief executive and other senior managers to feel that managers are taking an interest in what people are doing and saying. A chief executive must be ruthless in controlling his time. There are many aids to time management, but the simplest and most effective that I have used is to prepare a monthly "time and objectives plan". It is more correctly called an "objectives and time plan", in which I set out the major objectives for the month ahead, and allocate the time to match those objectives. The alarm bells should ring when uncompleted items are being transferred at the end of a month to the subsequent month for the third or fourth time'.*

Kearney said that he had always believed that good communication was the most underestimated management tool in modern business, and that the absence of good communication was often the major reason why companies did not achieve their full potential. This was particularly true of people-based organisations such as engineering service companies or even professional institutions.

He continued: *'Remarkable as it sounds, many projects are undertaken today where the scope of work is not written down at the time of award of the assignment. It is essential that an Agreement with an attached Scope of Work be signed as early as possible into the project. As change happens on all projects there should be a clear change procedure in place, structured to suit the client's approval procedures'.*

'For new clients we look for client's published annual reports and other corporate information, and photographs which gives an indication of the style of facilities elsewhere. We also press for our project team to be allowed to visit these facilities particularly to learn about the mistakes in design and layout that they would not want repeated. We ask in advance for the client's organisation structure and, if documented, for the approval limits for each level of their organisation. The formal structure will not always tell where the real power lies, but it takes time and patience to learn the more important informal structure and style of any client organisation'.

Kearney felt that a project manager must have the same capabilities as all managers. Ideally, he should be a good organiser of people and systems, be a good communicator and motivator, should have commercial and technical strengths, and have previous experience of similar projects. Most project managers would not have all these abilities, he said, and PM normally selected a project sponsor whose competence balances those areas where the project manager still needed development.

Kearney ended by referring to the immediate challenges facing the Institution, viz: the completion of the current 5-year Corporate Plan which concluded in June 2003. (This was a remarkable Plan in that 90% of the specific goals and targets had already been achieved). He noted that a number of significant initiatives had come to fruition as a result of the Plan. However, the success of the Plan had thrown up new challenges. Although

membership of the Institution had increased from 6000 in 1990 to 21,000 in 2002, the Institution represented less than one-third of all engineers currently working in Ireland, so there was great potential for further membership growth.

The Institution's Continuing Professional Development (CPD) programme had made a good start, with over 100 organisations signed up to the CPD protocol and twenty first-rate companies fully accredited. Extra guidance and assistance would be required for many organisations in the public and private sectors to get their administrative personnel training systems in place to secure their accreditation.

Kearney felt that the engineering profession must also demonstrate the essential contribution of engineers in the development of society and lead the way forward to a sustainable and prosperous future. He considered that there can be no better way to attract the youth of Ireland into the world of engineering.

Peter Langford, in his address in 2003, dealt briefly with the historical context of engineering, sketched the current contribution of engineers to economic and social progress, assessed the major challenges facing society and discussed the role of the engineering profession in meeting those challenges.

Langford observed that *'increasingly, we find ourselves working with other professionals in collaborative teams when discharging our mission. As the range of engineering disciplines and specialisms has expanded, so too has the degree of overlap between engineering and other professions. This requires us to continually adapt and broaden our horizons into the social and economic areas, frequently taking leadership roles previously unfamiliar to engineers'.*

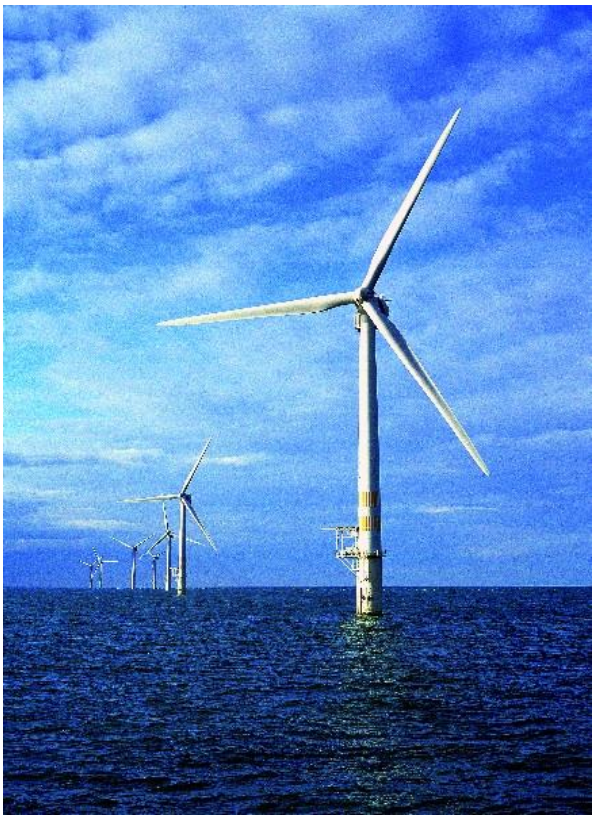
He continued: '*We may sometimes wonder whether we have actually made progress and improved the lot of mankind in moving from one generation to the next. A few key facts, however, leave us in no doubt that we have moved significantly in a positive direction, despite some setbacks'*.

The contribution of the engineering profession, for example through the provision of clean water and sanitation, has been an essential and intrinsic element in the development of the twenty-first century world. To ensure that normal life goes on each day, a huge number of engineers and technicians play the role of unsung heroes: keeping our water and wastewater systems functioning properly, collecting our waste and ensuring its proper disposal, ensuring our transport systems operate satisfactorily, providing the energy to meet working and domestic needs, maintaining and improving communications services, and monitoring, controlling and improving environmental performance.

It is in the area of communications that engineering innovation has been at its most effective in linking people globally. With the arrival of the internet we now have a highly competitive global communications system that provides widespread benefits and opportunities for rich and poor alike.

Another area where engineering innovation has led to major improvements in quality of life is that of healthcare. A notable feature has been the essential collaboration between engineers, scientists and the medical profession, spawning a new branch of the profession called biomedical engineering. The challenges for engineers are twofold: actions are required to halt and, if possible, to reverse climate change, and, because of the long-term nature of corrective action, the need to plan for the inevitable changes already in train.

Much of our concern about the future revolves around ongoing threats to our environment, depletion of natural resources and the fight against poverty. The most publicised issue to be addressed in seeking a sustainable future is that of global warming.



Langford opined that the significant depletion of fossil fuel resources by mid-century required us to address the issue as a matter of urgency. *'The three areas in which the engineering profession can exert the most influence are: innovative design of buildings, products and systems to minimise energy usage, development of new energy sources, particularly renewables, and invention and development of new technologies that enable the efficient and equitable management of energy usage'.*

The search for alternative energy sources is being pursued worldwide with particular emphasis on wind, solar and wave power as well as biomass. Wind energy appears to be the best option for Europe, and particularly for Ireland. Developments in solar energy have generally been on a different scale to those in the wind energy sector, but are no less exciting. They have tended to relate to specific project uses rather than producing major quantities of electricity for the national grids.

Regarding transportation, Langford commented that *'In Ireland, we are faced with a situation where car ownership levels have increased very significantly in the last decade and yet are still below European levels. We also have a high level of car usage, in part at least, due to the underdeveloped state of our public transport network. While we have network improvement plans in place as well as plans to improve public transport, we must also think in terms of twenty, thirty or even fifty years hence. It is becoming accepted now however that we cannot continue to provide untrammelled freedom to car users'.*

Water supply will pose major problems for us all over the next few decades. Water can no longer be treated as a free commodity with unlimited supply. The situation is best summed up in the opening words of the EC Water Framework Directive: "Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such". Engineering innovation and action can lead the way by developing systems which harness and use our rainfall resources more effectively and also ensure that wastewater is re-used or disposed of in a sustainable manner. Improving technology will also allow for greater monitoring of water usage so that appropriate incentives or charges can be put in place readily to minimise wastage of a precious resource.

For those in the developing world it is now a global priority to accelerate efforts to remedy their appalling water supply predicament. The engineering profession will play a key role in providing solutions based on appropriate technology, educating and training local communities to maintain and develop their systems and providing support until they attain self-sufficiency. A further area where the engineering profession is becoming increasingly involved is in the provision of healthcare. Many of today's advances in medical diagnostics and treatments are available through the collaboration of the engineering and medical professions.

Meeting future challenges successfully will rely heavily on innovation and technological development. Further exciting developments in communications and information technology will undoubtedly lead to major improvements in productivity and competitiveness. Langford commented that we can only avail of these opportunities, however, with a plentiful supply of highly qualified engineers, scientists and technologists and increased investment in research and development. There was ongoing concern in the industrialised world at the reduction in the number of students seeking a career in the science, engineering and technology (SET) sector

in recent years. A reversal of this trend was essential and would require a concerted effort from government, the academic community and the engineering profession.

Langford said that it was current government policy to increase our competitiveness internationally by upgrading our knowledge and skill levels, as we have moved away from being a low-cost economy. The only effective response to deal with our new position in the economic hierarchy, and still maintain our quality of life and our low level of unemployment, was to invest in our manpower, and in the SET area. The highest quality education, research and innovation and an entrepreneurial environment are essential if we are to become a strong and competitive knowledge-based economy.

He continued: *'The engineering profession plays a central role in industrial development, in the provision of infrastructure, in education and in innovation, which brings with it a particular responsibility in meeting the challenges ahead. These challenges must, however, be approached in a positive manner and viewed by us as an opportunity to use our unique skills and expertise to shape a better world. In doing so, and in delivering on the Institution's mission statement, it behoves us to think globally as well as locally'.*

Kofi Annan, the then Secretary General of the United Nations, declared that the biggest challenge of this century was to turn the seemingly abstract concept of sustainable development into a reality for all the world's people. Langford felt that the engineering profession was ideally placed to take on this challenge. He said that '*in our daily lives we must create awareness and promote sustainability among those with whom we are engaged and also in the public arena'*. A key issue to be addressed by engineers was the need to ensure that plans and designs for projects in the future would cater for the inevitable consequences of climate change. A case in point was the predicted change in rainfall patterns which would directly affect Ireland 's water supply regime. To respond to this, the Institution had set up a high-level task force to prepare a submission to government on "Delivering Sustainable Water Services for the Twenty First Century".

On education, Langford said that *'we can only deliver on our aim to forge a better future for society if we have a plentiful supply of suitably qualified engineers and technicians. This is now a major problem globally as well as nationally. It is vital, therefore, that we convey to students the excitement and opportunities offered by our profession, when they are considering career choices. The Institution's STEPS programme has made an excellent start on this journey, but it needs to be expanded to reach more schools and promote the SET sector at junior cycle and primary level. The recent introduction of science at primary level and the Discover Science and Engineering Programme are very welcome initiatives from government*'. He felt that radical changes in engineering education were required if we were to attract more students into engineering courses. The structure and curriculum must reflect the emergence of new specialisms such as biomedical engineering. Greater flexibility must also be provided to allow students to explore alternative career paths as they progressed from general engineering initially, through to specialisation at graduation.

He noted that Ireland had attracted many of the world's major players in the high-technology pharmaceutical, biotechnology and ICT sectors over the last twenty-five years. They had located here because of the competitiveness of our business environment and the skilled manpower available. This development had contributed hugely to our economic and social progress during that period. A cornerstone of this success had been the ability of Irish engineers to adapt and grow in meeting the needs of the new enterprises. Without exception, they had matched, and frequently outshone, their equivalents in the home bases of these companies. The next stage of our growth would not be achieved merely by seeking to repeat our past success. It would require us to foster a greater entrepreneurial culture in our engineering graduates and to develop a vibrant research community, backed by a supportive business and financial framework.

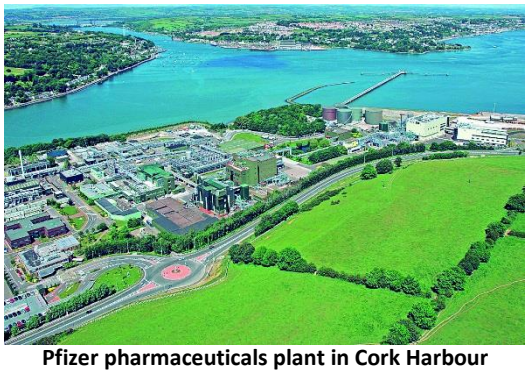
As well as our skills needs, all commentaries and reports on our competitiveness highlight the urgent need to improve our physical infrastructure as a driver of economic and social progress, particularly in the transportation, energy and communications sectors. Delivery of this infrastructure will be effected mainly by the engineering profession, once political and financial commitments are in place. Langford noted that the

Institution had been particularly active in this area, making submissions to government on the implementation of the National Development Plan, on cost estimation and control and on the proposed Strategic Infrastructure Bill. He said that *'we must continue to use our wide range of expertise to advise Government and seek the necessary commitment and prioritisation to ensure Irish society can achieve its full potential'*.

Langford concluded that *'we are rightly proud of our heritage as a profession and have learned much from the past achievements of engineers. If we are to meet the challenges ahead we must continue to learn, we must have courage and we must be prepared to lead. The challenges ahead may seem daunting, but the future for engineers in meeting them will surely be both exciting and fulfilling. We might usefully draw our inspiration from George Bernard Shaw…* "You see things, you say, Why? But I dream things that never were, and I say, Why not?"

Paddy Caffrey, elected President in 2004, had worked for thirty years in the pharmaceutical industry. He saw Ireland as facing strong global competition from low-cost countries and so must adapt to stay ahead. Our goods and services will only be in demand if they offer value to our customers and he continued: '*Our education system has played its part in Ireland's success but now faces the challenge of maintaining interest in the physical sciences at secondary school level. This is critical to ensure that the uptake for engineering courses at third level is sufficient to meet the demands of our economy; otherwise we could see a serious shortage of engineers in the very near future. Such a shortage would be a threat to the economic future of Ireland. IEI has grown its membership over the past ten years and has become an active voice for the profession but it too faces the challenge of understanding how to promote our profession in a very changing world and of being relevant and attractive to the next generation of engineers entering the workplace'.*

Caffrey observed that significant contributors to change had been political developments such as the formation of the European Union, removal of trade barriers and the development of world trade agreements such as GATT, scientific development such as new technologies, new materials, medical discovery, improved communications and the Internet, and mobility and access to low cost economies. He said that engineers had played a huge part in the industrial development of Ireland as providers of infrastructure, and designers, builders and operators of a new industrial base. The sectors that have fared best were those utilising high levels of intellectual property or knowledge capital, such as ICT, pharmaceutical and biomedical industries. He then proceeded to look specifically at the pharmaceutical manufacturing industry, what it had achieved and what lay ahead.
Ireland had established itself as a major pharmaceutical manufacturing location, in global terms, establishing it as a very important part of the global pharmaceutical manufacturing base. The sector was then the single largest contributor to Ireland's exports.



Pfizer pharmaceuticals plant in Cork Harbour

Caffrey felt that pharmaceutical manufacturing had not yet harnessed the power of developing information technologies to dramatically improve its manufacturing efficiencies. The highly regulated environment within which it operated had been a major contributor to the hesitancy of the industry in adopting innovative technologies. At the time, the US Food & Drug Administration (FDA) was looking toward a 21st century-approach to regulation encouraging the adoption of new technological advances by the pharmaceutical industry.

This approach would exploit the already significant installed base of process automation to turn large quantities of data into actionable intelligence. The goal was to move from an unstructured, document-centric paradigm, to a highly structured data-driven environment. As a result, the technology-based manufacturing facilities of the future would deploy software applications that would seamlessly integrate all aspects of the supply chain, from process design, to production planning, to the manufacturing process itself, and finally to distribution.

Other tools for improvement in manufacturing performance in the quest for Right-First-Time manufacturing included:

• Six Sigma, a well-established methodology for achievement of near-zero defects through a framework that defines, measures, analyses, improves, and controls the manufacturing process

• Lean Manufacturing, which has been embraced by much of the ICT industry, as a means of delivering customer value through a relentless concentration on cost and efficiency, and

• Risk Management, a mitigation strategy focused on ensuring that the customer is protected from any hazards that may be created by variability or changes in the manufacturing process.

All of these approaches were well known and successfully operating in many other industries and could enable the pharmaceutical industry to achieve the same high standards.

In March 2000, the European Council in Lisbon set out a ten-year strategy to make the EU the world's most dynamic and competitive economy. This Lisbon Accord is a commitment to bring about economic, social and environmental renewal in the EU. Under the strategy, a stronger economy would drive job creation alongside social and environmental policies that would ensure sustainable development and social inclusion.

Caffrey considered that there were three key players that would have an important role in achieving success. The first of these was our excellent education system, which had been a corner stone of success to date. Secondly, Engineers Ireland must address how best it can achieve its role, articulated by our first president... "engaged in the service of Ireland and it is our duty ... to promote its prosperity to the utmost". And thirdly, our government must provide the leadership and political agenda to convert the many good ideas, reports and submissions into reality.

He continued: *'As a profession, our objective is to produce the right quality and quantity of engineering graduates and engineering technicians to meet the needs of the economy. With our aspiration to become a knowledge-based economy this demands that science, engineering and technology (SET) sectors make a greater contribution than ever before. This requires us to support an education and learning environment that fosters science at an early age and to provide the right facilities, curriculum and motivation for students with the appropriate skills to succeed once they have been given the opportunity'.*

It seemed to Caffrey that teachers, and the education system, had over the years provided the inspiration for students with good mathematical ability to pursue an engineering career and exploit their talent. As our economy expanded and the need for engineering resources grew, so did in general our ability to produce them. Our education system in Ireland has been rightly credited as the key ingredient in our recent economic success. That educational system has changed hugely to keep pace with needs over the period of the last 50 years. For the future, it is vital that teachers, curriculum, and facilities not only match demands of our changing economy but also help create it, as they have done in the past. Industry needs to be given a very strong lead and direction from IEI, with programmes such as STEPS (Science, Technology and Engineering Programme for Schools), which has received great recognition and must be continued and kept fresh and interesting. The curriculum for maths, science, applied science and engineering subjects at second level must be made more interesting and attractive to the student. Caffrey noted that, while huge progress had been made in the past 30 years in supplying engineering graduates to fuel the Irish economy, the engineering profession had failed to attract a proper proportion of females.

A recent OECD report on third-level education praised what had been achieved; in particular, it lauded the achievement in expanding student numbers while preserving quality. It recognised our vision that third-level education was a key driver of the economy. It was seen that the implementation of the Bologna Declaration had been essential to ensure that Ireland produced world-class engineers and technologists. An increase in the

numbers gaining Master degrees in engineering was needed to provide the feedstock required to double the numbers pursuing PhD degrees as recommended in the OECD Report. The willingness and ability to continue to learn and develop one's skills and competencies was recognised as essential to personal development and career progression. The IEI Continuing Professional Development (CPD) accreditation scheme was a recognised vehicle for companies and individuals to chart continuous career development for engineering employees and *de facto* for all employees. The latest IEI Corporate Plan, covering the period from 2003 to 2006, identified its first goal as being to "Position engineering as a leading profession, serving society and creating prosperity through sustainable development". While all the goals within the plan were important, this was seen as the critical one for our future relevance to members and the public and Caffrey proceeded to deal with it in some detail in his address.

A task force comprised of IEI members was established and set about achieving the following objectives:

• To develop, through market research, an in-depth understanding of the current attitudes, perceptions and expectations of key audiences towards IEI and towards the engineering profession;
• To establish the key issues facing IEI and the engineering profession based on an analysis of this market research;
• To determine/articulate the engineering profession's core values;
• To identify an engineering profession brand proposition;
• To develop a marketing/communications strategy and plan based on the outcomes;

The following key issues were identified following a programme of qualitative research:
• There was a need to reposition engineering as a fundamental driver of Ireland's "knowledge economy" led by IEl;
• The poor image of engineers among second level-students was inhibiting engineering as a career choice;
• There was a need to enhance the image of engineering among the general public by connecting the profession with successful high-profile projects and communicating the role of engineers in their success; and
• Students at second-level were more and more influenced by others, such as parents, peers, teachers, guidance counsellors, who may not understand or have misconceptions about engineering as a profession.

Caffrey felt that, despite great work done in recent years, the IEI needed to do much more to provide the right level of leadership to be a powerful voice and advocate for engineering. He considered that the quality of second-level students entering engineering and the quality of third-level graduates was declining. The task force identified three core values that, when combined, gave the strongest representation of what engineering was about viz. Innovation: bringing ideas and designs to life, ensuring their development and implementation; Delivery: committed to making things happen, seeing things through to completion, being solution orientated, and Responsibility: concern for sustainable development, dedicated to safety and security, intolerant of poor quality, hold themselves accountable. Combined, these were seen as the key values and strengths that made engineers powerful creators of progress.

To ensure that there was sufficient quantity and quality of engineering skills in Ireland, the marketing and communications plan needed to achieve these primary objectives:
• Ensure that more students, both male and female, were attracted to third-level engineering study;
• Increase the awareness and motivation of individual engineers and their employers for participation in CPD; and
• Increase IEI membership and participation.
This new approach also involved developing a new brand image for IEI.

Caffrey stated that the report and recommendations of the Task Force on the Physical Sciences and the report of the Expert Skills Group on Future Skills Needs on the Demand and Supply of Engineers and Engineering Technicians, between them, could form the basis of policy for education of our young people, guiding them to careers that would both satisfy them and provide them with the opportunity to deliver an enterprise strategy to achieve economic success. Our education system could only step up to the mark with the right level of funding. In addition, he considered that the government must encourage ongoing investment in lifelong learning, or CPD, so that the workforce could keep up with change and technology development. He felt that government needed to create the environment for investment in R&D through both public and private funding and that it would be particularly important to engage the indigenous small and medium enterprises in the process.

He concluded: *'The scale of R&D in Ireland will always be small in global terms, but this should not prevent us from becoming a leader in return-on-investment performance through good productivity and effective management. As engineers we can be very proud of our heritage, our achievements and our contribution to Ireland in the past'*.

The President in 2005, **Anne Butler** is an environmental consultant and was a founding Director of the Environmental Protection Agency (EPA). She said that her primary aim as President was to promote and raise the awareness and the profile of engineering in Ireland and by so doing, attract more and better students into engineering and to increase the number of women in the profession.

She considered that Industrialisation and subsequent population growth led to environmental problems on a scale with which we had not yet come to terms, but which no doubt engineers could solve. In Ireland, we were far behind on what we should be doing on issues of water, waste and emissions and Anne believed that the three most pressing challenges facing us in Ireland were:

- ensuring sustainable development;
- redressing the infrastructure deficit in this country; and
- putting an end to cost over-runs of major infrastructural investments.

A definition of engineering which she liked was that "engineering is a professional activity that uses imagination, judgement, and intelligence in the application of science, technology, mathematics and practical experience to design, produce, and operate useful objects or processes that meet the needs and desires of humanity."

She continued: *'The hardships and problems caused by the industrial revolution are well known. Those that remain with us, internationally, are global warming and pollution. The solution to these problems will, in the main, be delivered by innovative engineering, facilitated by political agreement'*. Today the modern factory is producing more goods than ever before, better goods, with far less people, with a much cleaner production and using much less resources. However, we have further to go to adapting the benefits of engineering to the environment – particularly in transport, in dealing with waste and in energy. It is scientists and engineers who are measuring the extent of the problems and it is they who will propose the solutions.

Anne commented: *'Some people believe that when we have problems, like a potential shortage of fuel or food or conditions like drought or flooding, a new technology will be rapidly developed which will solve the problem. While they may be correct, in many instances, when they are wrong the inertia can lead to very serious problems'.*

According to the EPA, some of the major issues for the environment today relate to meeting international commitments on air emissions such as Kyoto, water quality and dealing with waste. In addition, the EPA highlights the need for better integration of environmental considerations into the policies, plans and actions of economic sectors.

Waste management is also seen as one of the big environmental challenges for Ireland and there is a significant role for engineers in this area, providing the infrastructure required to manage the waste generated. Engineers will drive eco-efficiency, looking at ways of using fewer resources, reducing pollution and doing more with less.

Engineers are thus finding themselves drawn into areas which can be very controversial. In addition to the engineering professional skills, political skills are also being honed. While some engineers have to be partisan on particular issues where they are working, they must act professionally and ethically.

It is both curiosity and interest in problem-solving that makes for a good engineer. Good engineers are innovative yet responsible as they endeavour to solve some of the most complex issues. Engineering is a great qualification for anyone who wants to work in the electrical, structural, civil, mechanical, ICT, chemical, or pharmaceutical industries but it also provides a great training for many other interesting careers. Engineers, working in many walks of life, are bringing the unique focus of an engineer's training to diverse tasks and using it to positively contribute to society.

In 2003, a study of the demand and supply of engineers and engineering technicians found that while the numbers of engineering graduates had increased markedly since the 1980s, the proportion of engineers in the graduate population had already fallen. The report made a comprehensive list of excellent recommendations which needed to be acted upon and action was already underway on many of these, including the review and expansion of the STEPS programme.

Anne stressed the need to raise the profile of the profession where possible; by showing young people that the profession works in the material world, transforming physical matter from one form to another, more useful, form; that much of the work is visible and tangible; and that it is very fulfilling. She noted that Ireland was maintaining, if not expanding, its share of innovative manufacturing and output was at an all-time high. It was engineers who were dominating software, nano-technology, the new and exciting area of bio-medical engineering, communications engineering, and other emerging service sectors.

Many Irish firms are and have been run by executives who are from engineering backgrounds. Nevertheless, she felt that it was time to promote the idea of the engineer as an excellent alternative choice for senior appointments. If it is assumed that the proportion of engineers in the top management positions in the UK and US is reflected at the lower management levels, the position of the profession is quite good in those countries. The view that accountants dominate is not correct, although those with financial qualifications are very strongly represented. However, many engineers do also have such qualifications.

The fact that most engineers are actually in the services sector (which does after all, make up over two-thirds of all employment in Ireland) does show the great and varied career opportunities for the profession and its broad representation. Anne argued that engineers have the advantage of a longer-term perspective, both from their more technical background and their lower emphasis on immediate financial returns. On the issue of money or reward, it is true that a career in engineering seldom leads to great wealth, but it does lead to a good and often a high standard of living over a lifetime and a sense of fulfilment and of contributing to society.

Anne noted that, since the women's movement began in Ireland in the 1960s, there had been substantial progress. This has been from a very low base where women in Ireland had to resign from public office on marriage as recently as 1973, where men got paid more than women, and women were openly discriminated against in work and by society. The number of women engineers in Ireland had grown from ten graduates per annum in 1975 to 334 out of a total of 1850 in 2002. The acceptance of gender equality and the rapid increase in the participation rate of women in the workforce, which is now higher in Ireland than the average in Europe, and especially the rapid increase of married women in the workplace, meant that Irish women were rightly seeking to contribute more to society and the workplace. She believed that women bring a different, a complementary, view to design, and to the profession. In this way, they can stand equal with men and thus make their contribution. It is recognised that women face additional hurdles to men in many ways. The main burden

of child rearing falls on women, in spite of the support of many men. The profession must recognise and accommodate this so that we can attract the best of women into engineering and we must facilitate them at senior management level too.

The three core values of the engineering profession as defined by Engineers Ireland were:

- Innovation - Bringing ideas and designs to life and ensuring their development and implementation. Engineers are always searching out the fundamentals of how things work and applying these principles to getting things done;
- Delivery - commitment to making things happen. Engineers see things through to completion and are solution oriented. Engineers overcome obstacles and deliver on time at the right cost and quality in the most efficient and reliable way possible; and
- Responsibility - Engineers are concerned for and support future (sustainable) development.
  Engineers feel duty bound to continual and worthwhile improvement and are dedicated to the protection of public health and safety. Engineers have a sense of duty, a professional conscience and a code of honour, expertise (skill and competence) and professionalism (quality standards) are central and important values of engineering.

Anne considered that a core tenet of every engineer is that "if there is a problem - there is a solution" and it is our job to find the best one and to solve it rapidly. The tools have changed but the basic tenets remain. Today, sophisticated computer software helps with the mundane, but the ability to apply solutions is still the hallmark of the engineer. While it is vital that we build better roads linking our cities, a good urban public transport system represents sustainable development. Of course, it had to be a political decision to have an integrated urban public transport system in our cities and Transport 21 was a welcome start. If implemented in full, Transport 21 will mean considerable employment opportunities for engineers and related professions for a long time. However, engineers must play their part in the bigger picture, which is in successful delivery. Engineers will deliver quality technical work, but we must also be aware of the value for money issue. Delays are seldom caused by poor engineering but are due, in the main, to changes in the scope of projects as they progress.

Anne said that it was important to set out the complexity of the reasons for cost over-runs, and she would like engineers to take a different approach. She continued: *'instead of making the usual excuses, let us as a group of the leading professionals in the area of infrastructural investment set out a programme of how infrastructural investment should be handled cost effectively by the major client, the State, or its agencies'.* She noted that the government had introduced a number of Guidelines on Public Expenditure which had done much to ensure that major cost over-runs in infrastructural investment were less likely to occur.

She felt that the public sector had a major problem internally and that it was clear that it was lacking in expertise to supervise major projects. It needed a specialist unit staffed with economists, accountants, lawyers and engineers who would be able to undertake cost-benefit analyses before a major project was undertaken; to ensure that the project was properly scoped and costed; and then oversee its execution, on behalf of other State bodies and Departments, to completion. She felt that these skills were currently absent in the public service.

She continued: *'We have relatively low wealth compared to our high incomes. We have not had high incomes long enough for us to invest and to build up our wealth. There is a major difference between income and wealth and you need time and the processes to invest part of your income in building your wealth, be it public or private. It is the process or the management of investing in our future which needs reform. As a country, we must build our public wealth in first-class infrastructure, roads, rail networks, public transport linking all areas of our cities to each other, modern hospitals, modern schools, courthouses, libraries, recreation and leisure facilities'.*

The Irish economy had seen the fastest catch up with Europe in the Celtic Tiger period from 1987 to 2001, when there was very rapid economic growth and phenomenal employment growth. During 2005, economic growth will have averaged 5.5 per cent compared to an average of only 1.2 per cent in the Euro area and next year looks

promising at 5 per cent growth. Anne continued: *'The outlook is rosy and with such strong growth there will be much work for engineers in every area of the economy. While there are no accurate statistics on this, we are already seeing an increasing number of foreign nationals applying for membership of Engineers Ireland, and I would like to welcome them here to share in our prosperity, to help build a better economy and to contribute to our diversity with their ideas and expertise'.*

Engineers Ireland, with the Irish Academy of Engineers, set up a task force, chaired by Liam Connellan, which produced an exceptional report, "Engineering a Knowledge Island 2020". This report envisaged the island of Ireland becoming one of the top five economies in the world by 2020, in terms of income per capita. In order to achieve this, the report states that we will need to become an advanced, knowledge-based economy, heavily dependent on engineering. Achievement of this vision will need close co-operation between people north and south to develop the necessary economic and skills development. The report looked at our recent history of economic growth and found a close relationship between economic growth and the growth in numbers of engineers .... for every 1% economic growth, there was a corresponding 1.25% increase in the number of engineers.

However, as Ireland lags behind leading countries in its R&D expenditure, and much of our strong performance comes from embedded R&D in the foreign sector which has invested here, our success is not as strongly based as a superficial examination of the economy would lead us to believe. Thus, the role of government, of industry, of engineers and policy makers in increasing R&D spend and ensuring the investment is well spent, is crucial.

Anne concluded her lengthy address with these words:

Engineering drove the first industrial revolution and engineers are driving the post-industrial revolution, with the development of software, miniaturisation, more efficient transport and modern communications. But engineers are also dealing with waste and pollution. Engineering has contributed greatly to solving society's problems, to the immense strides in productivity and to raising living standards to levels undreamt of by our forefathers. Irish engineers will continue to tackle the daunting challenges of modern society and to provide practical and diverse solutions.

In 2006, **Jack McGowan** spoke about *Competitiveness & Productivity.* He began by saying that there was no place in the global economy to hide from the forces of international competition. In 2006, Ireland was seen as an export-focused country and a high-cost economy. The higher cost had to be offset by higher productivity, resulting from capital investment and/or improved or innovative methodologies.

McGowan said that committing ourselves to a sustained drive on competitiveness was a national imperative. *'We have a solid advantage in our lower corporation tax; but this advantage has been eroded in recent years by domestic price rises, and by other countries offering increasingly larger incentive packages. We need to counter this erosion by firstly promoting a greater awareness of this threat to our prosperity. We obviously need an efficient infrastructure, both to enable commerce and manufacturing, and also to support social cohesion. And we simultaneously need to work on our cost efficiency'.*

McGowan continued:
'Two principles underpin any cost competitiveness program: both of which should be key personal attributes for all of us in the engineering profession: Firstly, a commitment to systematic continuous improvement, in other words productivity gains, and secondly, promotion of studied risk taking, in other words innovating. These principles apply equally well to manufacturing, construction, facilities management and to R&D: Continuous improvement needs benchmarking and aggressive target setting; studied risk-taking involves adopting new technology, or devising "out of the box" solutions. The qualifier "studied" is deliberately included to stipulate the need for a proper engineering risk assessment as part of the process; gut feeling has no part to play in studied risk taking!'

He said that facing competitive challenges was not a new situation for us on this island and that we had successfully transitioned from being a low-cost manufacturing and commodity food producer, to being a preferred location for sophisticated manufacturing, services and product development. He stressed that the competitive pressure never stops. *'Other countries use us as the quintessential role model for their on-going industrial and service industry development. Our situation has not been made any easier by a disproportionate rise in energy prices and escalating Euro values'*.

Viewed from the perspective of earlier decades, economic growth in recent years had been unprecedented, and a welcome result from the development strategies of the eighties and nineties. Engineers had been core contributors to this economic growth, and to the improvement in the quality of life and prosperity on the island. National confidence had soared, and with it the entrepreneurial spirit, which in turn had reinforced growth in a so-far virtuous cycle. But the very success of our growth had stretched the infrastructure, despite unprecedented investment in it in the past fifteen years.

A developed infrastructure was essential for a productive and competitive business environment. McGowan suggested that, as a minimum this consisted of:

- A transport infrastructure capable of efficiently distributing goods, people and services;
- Two-hour road access to airports from all parts of the island;
- Readily available utilities and waste services;
- Universally available telephony and broad-band services;
- A world class education sector, which also supports continuous professional development; and a
- Strong sense of social cohesion and political stability.

He noted that there was considerable ongoing investment in infrastructure in Ireland, most of it being delivered by engineers. And there were solid ongoing plans being drafted such as the latest National Development Plan. The challenge was to have the courage and foresight to base the plan on continued aggressive growth, and deliver its scope as early as possible. Imagination, as well as an enhanced focus on the common good, was needed in devising solutions to quality of life issues.

The root cause of commuting congestion on the roads was the limited availability of attractive affordable housing closer to work, and the reluctance of couples to raise families in small high-rise apartment blocks. In other cities people live happily in large apartments in high-rise blocks; but that form of housing had yet to find broad favour in Ireland. McGowan noted that we basically have two options to improve the lot of commuters. The first is the development of integrated communities in our cities and larger towns. There were models being developed for new balanced communities of this type in Ireland. The key is development plans that combine employment, attractive social, affordable and private housing, comprehensive public services, entertainment and well-developed public transport systems. The promise is a fulfilling living environment, proximity to work and thus freedom from commuting hell! Many of the people currently commuting into the city work in offices. Their jobs do not require constant face to face contact with their peers and customers. McGowan asked *'Why could they not work in satellite offices in Mullingar or Wicklow?*' With proper broadband connectivity, there was no reason why people could not "*telecommute*".

Incoming foreign direct investment (FDI) in industrial plants is encouraged, where possible, to locate in the less developed parts of the country, with a view to balancing the growth of Dublin. This pragmatic principle can run foul of under-developed local infrastructure. Sites often require major investments to deliver double-ended power, water supply, connections to waste water treatment plants and other utilities services. Remedying these gaps requires a whole separate set of planning applications and environmental impact assessments, all of which adds to the schedule risk. The absence of a comprehensive waste infrastructure forces us, in many cases, to look abroad for solutions for our waste treatment, and so impacts our competitiveness. Provision of a comprehensive health service was also an expectation of all citizens and incoming investing companies.

McGowan then turned to the issue of cost competitiveness. His role in all location decision making in Intel gave him an insight into the accelerating level of competition for FDI. The advent of globalisation after the Uruguay Round of tariff reductions had produced growth and prosperity in all continents. Countries, particularly in Asia and Eastern Europe were seeking to upgrade their industrial base and to develop their economies. They had benchmarked those countries that they considered to be the best, including unsurprisingly, Ireland. They had determined or surmised some of the reasons for Ireland's success, namely;

- Low corporation tax;
- Education, including English speaking;
- Developed infrastructure; and
- Legal system, independent of government, which will protect their Intellectual Property.

These countries would typically have a cost advantage in payroll and utility costs over Ireland, the latter often because of their willingness to subsidise any tariffs.

McGowan said that his biggest learning in Intel was the relentless drive for competitiveness in all of their facilities services, maintenance, construction and real estate. Their internal customers faced a unique challenge of a product with a declining average selling price; each generation of micro-processor delivered multiple degrees of improved performance for a lower price. This made tight management of costs a business imperative. Their competitiveness program was based on the dual principles of firstly, benchmarking the best in class, internally and, where available, externally, as a basis for setting stretch goals; and secondly, adopting a philosophy of continuous improvement.

Ireland has a long history of attracting capital intensive industries. Each of these location decisions was made on the basis of a set of criteria that included tax, grants, salary levels, skills availability, housing, energy pricing, political stability, corruption levels, logistics and ease of permitting. No location is perfect, but Ireland has always scored well in these assessments. We need to accelerate the creation of an all-island market in electricity, and increase our investment in renewable energy to reduce our dependence on cost volatile fossil fuel.

McGowan, having recently returned to work in the construction industry in Ireland, said that the major focus in recent years had been to successfully deliver on the huge increase in volume of construction. While there were multiple examples of innovation on individual projects, little effort seemed to have been made to systematically improve productivity and broadly adopt innovative technologies. He felt that this would be increasingly necessary if we were to deliver on the government's value for money challenge.

McGowan then discussed some of the technologies that he had personally encountered in recent years, which held out promise of significant productivity gains. Communications had revolutionised working (and leisure). Computers & LAN's had given way to laptops, PDA's, WAN's and 3G. It was contended that as communication becomes cheaper and all pervasive, and computing power increased exponentially, a wave of creativity would be quickly unleashed. Universally available broadband & 3G at an affordable cost, either fibre or wireless, opens up business to real productivity gains. Software that integrates all project databases, so that the data survives for the life-cycles of the building or plant, not just the dimensions. This includes cost, procurement, warranty, spare parts maintenance schedules, equipment start-up data, vendor information, construction photos. All this data is linked to physical objects using the taxonomy created by the drawings to create a library. Laser Scanning, a technology that can be used in Intelligent Design, saves endless hours of on-site surveying.

Engineers thrive on challenges and the associated problem solving. In this context, these challenges span from:

- Delivering the infrastructure that will enhance competitiveness;
- Delivering on the "value for money" paradigm; through to
- Devising new products, methodologies and services that are competitive in global markets.

McGowan empathised completely with the Chairman of BP's recent observation to students that *"if you want to change the world, be an engineer*". He concluded: *'We, as a profession have changed this country for the better, and will continue to do so'.*

Jack Golden, the then HR Director at CRH, in his presidential address in 2007, spoke about leadership and asked: *'Do we ever consider leadership in the context of engineers?'* He continued: *'I believe that leadership in this context, is of vital importance not just to individual engineers but for the profession as a whole if we are going to have a greater impact on society and gain the proper recognition for the contribution engineering makes to humanity. I believe that our leadership as engineers will have a vital role to play in shaping our society and in overcoming the challenges of population growth, global warming, depleting natural resources and a planet that someday will have to run on little or no oil'.*

'Real leadership is not to be confused with celebrity. Real leadership is about the impact an individual or group of people makes on others, their organisation and ultimately on society. It has of course to be measured by short-term results, but also by the strength of that organisation and the development of that society over a long period of time'.

Golden quoted Robert Katz (1955) when he argued that successful leadership depended on three fundamental skills: technical, human and conceptual. Technical skills are specific to the work being actively carried out and include analytical ability. Human skills are those which allow leaders to work effectively with the people around them and conceptual skills are essentially an individual's ability to work with ideas. Early in one's career, technical and human skills are needed more than conceptual skills. In mid–career, all three skills are almost equally important and at higher levels of responsibility the requirement for technical ability diminishes as the need for conceptual skills increases. In designing Continuing Professional Development (CPD) programmes for engineers, he advised that we must ensure that all three skill types are catered for appropriately and avoid overly concentrating on the technical aspects of the engineer's role.

The concept of emotional intelligence in leadership is divided into four domains, each of which can be developed in individuals and organisations. This essentially involves understanding and managing one's emotions, having the capacity to read people and act appropriately to enlist their support in achieving common goals.

Golden opined that the latest research on leadership focused much more on how to get the wider team engaged and committed to the common goal. With our changing society, the concept of the heroic leader articulating a vision and charismatically persuading people to follow, was falling out of favour. Instead the focus had turned to creating a culture of engagement based on "distributed leadership" which meant:

- Involving people in decision making;
- Recognising their contribution;
- Giving them sufficient autonomy in their jobs; and
- Providing them with career opportunities.

Golden continued: *'After a century of research by academics into the subject of leadership and more particularly of leadership in organisations, we know that examining personality traits, analysing behaviours, applying the lessons of emotional intelligence and the more recent "distributed leadership" models that focus on the wider organisation and its culture, all contribute to giving us a fuller understanding of the complexity of the leadership process. We may not yet have all the answers, but I do suspect we have come a long way. We know that certain traits, often apparent early in life are important. We know that many of the skills of leading can be taught and that the influence of the wider organisation or its culture can be enormous in developing the leadership capacity*

of an individual. If engineers are to truly shape the future and to lay the foundations for a sustainable world, we need to attract the brightest and best into the profession and help them acquire the technical and leadership skills to meet the challenges of today and tomorrow'.

'Engineers have the technical knowledge and the skills to solve many of Society's problems, but if we are to ensure these skills are used effectively, we must increase the impact of the profession and that's where leadership comes in. So, if we accept that leadership is an important ingredient for success, that it is the art of persuading people to work towards a common goal and that we can teach people many of the skills of leadership – how should we go about doing so? Traditionally this has been left to the business schools and many engineers have accelerated their career progression by completing an MBA or by attending other courses'.

'Maybe we expect too much of business schools. We can, of course, also learn a vast amount about leadership on the job – through overcoming challenges, through failure and through experience. Remember the joy of success, the misery of failure – and most importantly the determination never to let that happen again'.

Golden said: *'If we want the engineers of today to be the leaders of tomorrow, we have to give them challenging jobs, to give them real responsibility and sufficient autonomy to grow. They have to be able to make some mistakes along the way without being punished. Of course, if they keep making the same mistakes, some form of punishment will be inevitable'.*

The second important element in growing leaders is coaching. In every organisation, there are experienced people who can have a real impact on the development of their younger colleagues by providing a sounding board and advice to get them through the challenges of their early careers.

With reference to formal training initiatives, Golden said that at one level we needed training to help people do today's job better, but we also have to help them acquire the skills for tomorrow. There were many ways to develop the leadership skills of our engineers. Every organization needed to develop its own approach, but there were many examples of good practice around the world which could be adapted to a particular situation. He considered that Engineers Ireland, through its programme of courses and seminars, and particularly through its CPD Accreditation Scheme, could have a powerful impact on the enhancement of technical, communication and leadership skills for engineers on this island. At the time, 96 companies had been accredited for CPD and the Institution was now starting to target small and medium-sized organisations. With hard-won funding it was possible to make a real difference to the performance of small and medium-sized enterprises in the country and contribute to the development of engineers and other professionals across the whole economy.

Golden stressed that Engineers Ireland could play a major leadership role in Ireland. '*We have a vibrant network of regional committees and specialist societies who have contributed enormously to issues of regional and national importance'.* At the same time, the Irish Academy of Engineering had contributed to the debate on a wide range of issues affecting society through its report *"Engineering a Knowledge Island 2020"* and its recent publication on our water resources.

Golden said: *'It is up to Engineers Ireland and indeed, all the engineering institutions, to demonstrate the impact of engineering on the world and the real opportunities for leadership roles offered by a career as an engineer. The value proposition for students must be clear. We must be able to show that the effort required in education will reap rewards – not just monetary rewards, but in the impact it can have on an evolving world'.*

He continued: *'We can develop a programme to address the information gap in secondary schools. With the educational requirement for Chartered Engineer being raised to Masters level and many courses increasing in length to five years, we have the ideal opportunity to re–shape engineering education at third-level now, not just to make it*

more attractive to students but to meet the future needs of a changing economy. We must continue to mobilise our membership when key decisions affecting future generations are being made to ensure we don't allow our political leaders to repeat the mistakes of the past. Engineers have the potential to change the world. Their skills are needed to develop the new technologies which will shape the lives of future generations. In many research fields, it is the engineers who lead the development by integrating the work of other professionals to create revolutionary new products and processes'.

At the same time, there was vast potential for the continuing development of existing technologies. Incremental improvements in fuel efficiencies of cars and jet engines, better insulation of buildings, improved preservation and storage of natural foods and constant innovation in communications and information technology that will enhance our quality of life and provide an unlimited range of opportunities for the engineers of today and tomorrow. Technology will provide many platforms for engineers to exploit their talents but engineers with leadership ability will be required to maximise the potential of this technology.

Golden continued: *'As an Institution, we have to anticipate and plan for the changes in society around us. We have to lead the debate on difficult issues, whether that is Nuclear Power or Genetically Modified Organisms. We have to remain focused on continually developing the technical, interpersonal and leadership skills of the engineers of today and tomorrow. We will also have to address some sacred cows if we are to be successful. If we wish to remain relevant, we may well have to re–examine what it means to be a Chartered Engineer and find a way without compromising standards to meet the needs of the engineers of the future as well as the engineers of today. We will have to recognise a wider range of alternative routes to achieving the title of Chartered Engineer and prepare for a greater degree of diversity in our membership'*.

He noted that much of this work was being undertaken through the various task forces and discussion groups working on the Engineers Ireland Strategic Plan. He felt that we needed to accelerate this process in the year following and he looked forward to hearing from the various working groups throughout the year. He said: *'If we achieve this, we will truly be able to say to the next generation of school leavers: "If you want to change the world – become an engineer" and more importantly – they will understand our message'*. The job prospects for engineers had never been better and the opportunities to grow into leadership positions whether in the private or public sector were vast for those with the talent and ambition to do so.

Golden concluded his address by saying: *'This is a great profession. It is one which has given many of us, myself included, great career opportunities. It is a profession whose continued evolution and development is critical to the sustainability of this planet and its inhabitants. Closer to home, it is critical to the wellbeing and prosperity of our society. If we accept the validity of Darwin's theory that the species who survive and prosper are not the strongest, but the most adaptable, then as engineers, we must lead society to a sustainable future, by attracting the brightest and best to our profession, by supporting them with CPD and recognition along the way and by giving them the authority and responsibility early in their careers so that they will be the leaders of tomorrow'.*

The 2009 presidential address by **Jim Browne** was entitled *Engineering the Future.* He was convinced that engineers are and will be major players in the creation and shaping of the future of our society and economy. He believed that creativity and design were the very essence of engineering, indeed were at the very heart of the engineering profession.

Noting how the world had changed, Browne commented that engineers now design artefacts and systems that range across the totality of our life experience, from anatomical components which prolong life and greatly improve the quality of life of individuals, to wireless networks which allow us to interact with each other in a seam-less manner; and facilitate ubiquitous computing and information availability. He felt that our professional

society, Engineers Ireland, and indeed the country, had kept pace with this change.

Browne continued: *'we live and work in a country and an economy which is highly globalised. As a measure of our success, we can point to the following. Ireland now hosts:*

- *Seven of the world's top ten Information & Communications Technology companies;*
- *Fifteen of the world's top twenty-five medical device companies; and*
- *Nine of the world's top ten pharmaceutical companies.*

The great majority of these companies are high technology companies which tend to employ engineers and technologists in great numbers and even more importantly offer great career opportunities to engineers and engineering graduates. Furthermore, they are involved in the production and distribution of a range of engineered products which could hardly have been imagined only 40 years ago'.

These companies offer opportunities to our engineers to work on products and processes at the very forefront of advanced engineering design and practice. Many of these companies are now looking beyond what might have been their initial focus on manufacturing, production and distribution and are becoming involved in research and development with a view to new product and process development.

Browne continued: '*Our profession has risen to the challenge. As the economy has developed and the demand for new types of engineer emerged, we have refined our thinking and created new styles of engineering programmes which respond well to the requirements of employers and the developing economy. Thus for instance new engineering programmes in areas such as biomedical engineering, computer and software engineering and environmental engineering have emerged in our Universities and Institutes of Technology and have been properly validated and accredited by Engineers Ireland. All of the newly accredited engineering programmes share the common platform on which all professional engineering programmes are built, namely an emphasis on rigorous analysis and design and a clear focus on problem solving'.*

But the challenge he stressed continued unabated. The government had recently published its thinking on how the country would deal with the tremendous economic challenges we now face. The publication entitled *'Building Ireland's Smart Economy – A Framework for Sustainable Economic Renewal'* rewarded a close reading. While severe short to medium-term economic challenges were acknowledged and presumed to be tackled, the focus was on a return to sustainable growth; this was to be achieved by

- investment in and commercialisation of research and development;
- the development of 'green energy' and an associated enterprise sector; and
- continuing investment in infrastructure.

This approach was summed up under the sobriquet *Smart Economy*.

Browne said that he was encouraged by the emphasis on development and on the role of technology. It was clear to him that our future was dependent on our efforts as a nation to develop new products and new services which we could successfully deliver to international markets. We as engineers had a huge role to play in developing a successful *Smart Economy*.

The Irish economy was in a stage of transition and industry was seeking to move up the value chain, to develop new products, processes and services, to develop R&D capability and to move to a situation where products and services are designed, rather than manufacturing the products and delivering the services which have been conceived and designed by others. Browne supposed that the ultimate illustration of this was the mobile phone, a complex product which each of us own, but which is essentially given free to us if we agree to purchase the various services provided on it. The service provider in effect absorbs the cost of manufacturing in order to sell us the associated services. In simple terms, the product is to all intents and purpose provided free at the point of use; however the services which sit on it are expensive. In fact the services pay for the infrastructure, the

telecommunications network, and the individual product. This phenomenon is known and described in the academic literature as the Extended Product. In Browne's view this extended product phenomenon went some way to explaining the lack of appreciation of engineers and engineering.

Browne commented: '*Engineers are required to use our analysis, design and innovation skills to develop new types of what are often virtual products. Truly we have moved a long way from bricks and mortar*'. He continued: *'Do we as engineers distrust the term "services"? Does increased demand for services suggest reduced demand for engineers? In his view the answer was an unequivocal no! Today engineers and engineering skills are required to design services, just as they are and were required to design physical products'.* He felt that it was worth pointing out that the decision to require Level 9 qualifications for recognition as a Chartered Engineer reflected the reality that engineers today needed a broader and deeper set of skills and knowledge than previously.

Referring to the report of the High-Level Group on Manufacturing, Browne noted that it was interesting to read their comments on what they termed "sectoral convergence", because there was a parallel tendency in what he called "engineering convergence", an example being the digital content sector which had emerged as a result of convergence across media content, software and telecommunications. He felt that, if there were implications for high-tech manufacturing firms, there were implications for engineers and indeed Engineers Ireland. These implications were not only for our understanding of the nature of engineering and the training of engineers, but also for our CPD programme.

These implications included:

- our ability to deal with multiple and quite diverse disciplines;
- our capacity to appreciate that many engineered products and their associated services are tightly coupled; and
- the need to develop engineering programmes which produce engineers who can use their analysis, design, synthesis and problem-solving skills in multidisciplinary engineering teams.

Browne considered that the challenge facing engineers and engineering was the variety of areas and of problems in which engineers and engineering are expected to contribute. We had been asked to shape the future in areas as diverse as the provision of clean sustainable energy and transport systems, infrastructure, water supplies, entertainment and education products, medical products, customised and personalised services. As engineers, our common contribution to all of these areas is our ability to analyse problems, to imagine and bring to fruition new solutions, through our well-developed strengths in design, creativity and innovation. Engineers uniquely have the training and the skills to address this series of challenges and to deliver on our obligations to our fellow man.

Browne put it to the audience that the diversity and the great scope of the issues identified above indicated the extent to which human activity, human comfort and indeed human survival depended on progress in engineering and on the work and ingenuity of engineers. He said: *'Truly we are challenged to engineer the future'.* So, he asked the question: *'Given the great successes of the past; the extent of the challenges facing us and the central importance of dealing with the challenges for the future of mankind, and the reality that engineers are key to overcoming these challenges, why is engineering not held in higher esteem in our society? Why does engineering appear to be unattractive to potential students?'*

Browne saw two problems: Our work, for all of its importance and impact on everyday reality, is effectively invisible. We get no public credit for our contribution to the quality of life; and secondly, we have not made the best case for ourselves in how we represent our profession, or how we talk about our activities and communicate our contribution to society in general, and the economy in particular. His contention was that we undersell the most interesting and attractive aspect of engineering, namely the emphasis on creativity, innovation and design.

Browne felt that creativity and innovation should be recognized as the most attractive aspects of any engineering programme and of the engineering profession. Instead we give priority in our discussion on engineering, in our formal definitions and indeed in the descriptions of our courses, to mathematics and sciences. As it happens, he felt that these were the least attractive programmes to second-level students. He felt that we needed to reinvent the discussion and the nature of the conversation on engineering. He contended that we needed to rewrite the language we use to describe our profession. We need to put the focus on the "ends" and "objectives" of the engineering profession, which are about the creation and development of beautiful artefacts of all shapes and sizes that are of great value to society.

In conclusion, Browne commented: *'We explain engineering and we associate our profession with relatively theoretical science which is taught and studied largely without access to applications and laboratories. But is it not the case that potential engineering students are predisposed to practice and application, not theory for its own sake? We need to talk about engineering programmes and engineering concerns in terms of the wide range of interesting products, process and services that engineers design and work with'.* His contention was that what interests young people who are attracted to engineering is not mathematics or the physical sciences per se. It is the use which can be made of these disciplines to develop interesting products and services, which are of value to, and increase the quality of life of, their fellow human beings.

In 2009, **Chris Horn**, a computer software expert, began by noting that safety was a critical ethos of engineering. Engineering works which are not developed and subsequently maintained in a professional manner could cause not just inconvenience, but material damage and even loss of life. Computer software was now a technological foundation for society. Software failures can, and have, caused substantial damage, and loss of life. He asked *'Why is it so difficult to correctly engineer software? Can software ever be safely and rigorously designed, as do the traditional engineering disciplines?'* To answer these questions, Horn presented a basic understanding of the boundary between computer hardware and software.

The basic structure of most general purpose computers, including the laptop or desktop computer is of a central processing unit (or CPU); a memory, which in most computers loses its content when the power is turned off; one or more disks, which provide longer-term memory and which survive power downs, but which are slower than the main memory; a keyboard and mouse device; and a screen. There may well be other peripherals too such as network devices, camera, speakers and microphone and so on. All of these, and in particular the CPU and main memory, are interconnected by a fast backplane, or "bus".

Focussing on the CPU and main memory: The main memory holds software programs which are being executed by the CPU, together with data also in the memory. The CPU itself consists of an arithmetic unit, capable of carrying out in hardware at least addition and subtraction, together with other hardware operations such as testing for positive or negative, and logical operations with patterns of bits. The CPU also has a program counter which identifies the location within the main memory which holds the current machine instruction. The CPU executes a program by stepping through the indicated list of instructions, including making use of subroutines to which certain tasks can be subcontracted before handing back control to their caller.

The design of a CPU includes specifying what specific machine instructions can be carried out in the hardware of the CPU. This portfolio of instructions defines the boundary between the hardware and the software for the machine. A software program specifies a list of specific instructions in a program; the hardware engineer has to ensure that the CPU accurately implements every instruction. Each CPU instruction set works on batches of bits at a time; 8-bits for example, representing any number from 0 to 255; or 16 bits, representing any number from 0 to 65,535. The size of the batch of bits manipulated at a time can be important. Over time, the capacity, speed and cost of different CPUs have improved.

A software program is a list of specific instructions, and thus must be written for a particular instruction set. In moving to a different computer, software may therefore need to be re-written. In the early days of computing this was indeed the case, although this problem has now been solved to a greater or lesser extent. Writing software by listing the specific machine instructions required is tedious and error prone, although it was the way in which computers were originally programmed. Then, in 1953, John Backus created the Fortran programming language. Fortran enabled software programs to work at a more abstract level than machine instructions. Backus wrote a remarkable program, called the Fortran compiler, which is a software program which reads any Fortran software program and converts it into an equivalent and longer list of machine instructions, for any of several different instruction sets.

Fortran provided a quantum step in computing. Instead of talking to a machine at its own level of the hardware, a programmer could work at something closer to human language. With the advent of Fortran, it became much easier for programmers to share their work with others. Fifty years later, there are now myriad programming languages, each specialised in some way. Programming languages differ in speed of execution and in how well the constructs of the language directly support particular fields - scientific computations, financial processing, the web, and so on. Software tools and middleware have been developed which automatically convert the format of data and numbers, and the invocation conventions, of one programming language to another.

Students of architecture are taught the classic forms and structures of design. They study the great works and icons of their profession, and learn the careers of the great protagonists of their art. Classical engineering is often instructed in the same way: civil engineers not only study the great buildings, but also the great bridges and transport systems. Mechanical engineers learn of the great engine designs which advanced their profession. Electronics engineers study model circuits, by which their profession advanced. Until the last fifteen years or so, students of software engineering rarely studied the great works of their profession. The great works were unavailable to be studied: software companies jealously guarded the software code of their products, only allowing a limited number of employees to see their inner workings. The open source movement, originally promoted only by certain academics in the mid-1980s, then started publishing software code. Some of these works are classic works of software, and in particular the Linux system and environment.

Horn asked: '*How can the construction of large software systems, running to millions of lines of code, many software developers, and potentially large sums of money, be managed. How can you measure and manage the progress of a software project? The fruit produced each day by a software engineer is software code. As a manager, you can of course measure the lines of software code written so far, and thus how productive your software developers are. However, this is misleading: large cumbersome bloated code may contain many lines, but a more concise carefully written version may perform better and often will be easier for others to understand. There are other metrics: how many features have been developed so far - but then features can vary tremendously in scope and effort required to implement; how many defects have been detected and repaired - but sometimes as the defect rate rises, paradoxically you may be closer to a finished project; and so on'.*

'How do you know whether a program is correct and works, after it has been written? How do you know that it does what it's supposed to do?' The obvious way of course is simply to test it: give it data and inputs, and see whether it produces the correct behaviour and results. Usually there are a large number, or even infinite number of test scenarios, with a finite amount of time and resources, with a consequence that it is impossible to test everything. Frequently, one is reduced to testing for some representative sample of inputs, with the risk that that implies'.

Software engineers have frequently operated under instruction that their work be "good enough" - that a software system has no major problems, and should be OK to use, even though it may not be error free. Horn continued: *'But what is a definition of "good enough"? Is it by consensus across the team? Is it when predetermined criteria are met, and then testing be stopped? Should testing cease once the costs of testing (including salary costs) have begun to climb above what is acceptable? Do you stop testing when the rate of*

discovery of defects drops below an agreed level? Or, as happens persuasively and usually indisputably, you stop testing when your manager says "stop testing and ship it".

Rather than testing for some subset of possible inputs and timing conditions, could the software test itself? Self-testing software is of course common, and it is also common for software engineers to ensure that their software verifies that certain design assertions are valid as the software progresses. Then there is of course the issue of what should be done if the software discovers that a design assertion is actually invalid. If the assertion is suddenly found to be invalid, how should the system deal with the failure in its design?

A component can be specified by a function: give this value, or signal, as input, then this will be the corresponding output. If you load this beam in a bridge, then this will be the expected deflection, and stress; if you increase the air flow, then this will be the exhaust manifold pressure; if you increase the inductance, then this will be the output voltage; and so on. Indeed, software tools, such as CAD systems, help engineers design and build machines and artifacts, predicting how for example a specific design for a bridge, an airframe, a powerplant, or a transformer substation, will behave under various operating conditions.

Simple software components can behave in a similar fashion to other engineering components - when you change the input, this is what the output will be. Most software components, like many other engineering components, in fact have more than one input variable – i.e. more than one degree of freedom - and more than one output value. Horn commented: *'So, why cannot software components be managed like other engineering components - what precisely is the issue preventing this? The biggest issue is that software components almost invariably have state: they can record values, and their outputs in the future can depend on what inputs they have seen in the past. The concept of time and state is intrinsic in many software components as they model the real world'.*

'As software engineers, we are getting better than we were a decade ago at capturing the specification for a system; we are getting better at designing an implementation of that specification; we are getting better at predicting the performance response of that implementation; we are getting better at building that implementation by re-using other components; and we are getting better at describing our implementation so that other software engineers after us can maintain and extend what we have done'.

'But nevertheless, we still lack a tractable physics of software that allows our profession to reason and predict how complex assemblies of varieties of software components will interact and behave under all the potential operating conditions which they may encounter during their lifetime. Without such a physics, it appears difficult to analytically evaluate alternative designs; without such a physics, it appears difficult to understand our systems, how they actually operate and sometimes why they fail; without such a physics, it appears difficult to confidently provide design guidelines; and until we have such a physics, software engineering may continue to be a creative undertaking based on heuristics and experience, rather than an applied science with a sound analytical base'.

In conclusion, Horn stated that it was Engineers Ireland's view that all engineering projects which may affect health and safety of the public, or may damage property, should be certified by a professional engineer. He continued: '*Currently the Irish engineering profession is weakly regulated, and compares unfavourably to certain other jurisdictions in which certification of all engineering works is legally required. Engineers Ireland is taking initiatives to safeguard the public against poor engineering judgement and unprofessional analysis*'.

The title of **Martin Lowery's** presidential address in 2010 was E*nterprising Engineers.* He began by speaking about new sources of wealth creation and economic development that were needed, if Ireland is to have any success in restoring the losses of the past few years due to the virtual collapse of the construction and financial sectors. Also, climate change and energy were universally accepted as issues that have to be addressed. He felt that economic growth and wealth creation were the only means by which we could ensure a return to jobs and prosperity for the people and this, of course, was where engineers would come into their own. While engineers always played a central role in economic development, they were needed more than ever before to deal with the increasing complexity of modern economic and environmental systems. Engineers were uniquely equipped to manage and improve complex systems in many areas because they use a mix of intuition, instinct and subjectivity, together with rationality, objectivity, and understanding, to reach good decisions, even in areas where complete knowledge and understanding is missing. These were also competencies that Ireland now needed to chart a path that would provide sustainable jobs and better living standards for the people. Lowery said: '*This time around engineers should ensure that they have a far greater say*'.

He considered that the best prospects for the development of internationally competitive indigenous industry appeared to be in either natural resource-based industries, such as food and forestry, or in technology-based industries such as healthcare, electronics, energy, and software. Our damp temperate climate for all its faults, gives us inherent competitive advantage for food and forestry while the infrastructure needed to support high-tech overseas industry should also provide a platform from which to develop an indigenous high-tech sector.

The basic case for forestry was: First, like grass growing, tree growing is one of the few areas in which Ireland has inherent competitive advantage. It is the undisputed best use for over 17% of Irish land. Forestry cover is currently just over 9% so it has potential to almost double in size. Secondly, forestry operations, including the processing industries are located mainly in rural and provincial areas which are less impacted by wider economic development.

There is still enormous untapped potential to develop the food industry. There are opportunities for our dairy industry with the ending of quotas, but our beef industry could be threatened by the opening up of markets to third-world countries. Lowery said that a lot of thought and effort had gone into the development of the industry over the years and there was considerable progress, but it appeared that some of the fundamental problems were still there, i.e. a commodity approach based on the perceived needs of the farmer producers rather than a market, product and innovation approach based on the needs of the consumer. He continued: *'We have considerable inherent competitive advantages. We have one of the best grass growing conditions in the world which is the basis for our high-quality beef and dairy products. The industry we have is well regulated and we have an international reputation for quality and standards'.*

The increasing scarcity and cost of hydrocarbons combined with concerns about climate change meant that the energy sector was undergoing major change. He felt that Ireland should have two complementary objectives in energy policy. The first was to meet our future energy needs on an internationally competitive basis and the second was to sell internationally the technologies and products developed in meeting the country's needs. In Ireland's case we needed new energy sources that:

- were competitive to support our internationally trading industries;
- were secure i.e. are not dependent on hydrocarbons from unstable parts of the world; and
- helped us to meet our climate change objectives.

Some of these objectives were clearly in conflict with each other and an appropriate balance would have to be found. They do however point to energy conservation, renewables, carbon capture, energy storage and possibly even nuclear as featuring in Irelands future energy mix.

Lowery felt that the really big opportunity for the development of indigenous industry had to be in high-tech areas such as nanotechnology, biomedical/healthcare, communications, speciality materials and software. The presence here of so many high-tech overseas companies was seen as a unique strength. It had driven the development of the supporting infrastructure such as management capability, technological education, research and sub-supply industries.

Lowery than went on to explore the role of engineers in wealth and job creation and in particular, what more engineers could do in this regard in the current (2010) difficult economic environment. He said that engineers were required to develop new competencies and capabilities in areas such as innovation, entrepreneurship, leadership and international focus. These competencies were needed by all engineers in the context of economic development and job creation. They applied to engineers of all disciplines in the public and the private sector whether directly involved in industry or whether providing the services needed by industry or by the general public.

He commented *'Ireland is short of entrepreneurs and, in particular, engineers who are also entrepreneurs'.* Engineering principles and engineering education provide an excellent basis for understanding entrepreneurship and business concepts. Engineers who understand and apply the key driving forces of business in their area of activity make the best entrepreneurs and the best leaders. Engineers already have the analytical skills to succeed in business. These tools need to be augmented by business, knowledge, strong communication skills, and leadership skills to ensure that good ideas are turned into reality and success.

Speaking about engineers as leaders, Lowery said that there were many examples of engineers in leadership positions in the private sector and in the commercial state companies, but the same is not always true in the public sector. This should be an issue of concern, not just for engineers, but for the general public, who need good decision making in areas that are increasingly technical and complex. Engineers should aspire to the top positions, not just in the private sector, but also in the civil service, the local authorities, and in the non-commercial state bodies.

In Lowery's view, there were two things that were needed to ensure that engineers were facilitated and encouraged to compete for the top positions in the public service and were equipped to assume these leadership roles. The first was that engineers should no longer tolerate the dual structure where it still exists in the public service and if necessary campaign to have it eliminated. Secondly it was to have a structured programme combining on-the-job training and experience, with internal and external courses to develop the necessary skills and competencies for top leadership positions.

He considered that there was clearly a role for Engineers Ireland and its CPD programme to define what is needed to give engineers the necessary skills and possibly participate in delivering the necessary programmes. Leadership skills and competencies would enable engineers to contribute much more effectively to the process of economic recovery and development. Engineers should be the entrepreneurs to develop the businesses, be the innovators to develop the processes, the products and the services needed by the marketplace, and engineers needed to ensure that the infrastructure was internationally competitive and met the needs of industry. Clearly competitiveness was absolutely essential for export-led growth and job creation. Our physical infrastructure, all of our public services and private services of all kinds, are all heavily interdependent in ensuring that we have a competitive economy.

Engineers of all disciplines are at the heart of providing the infrastructure needed for industrial development

viz:

energy

- electricity
- communications
- transport
- water
- waste disposal
- buildings
- environmental services

Lowery opined that *'Engineers must give leadership in ensuring that decisions are technically and strategically correct while still supporting international competitiveness. Many of the changes in modern society are driven by advances in modern technology. Engineers are largely responsible for these technological advances. Ironically these changes, in turn, impose a requirement on engineers to widen their perspective in the context and environment in which modern Irish industry must compete. It was not enough that Irish engineers were technically excellent. They had to be internationally aware, socially aware and objective in ensuring that policies and practices reflected the needs of a modern internationally trading economy'.*

Referring to the *Smart Economy*, Lowery said that the essence of the smart economy was to use the knowledge, skills, and creativity of people to translate ideas, into valuable processes, products, and services. It spanned all areas of activity including:

- enterprise and competitiveness;
- innovation;
- the environment and energy supplies;
- physical infrastructure; and
- public services and regulation.

These were the ingredients needed to stimulate and support modern competitive industries and services.

Lowery continued: *'Productivity improvement is clearly important to competitiveness but technical innovation is central to wealth creation and economic growth. It is mainly engineers who will develop the new processes and products and who will create and manage the new systems for civil infrastructure, manufacturing, healthcare, information, communications and so on. It is engineers who put knowledge to work for society and knowledge today is extensive and widely distributed. If the essence of engineering is to integrate different forms of knowledge to meet an objective, then engineers need to work across different disciplines and fields. In practice, this means that engineers need to find ways to work collaboratively with other disciplines, such as medicine and science in the case of biotechnology, and environmental scientists in the case of energy and environmental services'*.

'*Engineers Ireland already has far-reaching initiatives underway which will enhance the contribution of engineers and engineering to economic development. The decision to separate membership from titles has the potential to both broaden and deepen the influence of Engineers Ireland on many aspects of Irish life. While more members will broaden the range of Engineer Ireland the real benefits will come from creating a culture of ongoing learning among members in pursuit of titles and also, I believe, ongoing learning should be made a requirement for the retention of titles.*

Lowery stressed that the entire effort should be underpinned by a positive response from government to a recent Engineers Ireland proposal to the Minister for the Environment that we move to international best practice in the regulation and licensing of the engineering profession in Ireland. The essence of the proposal was that: "every engineering process, system or project, across all disciplines, that has an individual or public health

or safety dimension or is of significant value or cost, or is potentially damaging to our environment, must be authorised by a Chartered Engineer."

'This was seen as logical and so clearly in the public interest but it would not necessarily be easy to achieve. It would probably require a determined and sustained political campaign to get the necessary regulation enacted. The prize though would be great. It would give proper recognition to the standards associated with the title Chartered Engineer and the Institution would then have in place the various pathways by which all engineers could achieve that standard'.

PJ Rudden in 2011 spoke about *Building a Sustainable Recovery.* He explored how engineers could make Ireland a better place, not just in terms of infrastructure, but in terms of resource efficiency, competitiveness and job creation. He said: '*We want to work towards economic recovery, but it has to be sustainable in environmental and social terms too. We are getting better as a nation in fast-tracking badly-needed infrastructure projects, but we can do even better with more 'joined up' reform in our planning system We need to strike a balance between the 'public interest' and the valid objections that many projects have to entertain. That will only come with political leadership mandated on the strength of sustainable policies adequately informed in planning, engineering, environmental, and in public communications terms'.* Rudden continued: '*We also need to ensure that we can inspire, nurture and grow the next generation of engineers who will meet even bigger challenges with the next generation of infrastructure and who too will have to manage the great forces of nature for the benefit of us all*''.

Rudden also focussed on our educational system at primary, secondary, third and indeed fourth level to ensure that we are preparing our young engineers for work and early graduate experience, as our education system in Ireland has always been the key driver of our competitive advantage. He said*: 'We also need to provide an adequate system encouraging "life-long learning" to the professional community to meet the growing demands of a dynamic economy where the "shelf life" of many of our skills are constantly challenged'.*

The financial crisis over recent years had prevented long-term economic planning happening to any serious degree. The Four-Year National Recovery Plan 2010-2014 published by the previous government in Autumn 2010 had been accepted by the current government, the EU and the IMF. While this was a necessary response to the unfortunate fiscal and banking crisis it did not help us with the required strategic longer-term planning of the nation's infrastructure.

During the year, important decisions were advanced within Engineers Ireland (EI) - some of these were difficult decisions but all were designed to give strength to the engineering profession to make it more relevant to Irish society and to be a stronger driver of new enterprise.

- EI confirmed the raising of the standard for Chartered Engineer to a 5-Year Masters degree or equivalent from the 2013 graduation year;
- EI made further progress on the admittance of Bachelor Degree level 7 and also level 7 and level 8 degrees in 'cognate ' professions to full membership by working towards fully documented Routes to Titles for these members.
- EI put plans in train to raise the profile of Chartered Engineer nationally through a new public communications campaign.

Engineers Ireland had profiled the continued importance of infrastructure in terms of transport, water, energy, waste and communications through an Infrastructure Report and other activities. The Institution sought to highlight the enterprise and job creation possibilities in the third-level colleges and research institutes in renewable energy, nanotechnology, biomedical engineering and information technology. These research areas

strongly support and nurture the current growth areas of the economy namely ICT, Biomedical, Energy and Pharmaceutical Engineering.

Rudden said: '*While we need to encourage current engineering endeavour, we also need to ask ourselves what seed corns can we lay in our education system starting at primary level, what green shoots can we fertilise to produce the future crops of enterprise?*'

He continued: *'The degree to which we can contribute to a new frontier of enterprise and innovation is informed by a supporting role in a radical reform of the Irish education system starting in primary school. Some of this is currently underway at second level but more needs to be done. We need to educate to think not to learn by heart. We need to educate to understand not apply mere theorems or formulae. We need to educate to invent and to innovate not to copy, replicate or play it safe. We need to learn the skill not only to influence but to inspire and lead. We need to learn to communicate with the public. These creative skills don't come easy to the generations of engineers and scientists brought up on a diet of "rote learning", formulae and theorems'.*

'Of course, engineers can be leaders of projects and enterprise, but can only do so if we broaden our horizons and our interest beyond pure engineering into the cognate professional areas. So, if we are to create enterprise we cannot ignore the social, environmental, political or communications challenges in finding new energy resources, new water resources and new resources from waste. As engineers, we need to integrate with the planners, the environmental scientists, the social and political scientists, the economists and the communications specialists to create the holistic "conversation" that can convince people to maximise the benefit of infrastructure and enterprise in the economy. In terms of job creation, we also need to educate for current and future markets. These are markedly different from the markets of the past. We also need a broader attitude if not a broader education to meet the challenges of future engineering'.

Rudden felt that the most worrying feature now in his view was not only the challenge facing students, who can be quite adaptable, but the difficulties confronting teachers in the system. Many of these lack the basic IT skills to even learn the new systems. Up to recently our educational system allowed some of them to teach maths with little technical qualification other than standard teaching skills. This could only lead to low interest and little passion for a difficult subject.

He felt that it was not the teachers' fault that so many of them were unqualified, it was the fault of the system. It must be said though that this situation will not reoccur since the setting up of the Teaching Council requiring teacher registration since 2006. There are many historical reasons for what happened arising from the management and patronage of schools, the protocols for principals and the lack of an adequate teacher registration system at national level. The current maths situation in Ireland is a systemic failure in the educational system at national level.

Rudden said that it was his view that all third-level engineering colleges should be capable of a high-level vision for innovation and enterprise to meet the demands of the future economy. In this regard, there was increasing evidence of integration of skills across the various engineering disciplines where civil, mechanical, electrical, electronic, chemical and environmental skills combine to solve increasingly complex problems and even some involving schools of business, social science and public policy. Engineers Ireland was to continue making improvements through the STEPS programme to make the STEM subjects - science, technology, engineering & mathematics - more relevant to school leavers and to assist in the better training of teachers.

Turning to the translation of engineering knowledge to the development of projects in Ireland, he noted that the planning system in Ireland had evolved since the early 1960s and was now reasonably robust. In particular the new Planning and Development Act 2000 consolidated the planning laws and was strengthened by the Strategic Infrastructure legislation in 2006. An Bord Pleanala has functioned well and efficiently in recent years on land-based developments and particularly well on strategic infrastructure projects. There was now an urgent

need to provide a similar statutory framework for all marine-based projects to assist the development of offshore renewables and other marine development.

Infrastructural projects needed to be part of a 'strategic planning framework' which involved sufficient measure of community engagement to get public “buy-in” to necessary projects at pre-implementation stage. In addition, modern building and infrastructural developments in Ireland now needed to be “plan led” not “developer led”, unless underpinned by the City/County Development Plans or Local Area Plans.

Rudden commented: ‘*The general public who are the ultimate client for our goods and services are sensible enough to discern the "common good". If there is misinformation or disinformation from opposition groups this needs correction in the media. It also needs sufficient political maturity based on a strong mandate, particularly in the whole planning, environment and local government area and in other areas also’. ‘To portray our profession accurately therefore, we need to profile our role models as the people who serve the legitimate public interest by keeping traffic moving, who design our power stations and wind farms, supervise biomedical operations in hospitals and maintain our broadband to feed our social media and mass communications. I think that the profession does not give itself enough credit for work that is generally done in the public interest and in a trustworthy ethical fashion for which other professions are often respected.’*

Rudden felt that, if our response to a traffic problem was necessarily to build a new road rather than traffic calm or to a water shortage is solely to seek a new source rather than fix the leaks or conserve water or rely solely on fossil fuels to solve our energy problems, then we were unlikely to develop a sustainable future or communicate well with the general public. Very often technically we may actually be correct in offering purely technical solutions but there's more to life than technical solutions! Rudden added, for instance, *‘if we ignore the need for a “low carbon infrastructure” because of climate change considerations and say that our electricity interconnectors don't make economic sense to assist renewable energy, then we might satisfy some objectors to proposed overhead power lines but we won't have credibility to lead our national infrastructure efforts, we will not be able to have a real influence on policy and we certainly won't inspire!’*

Rudden continued: *‘We have to integrate our great talents with the other professions to have a holistic approach to policy drivers in terms of creating new products and services while meeting the global challenges of climate change, market volatility and competitiveness. We also need to internationalise ourselves with cultural diversity and language skills. We now live in a world where technology has made it possible for companies to take their business anywhere. We have to change the way we do business to be export-led to compete in dynamic highly globalised markets abroad while maintaining and growing our innovation ecosystem at home. To help competitiveness we need to market our unique skills of education, innovation and enterprise to give added value to our customer.’*

Rudden concluded by saying *‘We need to help our development agencies build the ‘Transformation Ireland’ that will continue to attract inward investment, but will also allow us to export our value-added knowledge services increasingly to foreign markets. In terms of recovering our economy it has to be that 'twin track' approach. As the authentic and elected voice of engineering in Ireland let us lead our enterprise forward. This land is our land, this land is your land and we are proud of what we can do. We need to show the Irish people more clearly what engineers can do and will do to help build a sustainable future across all of our sectors’.*

In 2012, Dublin City Engineer, **Michael Phillips,** took as his theme *Engineering in Society*, in particular reflecting on the evolution of Dublin’s needs.

Phillips began by noting that in Dublin (when) a citizen wakes up in the morning: clean water flows from the tap, the dirty water is removed, bins are collected, the streets cleaned, electricity and gas come from pipes in the road, he or she drives along a public highway to work or walks along a footway, maybe uses a cycle way; perhaps over a few bridges, passing through numerous managed and signalised junctions; later they may take a lunch break in a public park. These activities are reversed on the way home, whereas at night the public lights

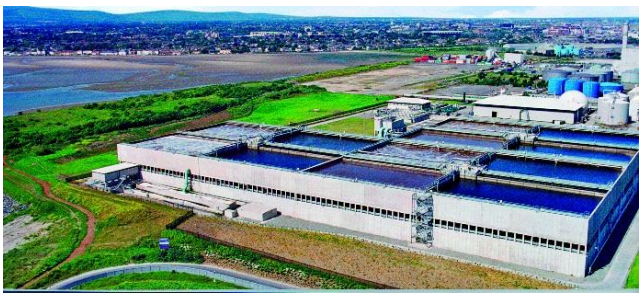
keep the streets lit and safe. Throughout the day one may encounter one of Dublin City Council's many emergency services which operate on a 24/7 basis. Air, noise and water pollution is monitored and measures are continuously under review so as to improve the environment or mitigate against it deteriorating. All these services are provided by the engineers and technicians of the local authority on a 24/7 basis, 365 days of the year and it is a testament to the quality of those services that they largely go unnoticed.

The publication of the *Myles Wright Report* in 1967 proposed the development of four towns – Tallaght, Clondalkin, Lucan and Blanchardstown - outside Dublin city and was the first formal plan which "sowed the seed" for the city and county engineers of the time to develop strategic plans for water, wastewater and roads on a regional basis. Development of any area requires sewers both to transport the foul sewage and storm water. The scale and location of the proposed towns involved large dedicated sewers being laid from such places as Tallaght and Blanchardstown to a completely new treatment works at Ringsend which incorporated one of the largest pumping stations ever built. These sewers also involved tunnels of many sizes the largest being the Grand Canal Tunnel, divided to cater for both storm water and foul waste disposal.

Phillips stated that, since 1996, it had been identified that the extraction of raw water from existing sources was at the maximum permissible limits and a new major source was required. This had been identified as the river Shannon and planning was underway. The situation in Dublin in relation to water supply in the late 1990's was that unaccounted-for water had reached 42%. This was due to the fact that there was virtually no investment in the replacement of pipes in the ground. There were 2,700kms of watermains in the ground of which 800kms were over 80 years old. The government, in a policy change, provided funds for a conservation programme, but more importantly for the provision of a telemetry system. The technology revolutionised how the council supply and distribute water. It allows valves to be opened remotely, meters to be read, pressures to be adjusted, reservoir levels and flows and treatment work's outputs to be read and interpreted on laptop computers. This immediately changed the organisation from being reactive to proactive and reduced the unaccounted for water to 28%. The introduction of the EU Urban Waste Water Directive in 1991 resulted in the upgrading of the wastewater treatment works in Ringsend from primary treatment to secondary.

Today the six themes adopted by the city council to assist in continuing to run a successful city are - economic, social, movement, environment, cultural and urban form. These themes are then captured in a series of strategies for housing, water, drainage, transport, retail etc. In order to implement such a strategy, the infrastructure must be planned and provided for. This infrastructure includes – water, wastewater, solid waste, environmental, mobility and utilities - which do not necessarily stop at the city boundary.

Phillips said that the regeneration of the city centre had led to an increased population. In order to continue to provide for the residents and users of the city centre, it was decided to reduce traffic and improve the quality of the streetscape. Two ambitious bridge projects were embarked on, namely the construction of the James Joyce and Samuel Beckett bridges, to enable traffic to be diverted west and east from the O'Connell Street area. In parallel with this was the construction of the Dublin Port Tunnel, the purpose of which being to remove HGVs from the streets as the main exit route from the port had hitherto been along the quays and through the city centre.



Ringsend wastewater treatment works, Dublin

The new treatment works in Ringsend, completed in 2003, provided additional capacity and treatment to meet the demands of the economy at the time. Further environmental benefits were that dumping of sludge at sea ceased and an untreated outfall off Howth was demobilised and replaced by a pipeline laid in the seabed from Sutton to the treatment works at Ringsend. At the

time it was the largest curved pipeline in the world to be pulled into position while assembled on the shore. Engineering solutions are daily being implemented to facilitate the efficient running of the plant at the most economical cost. Balancing these demands in order to mitigate pollution can be exacting, particularly with the changes in weather patterns and the increasing occurrences of severe weather incidents.

Regarding mobility and traffic, Phillips felt that, while the average person may not be aware of water distribution issues in particular areas, they are all experts on traffic issues everywhere. It is a discipline that is very much in the public domain whether it is a local issue, such as ramps, speeding or region-wide, such as a motorway. For the Council engineer though movement in an urban area today has to take into consideration all modes of mobility namely, public transport which includes buses – public, private, urban, interurban and regional; the rail systems of DART, Luas, commuter and intercity; and taxis - hackney, limousine and rank.

Private vehicles that have to be catered for include cars and motorcycles - commuter, business and shopper; HGV and trucks transporting freight to and from the port and making deliveries. And finally catering for cyclists and pedestrians to ensure they have adequate road space, ease of movement and are safe. Phillips said: *'People do get used to using their own private car and for them to change to public transport we have to understand what their concerns are and try to mitigate them'.*

The daily management of traffic is carried out from a control room in the Civic Offices which operates 24/7. From the control room operatives oversee 850 sets of traffic lights of which 700 will automatically adapt to prevailing conditions or they can be manually adjusted from the control room. In addition, there are 230 cameras, 40 large variable information signs and 450 real-time passenger information signs.

The council identified the need for coordinated response procedures appropriate to the scale of severe weather events and based on validated information. The cost of mobilising crews for weather events which may or may not occur can be significant. As a result, it is essential to have as much available information to hand so as to activate the appropriate response. The response procedures are based on the major emergency plan but the level of resources applied is based on a risk analysis of the information gathered as the event approaches. Phillips continued: *'Communicating with the public is absolutely critical on such occasions in order to keep them informed of what is happening, what is being done to address the situation and how long it will take to resolve. This is a vital role for the engineers as they have the expertise and understand the situation.'*

Today's society depends on a potable water supply, robust flood defences and a dependable energy supply. This critical infrastructure is essential to ensure continuity as we know it and particularly in an urban environment. This infrastructure is increasingly at risk because of climate change which will put water supply at risk with increasing demands on energy facilities from changing weather patterns or flooding.

In his address, Phillips illustrated the vast changes that the local authority has had to adapt to, particularly over the previous twenty years. While civil was still the dominant discipline it was obvious that there was now a role for many disciplines in the local authority. In addition, the role of the engineer in communicating with other professions, businesses, communities and media in order to plan for the future or solve existing problems had expanded greatly because everyone now wanted to make a contribution. Phillips felt that *'the engineer has a unique skill in interpreting what society needs and providing a solution - our difficulty very often is in communicating the latter.'*

Phillips referred to the title Chartered Engineer - the only independent verification of engineering competence in Ireland. He said that Engineers Ireland applauded the requirement for people with proven competence being required to complete a wide range of functions, such as architects, medical professionals, accountants, lawyers, pharmacists, etc. in their chosen fields, and asked: *'why don't we have a similar requirement in the*

engineering fields - surely given the importance and potential impact of the work done by engineers, the need for such insistence on proven competence is all the greater.' He called on government to work with Engineers Ireland to help raise the overall standards of all engineering services in the country by transitioning to a situation where only independently-verified competent engineers can sign off on projects that have a potential safety or environmental impact.

Phillips said that we should never lose sight of the fact that this generation, difficult and all as it may be, must never abdicate its responsibility to pass on to future generations a world and society better than what we inherited from those who went before us - this in itself highlights significant obligations.

Demonstrating engineering principles to primary school children

Thus, the formation of our engineers is critical, and our educationalists have a key role to play here - we need technically competent people across all engineering disciplines. But technical competence on its own is of limited value. We need our engineers to:

- have the confidence to assume responsibility and take the lead because they are best equipped to do so;
- be competent communicators;
- be capable of managing multi-disciplinary teams of experts;
- understand and address the impact of their actions / projects on local communities and the wider society; and
- be proud of their profession and promote it accordingly.

From cradle to grave every facet of our lives is directly and significantly affected by the contribution of engineers - medical advances, entertainment, communications, infrastructure, sport, food production and distribution, transport, security. The message that Phillips wished to leave with his audience was simple:

- *'engineers make a difference for the good of mankind;*
- *we add real value;*
- *we are at the centre of all human development;*
- *we are the natural leaders and let's never be afraid to assume that responsibility - leaving it to others alone is too risky; and*
- *let's all, together or individually, do our bit to position our profession where it rightfully belongs by virtue of its contribution - the most respected of all professions'.*

The presidential address by **John O'Dea** in 2013 concentrated on his experiences over 23 years in the medical devices industry. He reported that the medical device industry in Ireland was in strong health. In 2013, this heavily manufacturing focused industry employed close on 26,000 people and was close to reaching export levels of €7 billion. The industry employed a wide range of technicians and engineers working in a variety of manufacturing and design disciplines. Recognising the growth of the industry, the third-level

institutions had developed specialist engineering degree, masters and PhD courses, targeted at supplying appropriate skills to the industry, but the majority of engineers currently working in the industry had graduated with degrees from traditional engineering disciplines.

The diversity of the industry had seen physicists, scientists, computer scientists and electronic engineers adding to the cadre of mechanical and biomedical engineers that populated the engineering ranks in medical device design and manufacturing. O'Dea said *'One must look at where medical device technology is evolving in order to ascertain where the jobs growth will come from. It is my fervent belief that in the coming decade we are going to transition from putting bits of metal and plastic in people to an era of regenerative medicine, where we help the body to regrow damaged tissues and organs'*. He noted that 15 of the top 25 medical devices companies in the world had their European facilities in Ireland.

Turning to medical device design, O'Dea said that engineers were playing a key role in the betterment of health in translating clinical ideas into a functional reality. Most of the best medical device ideas had come from practicing clinicians working with engineers. He then presented some very exciting new technologies just to give a flavour of what engineers were doing to improve the health and wellbeing of patients with various illnesses. Several of these were being worked on in Ireland.

Natural orifice surgery

One of the most exciting developments in recent years had been the introduction of transfemoral heart valves, whereby an entire heart valve can be inserted through the leg, much like a regular stent, and be deployed into the heart without opening the chest, as is normally required for a new heart valve. Two companies in Ireland were currently engaged in developing products to help doctors insert these valves into the body, and to close up the incision made when the large valve is introduced via the femoral artery or via a small incision in the chest. O'Dea continued:

'When one looks at the valve one can see that the prime engineering resources relate to mechanical engineering of the stent and the deployment device. This would be a good example of where engineers are designing structures, performing structural analysis, selecting materials - OK they are small structures - but nevertheless the skills required are already the well-oiled parts of any civil engineer's toolkit. This is why I maintain that engineers contemplating entering a particular industry should not feel constrained by past career choices'.

He said that an area close to his professional interest was surgery for chronic gastrointestinal reflux disease or GERD i.e. severe heartburn. A number of companies were seeking to develop solutions for minimally invasive surgery for GERD, the objective being to replace a life-long regimen of drugs, in this case so-called proton pump inhibitors. These devices tended to be designed by mechanical engineers. *'I have heard it said we need more engineers with experience in linkages and micro-motion to participate in the design of such equipment. It is probably true, as one area we have not been as active in is in surgery (other than orthopaedics), where a lot of engineers with such skills are employed. It is probably an opportunity for development'*.

O'Dea continued: *'Perhaps one of the most elaborate tools generated by engineers for surgery is the surgical robot. The concept was largely developed to allow for potential use in situations where an expert surgeon could perform surgery on patients a long distance away. However, nowadays the devices, as*

typified by the DaVinci surgical robot, are used to provide greater control in small areas within the body, to surgeons within the operating theatre itself. The robot is a phenomenal piece of engineering, though at over a million dollars each, many hospitals have trouble justifying the expense, particularly when the surgeon is right there in the hospital'.

An area of strong interest in the medical device area is neuromodulation. We are all familiar with pacemakers and defibrillators, where electrical pulses may be applied to regularise heartbeat. However, there is a growing class of applications where nerves are being stimulated with implanted devices to achieve different purposes. One example that many will be familiar with is neurostimulation for reduction of pain.

Other applications include vagal nerve stimulation to reduce appetite in weight loss applications, stimulation of the sphincter between the stomach and the esophagus, to cause a reduction in reflux by toning up the sphincter muscles, or pacing of the stomach to improve transit of food. Stimulation of the brain is a new frontier. Whereas much has to be learned , engineers are now developing neural stimulation techniques for Parkinsons disease. Engineers in this latter area have specialist knowledge of signal processing.

One can see that there is a rich vein of engineering innovation in the medical device sector. However, a key challenge in the health system is cost. In some sense, the cheapest care is best delivered outside the hospital environment. Connected health is a growing area of interest. Whereas on one level one can become enamored by applying all sorts of sensors in the home environment, the reality is that most of us do not want to wear sensors as we go about our daily activities of life. Equally, there are not enough doctors with the time to be monitoring the output from a variety of sensors spewing out reams of health information from their patients. There was, in O'Dea's view an excellent opportunity for Ireland to become a leader in the management of such information.

O'Dea commented: '*As we look to the future of novel medical device technologies, we are at the dawn of an era of regenerative medicine, or as it is sometimes known, tissue engineering. We will in the medium-term be growing organs from stem cells obtained from patients themselves. The scaffolds upon which we grow these cells, the bio-reactors that will be needed to be designed and operated to simulate the conditions (mechanical, temperature, chemical) to cause these stem cells to be appropriately differentiated, present design and manufacturing challenges that will keep engineers occupied for decades to come'.* O'Dea felt that novel process engineering approaches would offer opportunities for manufacturing engineers. In particular, the scaling of these processes would be crucial. As these were heavily automated processes, making very high-value products, the jobs they create would not be threatened by low labour cost countries. However, we needed to both leverage from, and develop beyond, our existing process engineering capabilities, and adapt to these new, more complicated, engineering and manufacturing challenges.

Apart from the very strong multinational presence in the medical device sector in Ireland, O'Dea said that it should be noted that over half the membership of the Irish Medical Devices Association was represented by SME companies. There was an exceptionally strong base of companies supplying into the multinational sector. This cluster of supply companies was also available to the growing number of end-user medical device startups that were a growing part of the medical device landscape.

O'Dea concluded this part of his address by saying: *'I hope that the address has given you all a good feel of what a dynamic industry the medical device represents. It is technology-laden and engineering driven. As an engineer, one's actions can have a direct effect on the health and wellbeing of many more patients than one could hope to meet in a lifetime as a medical doctor. The industry employs the full breadth of engineering disciplines, and, I would add, thankfully maintains a more healthy engineering gender balance than some other industries.'*

As a regulated industry, the medical device industry has stood out from a viewpoint of there being no requirements on professional qualifications for those responsible for the release of product to the market. This is not the case in the pharmaceutical industry where this task is performed by a so-called "Qualified Person". This is about to change with the new Medical Device Directive currently before the European Parliament. There will now be a requirement for a Qualified Person at each manufacturing facility, if the current draft of the Directive is passed. Engineers Ireland have been very active in relation to this aspect of the revised Directive having, in consultation with MEP's and FEANI, proposed an amendment to the Directive which would, in effect, give presumed compliance with the requirements for a Qualified Person, to engineers holding a Chartered Engineer qualification (with relevant industrial experience).

O'Dea continued: *'Chartered Engineers in Ireland enjoy a tremendous degree of portability with their qualifications, by virtue of Engineers Ireland's participation in a wide range of international mutual recognition agreements. As an example of international outreach I look forward to signing an Agreement of Cooperation between Engineers Ireland and the American Society of Civil Engineers in Washington in November.'*

'We are now in an era where the standard for registration as a Chartered Engineer has risen. Equally we, as an Institution, need to promote the title amongst those who issue contracts, or who employ engineering professionals. Much background work is underway in this regard, led from the front, by our Director General. It is encouraging to note the increasing number of positions being advertised where CEng is a requirement'.

O'Dea said that Institution membership would only grow if children continue to see engineering as an attractive career. It is recognised that career decisions are made long before students enter third-level education. As such, we need to grow beyond the already strong engagement Engineers Ireland enjoys with students in third-level institutions. The STEPS programme is therefore focussed on second-level students.

Of course, education doesn't stop after college. With the increased standards for CEng certification will come a commitment to continuous professional development (CPD). It will consume significant resources at Engineers Ireland to put in place over the coming years a system which will track further education activities. This is another task that will be somewhat lightened by the recent years investment in IT. By 2017, CPD will be a mandatory element of maintaining CEng registration.

Finally, O'Dea had a word to say about the Institution's finances: *'Despite a drop in membership, and increased investments in IT infrastructure and promotion of the profession, we have managed to keep the books in good order. Indeed, this year has seen a noted improvement in our finances. However, we cannot be complacent, with the ever-pervasive risk of a double dip in economic circumstances. Last year a root and branch review was conducted of how we as an Institution are structured from a regional and divisional perspective. As with any organisation that has evolved over a long period of time, it is helpful to take a step back and assess why we are the way we are, and why we do things the way we do'.*

Regina Moran began her presidential address in 2014 by saying that she had chosen two main themes for her presidential year: convergence between all forms of engineering, and the challenge of attracting women to the profession. She said that she wanted Engineers Ireland to thrive and push the boundaries of our new interconnected world and that it was her ambition to make this happen. She first gave her audience an insight into her world - the company she worked with, Fujitsu, and the ICT sector where she had spent her career.

Regina continued: *'As your President I am excited and confident about the future year ahead but also realise the challenges that we face. As you know we are undertaking a strategic review. The challenge for us, as a member-based organisation, is to remain both relevant and in tune with our current and potential members'*.

She said that her presidency would be one of convergence - convergence of technology and all forms of engineering. It would be a presidency that celebrated all of our possibilities and diversity . One that continued to push boundaries and be of assistance and encouragement to those in schools and colleges who might consider engineering, and to companies who must encourage job creation in our sector. It was true that there was a huge convergence happening, between all the forms of engineering and technology. Not only was there convergence of technology itself but also of all our engineering disciplines.

Regina felt that this was also creating an opportunity for Engineers Ireland in the 21st century to expand our reach, increase our membership and provide a structured framework in which convergence is managed and controlled across multiple engineering disciplines, working in teams to solve multi-faceted problems.

In the past three years over 17,500 jobs had been announced by technology companies in the IT sector. The sector was responsible for 40% of our national exports and was home to eight of the top ten global technology companies. Ireland was emerging as a global technology hub. This was an opportunity for Engineers Ireland's membership and one that was largely untapped.

There was a collision happening between the physical world and the digital world, which was creating opportunities for all of us in the engineering and technology sectors. We all live in the physical world which increasingly we are sensing using IT, even wearable IT. This was generating large amounts of data, which then creates knowledge about our physical environment. This allows us to better navigate and make changes to improve our physical world. A new generation of the internet was emerging. People and the things around us, are all linked together, sharing information.

The World Economic Forum has called it the 'Hyper-connected World' and it has huge impacts for the future. More connectivity means more collaboration. It means vanishing boundaries. It means changes to the way businesses work and how society creates value. It also means risk and uncertainty. It means the future will be different from the past. There is enormous change happening. The hyper-connected world was made possible when the internet was born and all manner of things became accessible to almost everyone anywhere. The internet has brought together everybody and everything - people, companies, government and most recently machines.

The hyper-connected world is the foundation of modern communication, trade, human, scientific and economic development. It is ubiquitous. It is everywhere, and it encompasses almost everything and everybody within its borders. The economic, political, social and business consequences of this new landless continent are real and of a far greater magnitude than anyone could have imagined and we are only at the beginning of its exploration. It is the playground for all our businesses and organisations and how many of us now live. At the heart of the hyper-connected world is a new industrial revolution.

Regina commented: *'We in Engineers Ireland need to be very aware of the implications. This revolution is happening now as we connect all things to the internet and all things to each other. Harnessing information gives us new insight and greater control of our world. It creates knowledge. It also carries risk. With so much of what we do in the physical world now written down in bits in the digital world, we face a serious challenge to secure what we do and protect our privacy. We must defend ourselves from ever-increasing malicious threats. We must avoid the chaos that change always has the potential to bring. A huge*

challenge where engineers can make the critical interventions'.

Regina asked: *'How do we respond to the challenge of the hyperconnected world ? How do we take advantage of the opportunity? How do we guard against its many risks? These changes have huge implications for enterprises and bring new challenges for resource management, healthcare, disaster mitigation and our environment. Put simply, we need more engineers in our world!*' She continued: *'Women remain largely a great untapped resource in our profession. We must find ways of attracting young girls as well as young boys to join forces with us and tackle some of the world 's greatest issues'*.

The 2013 Engineering Perspectives Report informed that on average, the ratio of men to women in engineering was 9:1, whereas a fifth of all respondents in this survey were women. Of these, half were under the age of 35. Regina said that it was heartening to see that programmes like our STEPS schools outreach programme were producing results. Our STEPS campaigns, touching the lives and ambitions of more than 56,000 young people last year, was a testament to the dedication of Engineers Ireland and its members.

Regina ended by saying *'I am proud to be an engineer, a technologist and a female running a global company in Ireland but I am immensely proud to serve as your President.'*

In the introduction to his presidential address in 2015, **William (Bill) Grimson** considered that engineering was a challenging and challenged profession. Mark Twain, perhaps facetiously, said that "we should strive to do the right thing. It will gratify some people and astonish the rest". Like other practical professions, such as medicine, engineering within any given context aims to meet the twin objectives of "doing the right thing" and "doing it right". Grimson felt that it would be hard to disagree that this represented the fundamental challenge in engineering. There were many reasons why engineering could be considered as both a challenging and challenged profession.

He continued: '*While engineers of necessity need to organise (create, use and record) knowledge this is essentially not their primary objective, rather it is to make a contribution to how we live. The question we must all ask at some stage is whether the creations of engineers contribute in a positive way to "organised life" and in a manner that is or becomes acceptable to society*'.

Samuel Florman in his book *The Existential Pleasures of Engineering* wrote that "professionals have an obligation to lead, but they also have a duty to serve." He went on to add that "having been served, society then has no right to blame the professionals for its own short-sightedness." Grimson commented: *'Here in a nutshell is the first challenge in respect of how society and engineering interact. Should engineering refuse to serve society when it thinks it would be better not to? And should engineering give society something that has not been demanded, but which is believed by the profession to be justified? How can progress be moderated?'*

Grimson felt that it was probably conceited to imagine that we lived at a special time, but it is hard to resist the thought that in fact we do. With climate change, terrorism, migration, cyber-crime, food and water shortages across the world, to mention just a few, we are faced with huge challenges and engineering cannot be a mere spectator. In advance of the G7 summit in June 2015, the Japanese Prime Minister laid out what he considered were the main goals: Climate Change; Quality infrastructure - to sustain high quality growth that can enhance well-being now and in the future, developing countries will need high quality infrastructure in place; and Health and Medicine. It is clear that engineering has a role in all three areas (de-carbonised energy production, civil engineering in delivering infrastructure, bioengineering and bio-pharma in contributing to the medical profession).

Pope Francis has written: "We are the beneficiaries of two centuries of enormous waves of change: steam engines, railways, the telegraph, electricity, automobiles, aeroplanes, chemical industries, modern medicine, information technology and, more recently, the digital revolution, robotics, biotechnologies and nano-

technologies ... technology has remedied countless evils which used to harm and limit human beings. How can we not feel gratitude and appreciation for this progress, especially in the fields of medicine, engineering and communications? How could we not acknowledge the work of many scientists and engineers who have provided alternatives to make development sustainable?" But there is a worrying note eloquently expressed ... "never has humanity had such power over itself, yet nothing ensures that it will be used wisely, particularly when we consider how it is currently being used".

This then is a great challenge to mankind, society and of course engineers too, to use technology wisely in a sustainable manner. Grimson said '*We need to reflect deeply on the practice of the engineering profession both as individuals and in groups, businesses and institutions'*.

David Balmforth, President of the ICE, has said: "Engineering has in the past made very significant and beneficial contributions to the well-being of people. Think of the great water and sewage schemes in cities which it is often claimed did more to contribute to the health of its citizens than the combined efforts of the nursing and medical professions. But what about the future? We know predicting the future is harder than explaining the past but one rational initiative has used expert panels to consider those areas in the future most deserving of attention".

For example, the USA National Academy of Engineering (NAE) has identified fourteen grand challenges and opportunities for engineering during the world's next few generations. It pointed to engineering or scientific research and innovation that look promising for addressing each challenge as well as suggesting currently unmet research needs. The list of challenges was:

Make solar energy economical; Provide energy from fusion; Provide access to clean water; Reverse-engineer the brain; Advance personalized learning; Develop carbon sequestration methods; Engineer the tools of scientific discovery; Restore and improve urban infrastructure; Advance health informatics; Prevent nuclear terror; Engineer better medicines; Enhance virtual reality; Manage the nitrogen cycle; Secure cyberspace.

Earlier in this address, the interaction between the engineer and society was mentioned in considering two points made by Samuel Florman. One of the characteristics of such interaction is that both sides generally do not agree on the totality of the issues involved. In fact there is a fundamental imbalance between the views of society and the perspectives of both the funders and providers of solutions. Groups in society largely address single topics in limited time frames and from a narrow perspective. Funders and solution providers on the other hand need to take long-term and more holistic views. The situation, at least in Ireland, is not helped by virtue of the fact that our democratic system (in reacting to public opinion) is prone to short-termism and choosing heavily compromised solutions. The battlefield is often the Planning Process including its Appeals. No party has the right to demand a particular outcome, but the process has become excessively time-consuming and lengthy delays eventually can be very costly. Grimson said that he cannot but wonder is there not a better way for society to interact with the profession (and it is a two-way process). Consent was critical to moving forward. But this needed to be informed consent. The challenge is one of both informing society and maintaining trust.

Grimson then illustrated the underlying problem, by considering the provision of energy to meet our current and future needs. A non-exhaustive list might include the following sources: Fossil fuels (oil, gas & coal), Biomass, Fracking, Fission (nuclear), Fusion, Wind (Land-based and Offshore), Wave, Deep mine coal gasification, Solar, Hydro (dam), Imported (via undersea cables and distributed via networks). Not one of the sources is without its disadvantages and some have more than others. Society does not get exercised in general about which sources it wishes to use and is largely only concerned with having access to a steady supply of energy. That is until it is proposed to locate a facility in a given location in which case a protest group will be established to block its construction. We cannot be against everything unless we are willing to forgo the benefits of having energy supplied to our homes. To summarise the position: Each of the energy sources mentioned is not without significant undesirable attributes; the lobby groups, to a large extent, operate in isolation and are independent of each other; politicians because of the need to maintain a voting base, and because the lobbying is invariably local, find it almost impossible to challenge any lobbying; and it has to be admitted, that each of us unencumbered with more general or holistic considerations, either would support or have sympathy with one or more lobby groups. To return to Samuel Florman – "professionals have an obligation to lead, but they also

have a duty to serve. Grimson asked: 'have we as professionals got the right balance between leading and serving and are we participating with society in a climate of sustained dialogue and trust?"

Speaking about engineering education challenges, Grimson said '*that the expectation of "graduateness" by which an undergraduate is transformed from being hesitant and dependent to one of being decisive and autonomous with critical thinking skills and an appreciation of the uncertainty, ambiguity and limits of knowledge, is easier to define than deliver. Anyone who has any knowledge of devising or judging an engineering curriculum knows how difficult it is to achieve the right balance between theory and practice, content and application, so called hard and soft skills, not to mention fundamental science and mathematics. It is challenging.*'

Dr Brian MacCraith (DCU President) had noted that, over the past decade, high-profile employers across the world have emphasised the need for today's young professionals to possess not just deep disciplinary knowledge but a keen ability to operate effectively across disciplinary, social and cultural boundaries. Grimson quoted the view of a Dean of Engineering in 1955, N. W. Dougherty, "that the ideal engineer is a composite ... he is not a scientist, he is not a mathematician, he is not a sociologist or a writer; but he may use the knowledge and techniques of any or all of these disciplines in solving engineering problems". Ignoring the gender specific "he", Grimson felt that the sentiments were just as valid today as they were 60-odd years ago. The question can be asked is there an ideal all-encompassing engineering curriculum that "ticks all the boxes" and the answer is simply no; it is impossible. What is needed then is a variety of programmes with different footprints that collectively provide the profession with in-depth but wide coverage.

In conclusion, Grimson opined that what was required of the engineer and the engineering profession was multi-faceted, complex and undoubtedly demanding. It was clear that it was not , nor was it possible, for all individuals in the profession to be cast as the perfect rounded renaissance philosophical engineer. Somehow however the profession, as an ensemble of engineers, did need to meet the exacting demands that followed from the challenges. He summarised his address as follows:

'As a profession we should engage in identifying, agreeing and reviewing today's global challenges for engineering and then follow up accordingly.

We need to be part of and encourage a change of culture in society by which to oppose is replaced by one of collectively choosing the best from a set of options.

The engineering profession should actively maintain and continue its efforts to inform society of the issues it is concerned with and to work towards achieving the highest level of trust.

No one educational programme can be expected to provide the learning environment in which its graduates excel in all or most attributes linked to the ideal engineer.

What is required is greater diversity. Diversity should be valued both in respect of individuals and educational programmes and Accreditation Bodies should consider relaxing their criteria to allow for greater diversity in constructing engineering programmes.

The soft skills (emotional intelligence, critical thinking ...) are in fact hard or difficult to inculcate and need to be developed throughout the formation of the engineer (pre-university, undergraduate, post-graduate and in employment): a life-long challenge!'

Dermot Byrne, president in 2016, chose as his topic *Ireland's Energy Challenge*.

In Ireland, the transition from a traditional rural subsistence economy to the thriving first-world economy that we now experience and take for granted, was paralleled, and underpinned by, a transition in the energy system that powers our economy and our society. We had the development of the Shannon Scheme, and also the establishment of a national utility, the ESB, to manage the output from the scheme and to develop and manage the total electricity supply for the State. During the 1940's and 1950's we had the further harnessing of our hydro resources and the development of an indigenous peat industry. In the 1960's, as the economy opened up and

emerged from stagnation, oil became the prominent fuel. In response to the oil crises in the 1970's, we had a major push to diversify out of oil into natural gas and coal, such that by 1990 oil was reduced to 5% of primary energy source for electricity, from a figure of 65% a decade before. But perhaps the greatest energy transition that took place during the last century was that of rural electrification, in terms of impact on peoples' lives, on the rural economy, and on society as a whole.

Byrne said: *'As we face into the remaining 80 years of this century we are, I believe, facing into another major societal transformation, the outcome of which is far from certain, and which will be shaped by how we respond - through mitigation and adaptation - to the challenge of Climate Change. The reality of the challenge, and the existential threat, posed by Climate Change is, I believe, beyond question'.*

Byrne noted that evidence was emerging in Ireland of the impacts of climate change in relation to extreme weather events and ecosystem changes. Storms such as those experienced in 2014 are now becoming more frequent. World-wide, the insurance industry has woken up to this new reality and has recognised that Climate Change has the potential to make a nonsense of their risk models.

Byrne asked: '*Can we deliver the societal transformation and underpinning energy transition quickly enough to limit global warming to the 1.5 to 2°C range which is deemed to be acceptable? The speed at which the energy transition to a low-carbon future takes place is a critical consideration, and if action is not taken soon it may be too late'*.

Energy transitions can happen quickly - in the region of 15 years or so where there is centralised decision-making and implementation, and somewhat longer at 20 to 30 years, where there is a reliance on consumer behavioural change and adoption of new technologies. Deciding factors here include:

- availability of the enabling technology;
- a burning platform to change;
- clear customer benefits;
- and clear policy direction and implementation.

Byrne asked: *'What are those energy transitions that have to take place, and how quickly, if we are to leave the world a better place for our children and grandchildren?*'

Firstly, there is the transition to zero carbon in our electricity supply. Further down the road, certainly before 2030, coal and peat-fired generation will cease, taking two very large carbon emitters out of the equation. A combination of the drive for end-use efficiency and the shift to a services economy means that the link between GDP and load growth has effectively been broken. Nevertheless, there will be load growth, driven by developments such as data centres and the electrification of the heating and transport sectors.

Byrne continued: *'So where will new generation sources come from? Costs of wind and solar power are coming down, and the technical challenges associated with lack of system inertia are being addressed. In the absence of further high-volume energy storage, a combination of interconnection and low load-factor gas will be used to manage intermittency. Biomass will certainly be part of the mix'.*

Reservoir under drought conditions

Byrne stated that he believed that the global challenge of Climate Change required a global response, and part of that global response must include nuclear energy at scale. The reality was that, at the time, 30 countries worldwide were operating 444 nuclear reactors for electricity generation and 63 new nuclear plants were under construction in 15 countries. Nuclear power plants provide about 10% of the world's electricity production, and in the EU just short of 30%.

For Ireland, Byrne believed that at some point in the future, as the transition to a low-carbon energy system gathered momentum, it was conceivable that nuclear power could become an attractive option. However, for this to be considered a realistic policy option, the following would need to have happened:

- Next generation fission reactors (such as Generation – IV reactors) would need to have established a record of successful commercial and safe operation, and would need to be available in sizes appropriate to a relatively small country such as Ireland;
- Sustainable and proven solutions for the management of fissile materials and radioactive waste would need to be available;
- Demonstrable public support, based on a detailed understanding of the benefits and risks within an overall policy context, would need to be evident.

This latter requirement will be the most difficult of all, but it will not happen until we begin to have a proper grown-up debate on the issues.

Byrne noted that electricity supply represented only about 20% of the carbon emissions from the energy sector. Of greater importance at this stage were the heating and transport sectors - representing 21% and 26% of non-ETS GHG emissions respectively.

At present (2016), the number of residential homes in Ireland was about 1.7 million, and accounted for 44% of final thermal energy use, even greater than industry at 35%. First and foremost, the energy efficiency of these homes must be improved through a process of deep retrofit, and then their heating systems replaced with low-carbon heating systems. This requires investment decisions to be made by consumers; as the White Paper says*:* "the success of energy efficiency depends on the response of consumers. Ultimately it will be decisions by individuals that will make houses warmer, businesses more competitive, and public services more cost efficient."

Turning to the transport sector, Byrne said that one of the key differences between this sector and the electricity supply sector was the element of behavioural change and customer choice involved. Customers have to want to change from oil-based transport, and/or be incentivised to do so. This required attractive alternatives to be available. A modal shift from cars to public transport, to bicycles and to 'Shanks' Mare' - supported by policies and investments to make such shifts attractive - could play a role. The roll-out of bicycle lanes in Dublin and the Dublin Bike scheme were good examples. However, the real challenge was to transition out of oil in the passenger car and the heavy vehicle fleets and the gradual introduction of electric vehicles. The range of vehicles on offer from the major manufacturers continues to expand, and the research and development effort devoted to battery technologies continues to hammer away at the two major obstacles to large scale adoption: - cost and range.

Globally there are about one billion passenger cars on the road, and growing rapidly. These billion cars account for roughly 1/5th of total oil consumption. By the end of this year about two million of these cars, or 0.2%, will have a plug, up from 6000 in 2009. In terms of the product or technology adoption curve, the current market is being driven by the innovators and early adopters, people who are willing to pay over the odds, and by

government subsidies in support of climate change policies. Of course, subsidies cannot go on forever, especially as the sale of EVs continues to grow exponentially. The subsidies at this stage of market growth are critically important in driving up volumes and driving down costs. According to a recent Bloomberg report the real lift-off will happen when the total unsubsidised cost of ownership drops to that of oil-fuelled cars. That depends on the cost of the battery, which currently accounts for about a quarter of the total cost. However, battery prices fell 35% last year. Projecting the battery cost curve forward, the report estimates that the point of mass-market lift-off will occur in the mid-2020s, and that by 2040 sales of electric cars will account for 35% of all car sales.

When it comes to heavy vehicles, using CNG offers a real opportunity to reduce emissions from diesel-fuelled trucks and buses. Importantly, the introduction of CNG to the heavy vehicles fleet is a gateway for the future introduction of renewable gas into the transport sector. Renewable gas in the form of biomethane is an upgraded form of biogas, and is produced through the anaerobic digestion of organic matter. Where renewable gas is used in CNG vehicles, emissions are CO2 neutral, helping to address targets for renewable transport. Renewable gas can be produced from agricultural wastes, thereby also helping to address emissions from the agriculture and farming sector.

Byrne said he believed that we have a clear and unequivocal platform for change in the challenge of Global Warming. *'Certainly, enough to spur policy makers into action, as we have seen at global, EU and national levels. But is it a 'burning platform' - by that I mean is it universally felt as such across all levels of society to the extent that there is a shared sense of urgency? Unfortunately not, and the paradox is that by the time it is felt as a "burning platform" it may be too late. Consumer behavioural change must be sold on the basis of clear consumer benefits, as much as on the need to protect the planet'.*

In conclusion, Byrne opined: *'We in the engineering community have a central role to play. We do "technology" - it's what we're good at. Ireland has a very vibrant energy research and innovation ecosystem, but I believe we can do a lot more. We should make sure our voice is heard in policy formation, bringing a strong evidence base and energy modelling capability to bear. Institutions such as Engineers Ireland, and our sister organisation the Irish Academy of Engineering, can and will play a major role here in distilling the collective experience of the engineering community, and making it available to policy makers'.*

'But beyond that again I think we have a further role, and that is to get involved in communicating the reality of the "burning platform". As engineers, we tend to stand on the side-lines, and stick rigidly to "the facts". I believe we also need to engage at an emotional level, and with conviction. How can we not get emotional when we know with considerable certainty what is going to happen to this planet of ours if we don't take action soon. How can we not get emotional when we see the effect that flooding has on large sections of our population year in year out. How can we not get emotional when we see the effects of drought in large sections of Africa, and the resultant impact on migrant flows across the Mediterranean'.

In his presidential address in 2017, **Kieran Feighan** examined how harnessing energy to improve mobility had been the foundation for the development of many of the great empires in the world. He aimed to show that when a new energy source had been identified and harnessed, particularly harnessed to aid and improve mobility, then a transformative step change was created in the ability of a particular country or locality to rise above and in many cases dominate their neighbours, both locally and, more recently, globally. He looked briefly at a number of different empires, the Roman Empire 2,000 years ago, the Spanish empire about 500 years ago, the British Empire 200 years ago, the American empire which started about 120 years ago, and the Chinese empire, a nascent empire which started within the past fifteen years.

The world had again reached a point where the global economy was likely to be changed utterly as a new source of energy (renewables) is coupled with transforming technology (the Internet of Things, Big Data, Sensor Technology) and transport solutions (Autonomous and Connected vehicles, Electricity storage, Hydrogen fuel cells, Road networks as Energy distributors) to produce winners and losers at enterprise and national scales.

An enormous key to the success and longevity of the Roman Empire was transport. The primary energy source was biomass or food for both animals and humans. There was widespread use of manpower, including slavery to move boats in particular, with a secondary source of wind energy for maritime transport. In road transport, the carts and chariots were typically towed by harnessed animals, but ultimately the animals in turn derived their energy from biomass.

The well-managed Roman road network allowed the governance of landlocked areas and also allowed cities with ports to connect to one another and to move resources from one part of the empire to the other. They formed the basis of the first reliable communication or postal system, and then very importantly formed the basis of towns evolving from way-stations where animals were fed and rested. The road trade and culture that evolved allowed the spread of ideas from one part of the empire to the other including the spread of Christianity from a relatively isolated and backward location in Palestine across the Roman Empire.

The first truly "Global" Empire was the Spanish Empire with a Golden age between 1520 and 1640. The Spanish Empire was based on trading and exploitation of gold and silver from North and South America, and in trading with Asia in porcelain, silk, spices and jewels. The ability to move goods and people from continent to continent on the oceans was the key to the success of the Spanish Empire. The Spanish carracks and galleons could carry in excess of 1,000 tonnes, and formed the basis for the military and trade domination exerted by Spain. Wind power was the innovative energy source, harnessed via new hull designs and engineering designs to allow much bigger boats to be built with lower friction and with new and adapted sail technology to make them easier to navigate.

Steam-driven pumps

Moving forward 200 years, Britain was the undisputed world power, with direct economic control of many colonies and indirect economic control of many other territories including China and Argentina. What was the basis for this growth, this ability of a small country to be the undisputed world power for over a century? Again, the contention is that it was the evolution of new transport modes in conjunction with a new energy source and technology. In transport modes, the turnpike roads that developed in Britain in the late 1700s and early 1800s were really the first major network of roads that were built since the Romans. At the same time that the turnpike roads were evolving, Britain was developing a series of canals with features explicitly designed for transportation of goods on water, again using animals on the towpaths as the primary source of energy. In turn this development of canals opened up the interior of Britain, and the natural and mineral resources of Britain for mining and exploitation. A new energy source was also revealed on a large scale, the use of coal as an energy source to power a new engineering technology, the steam engine, using high-pressure steam to move pistons. Spurred on by the development of the railway for transporting coal from mines to sea ports, George and Robert Stephenson produced the Rocket steam locomotive in 1829 and very quickly thereafter, a massive revolution of the transport space. Brunel's developments for the Great Western Railway linking Bristol to London in the 1850s, a mere 20-25 years after the first coupling of the steam engine with rail, involved the building of massive engineering structures, the railway termini which could handle large volumes of passengers moving in and out of the cities, as well as goods. Bigger steam locomotives were required that could deal with much greater loads of people and goods. Engineers no longer followed the landscape, but imposed a gradient on the landscape, and as a result needed both very large-scale bridges and very significant tunnels. Railways were by far the cheapest way to move goods, especially high-volume goods, such as mineral ore and coal. As cities and countries grew wealthy from this access to resources, it became clear that the cheapest way of moving commuters was also along the high-density corridors that railways could offer.

The British had also evolved their naval capabilities hugely before the 1800s, but Brunel, among others, exploited new technologies and new materials including steel and riveted cast iron that were available to create much bigger ships, using a new power source, high-pressure steam, to replace wind power. There was a massive shift

in capability and capacity, again through the harnessing of a new source of energy, coal-powered steam, to move people and goods, in this case to move people across oceans.

The direct development of these transport technologies, in turn drove associated developments. The need for steel to manufacture the railway termini as well as the rails, the buildings and structures that were needed in turn allowed the development of multi-storey steel structures, facilitating the development of cities of much higher densities such as London and New York.

The British Empire was soon surpassed by the American Empire, which realistically dates from around 1900. An empire unlike the British Empire in that it continues to be primarily a trading economic and cultural empire, rather than a military empire, but it is also the predominant global military force in the world. The US economy grew and surpassed the British economy because it developed new energy sources and new forms of transportation/mobility, The United States in 1900 had abundant resources of coal and steel and was pioneering the initial development of electricity as a source of lighting, heating and power. Electricity was being generated in large volumes through hydroelectricity and coal-burning generation and there was significant availability of electricity throughout the large cities and smaller provincial cities in the USA.

John D Rockefeller was the key instigator in the discovery of a new energy source that would transform the globe in the 20th century. In his processing of natural oils to generate kerosene for heating and light, he realised there were many by-products from the distillation process that were not being used, and sought to find other uses for these by-products, in turn leading to the development of today's oil and petrochemical industries. The realisation that petrol and diesel "by-products" could be used in conjunction with the German diesel and internal combustion engines as a new source of energy to link to road-based and rail-based vehicles was a transformative revelation. Henry Ford broke the mould by integrating and developing the use of an assembly line to speed up the manufacturing process of the motor vehicle. Suddenly there was competition in the transport sector, and the road network was a huge challenge to the rail networks because it had a number of advantages. Spatial reach, flexibility of use, a range of different vehicle types and costs, affordable vehicles, an energy source that was readily available through the oil companies, an ability to go door to door with the same vehicle, not possible with railways, and most importantly personal freedom of choice.

The ability to move relatively light but high-value goods over large distances quickly created an underlying basis for the development of the air industry. The scale, carrying capacity and range of the aircraft developed hugely over the course of WW2. Today, we are familiar with massive aircraft able to move many hundreds of people over thousands of kilometres at speeds of 1,000 km/h. This incredible new transport technology further supported the pre-eminence of the USA as a global leader in economic terms as well as military terms. Widespread use of nuclear energy for the generation of electricity and innovative energy sources will continue to drive the growth and expansion of the global economy through the 21st century.

China has very rapidly become a trade and economic empire, with a clear focus on purchasing of energy, mineral and transport resources. China has identified the same factors that we have seen in the historic development of the great empires, with a huge investment in infrastructure and a clear focus on the purchasing of energy, mineral and transport resources worldwide. If we look at what China has created in terms of transport infrastructure, it has built a motorway network at the end of 2016 of 130,000 kilometres compared to the US 77,000 kilometres. China has a railway network of 120,000 kilometres, half of the US railway network length. However, in High Speed Rail (HSR), there are 60,000 kilometres of high speed rail currently in China; two thirds of the total length of HSR in the world is in China with plans to add another 16,000 kilometres by 2025.

Integration and impact of new and modified transport systems, both public and private, will have a huge impact on how society functions in both urban and rural areas. This is particularly timely in 2017 in Ireland, with the imminent roll-out of the National Planning Framework aiming to lay out an integrated land-use approach to development of Ireland's cities, towns and rural areas up to 2040.

To quote Sir John Armitt in his ICE Presidential address to our Institution in February 2016, "We are the holders of the knowledge necessary to create the systems. We are the best able to work with other engineering professions to assess solutions, the alternative technologies, to develop new technologies, to design, fabricate,

cost, build, operate and eventually decommission the systems. We have a responsibility to put all this information before politicians and investors and make it available to the public."

Feighan concluded his address with these words: *'History has shown us that the underlying driver of preferential economic growth is the discovery, adoption and adaptation of new sources of energy linked with new forms of transport. We are ideally placed to be a full-scale R&D laboratory, investigating solutions for congested cities, growing towns, rural areas and ultra-low rural density areas, using new energy sources and connected communications and IT systems, using the flexibility and ability to work together and develop pragmatic and practical solutions that Irish people, and Irish engineers in particular, are renowned for'.*

On 20 September 2018, **Peter Quinn** presented his presidential address entitled *A Blueprint for Housing – Plans for Growth*. He began by reminding his audience that the scourge of homelessness was still a reality for many in Ireland today and the desire to have a house of one's own had not abated. *'We are, without doubt, in the midst of a housing crisis. As ever, rents are only the symptom, the cause remains a chronic and worsening lack of rental supply'*. Housing problems such as unaffordable rents and property prices were particularly acute in Dublin and this situation was forcing many to commute long distances from the commuter belt and further afield.

Quinn concluded that *'as a country, our population is projected to grow by one million over the next twenty years. On a conservative estimate, this population increase will require Ireland to build at least 25,000 new housing units every single year to 2040 and beyond'.*

Before presenting his blueprint for this housing, Peter said a few words about the quality of the houses we build. *'Unfortunately, some of the homes built during the Celtic Tiger did not meet acceptable standards. Some of the problems that bedevilled our building endeavours in the past included low energy efficiency, a lack of fire-stopping and building in flood plains. While these issues may have affected a minority of homes, there were devastating consequences for some residents, one of these issues being pyrite'.*

The damage that pyrite can cause is stressful to the home owner and an expensive problem to remedy. The possibility that pyrite may have been used in a small number of homes in a development can have a very negative affect on all property values in the entire development. Pyrite in back-fill can take upwards of 40 years to fully oxidise (swell) and become stable. The removal of pyrite is an expensive task and typically involves supporting the existing first floor structure and roof, removing the existing concrete floor slab and partition walls resting on the floor slab, removal and replacement of all services in the affected area, removing all existing contaminated gravel and then replacing same with proper materials.

It is abundantly clear that the demand for quality housing – in the right locations – is far outstripping supply. At the peak of the Celtic Tiger building boom, the construction industry was delivering up to 90,000 homes per year. This collapsed to less than 5,000 in 2013. Now, in 2018, it is expected that 18,000 houses will be built. This is far short of medium-term demand of around 35,000 per year or even of long-term demand of at least 25,000 per year to 2040.

Quinn continued: *'The distance between current housing output and demand, combined with the time needed to ramp-up construction, means the market will remain under-supplied for some time to come. I believe we will see further house price and rent inflation over the next three years, albeit at a slowing rate as supply catches up and a base effect kicks-in'.*

'All of this means that the demand for social housing will continue to rise. Yet, we have perilously little social housing coming on stream and the public stock of housing is as low as it has ever been since the foundation of the State. I would therefore like to set out a blueprint – some engineering solutions – for housing, with a particular

focus on social housing'.

'Firstly, I believe that we must take a strategic approach to housing delivery, one which considers the wider system of infrastructure, technology and skills. For example, appropriate sites, clean water supplies, public transport, schools, hospitals and broadband, are all needed if we are to build sustainable communities'.

Quinn welcomed the Government's Project Ireland 2040. This consists of the National Planning Framework, which sets out a spatial strategy for Ireland to accommodate, in a sustainable and balanced fashion, significant demographic changes. The National Planning Framework is backed up by an infrastructure investment programme, the National Development Plan to 2027. In short, the State's infrastructure investment – the money – is guided by and follows the Plan. That is what makes Project Ireland 2040 different and a significant innovation in Irish public policy.

The hard part is delivering these vital projects on time and maximising benefits for the largest number of people, particularly in the area of housing. For example, we need to see public transport projects – like the Metro Link and expansions of the Luas lines – planned and built so as to unlock land for housing development and to reduce reliance on motor vehicles. Our transport authorities must work hand-in-hand with Irish Water, Government departments, local authorities and others to build up connected systems of infrastructure.

However, this programme of work touches on several other issues of strategic importance. Not least, that public engagement in project delivery (whether housing or civil infrastructure) remains key. Our engagement with the public and with other professions can help us to develop the best designs and to navigate planning.

Land availability and cost are major features of our housing crisis. We face particular land pressures in our cities, where the demand is greatest – and is projected to rise into the future. Yet the State has considerable land holdings, including in our cities. Urban land redevelopment offers fantastic potential to rejuvenate areas of our towns and cities.

A new Government agency, the Land Development Agency, has been established to manage State-owned lands, to develop homes and to regenerate under-utilised sites. The Agency will also buy private land adjoining existing prime sites held by State and semi-State organisations in order to assemble land holdings that will then be developed for housing.

The Agency will unlock the State-owned sites for private development to facilitate the construction of 150,000 homes by 2040. Under the plan, developers will have to agree to requirements such as ensuring the site has 30% affordable housing and 10% social housing. However, some parties are concerned that public land will effectively be privatised and that no houses will be delivered until at least 2020.

The Land Development Agency could become a key action in social and affordable housing supply and could transform whole districts of our cities, but:

- It must be given a strong mandate and legislative footing;
- It must be well-staffed with the necessary professional competence;
- It must maximise the public good and achieve value-for-money.

Turning to a more immediate solution, rapid-build social housing and off-site construction, Quinn mentioned houses built off-site and incorporating a steel frame. They are highly energy-efficient and have solar PV panels. The residents were overall very positive experience of their new accommodation, including the "bricks and mortar feel".

They were particularly impressed with the size, layout and energy efficiency of the houses, although some had concerns about the enduring quality of the homes in the long term. The report concluded that rapid-build housing can make a meaningful contribution to solving our housing problems. The construction of homes in a factory-controlled environment facilitates quality build and accelerated construction times.

Quinn opined that *'the way our houses are built directly impacts our daily lives, our health and how we interact with family and friends. These are some of the features that make a house a home. Strong standards and top-quality delivery are required for safe, energy-efficient, accessible and future-proofed homes. The current housing crisis simply must not lead to any dilution of building regulations and standards'*. He continued: *'A lot of attention is being paid to increasing housing supply, but we must not forget the benefits of retrofitting our existing stock'.*

New social houses, including rapid builds, must achieve the highest standards of building quality, while also being accessible and aesthetic. EU regulations require that all new buildings are nZEB by end of 2020 and all buildings acquired by public bodies by end of 2018. Those buildings will have high energy performance where a very low amount of energy input is required and where the energy requirement is met locally.

These requirements mean that all private completions in 2021 and beyond must achieve the nZEB Standard to comply with the Building Regulations. The time available is much shorter for Local Authority projects of residential units or public buildings.

Turning to the situation in Northern Ireland, Quinn commented that *'Since its formation in 1971, the NI Housing Executive achieved great success in the building of new homes and through the Repair Grant schemes. Under their stewardship, the quality of the housing stock improved dramatically and the quality of life for the community in general was greatly enhanced. Nevertheless, housing affordability, vacant homes, social exclusion and the legacy of conflict are still key issues facing deprived communities and vulnerable people in Northern Ireland'.*

Despite the housing crisis, the northern part of the island of Ireland had been transformed over recent decades, particularly since the Good Friday Agreement. The quality of life for communities had been utterly changed through enhanced cross-Border economic, social and cultural connections. This included positive developments in terms of international access, energy networks and security of supply, agriculture and tourism, environment, telecommunications and connectedness between key urban centres, labour market flows, education and skills, and healthcare.

Quinn concluded that *'the pending risks of Brexit, either hard or soft, make it is all the more necessary to continue to build enduring partnerships in key areas of economic, social and environmental mutual interest. Working together we can maximise the benefits of social and cultural interaction, mobility, job creation, skills development, productivity, trade and services for the population in both jurisdictions'.*

The Institution of Engineers of Ireland (Engineers Ireland)

Sources of Presidential Addresses

Year	*Name*	*Source*
1969	John Henry Harbison	TIEI (96) 1969-71
1971	Michael A Lynn	IE 24 (9) Nov.1971
1972	Robert Cormac Cuffe	TIEI (97) 1972
1973	Hugh Alexander Delap	TIEI (98) 1974-75
1974	Patrick Finbar Callanan	TIEI (99) 1975-76 / EJ 27 (10) 1974
1975	John D Barry	TIEI (100) 1975-76 / EJ 28 (10) 1975
1976	John H.Donovan	TIEI (101) 1976-7 / EJ 29 (10) NOV.1976
1977	William Wright	TIEI (102) 1977-78
1978	Lucas Collins	TIEI (103) 1978-79 / EJ 31 (10) 1978
1979	Morgan Sheehy	TIEI (104) 1979-80
1980	Liam O'Brien	TIEI (105) 1980-81 41
1981	Peter O'Keeffe	TIEI (106) 1981-82 73
1982	Eoin O Cionna	TIEI (107) 1982-83 41
1983	Patrick Joseph Lynch	TIEI (108) 1983-84 45
1984	Oliver Feighan	EJ 37 (12) DEC 1984
1985	Robert Noel Hayes	TIEI (110) 1985-86

1986	John Florence Lang	TIEI (111) 1986-87
1987	Michael D O'Donnell	TIEI (112) 1987-88
1988	Pierce Thomas Pigott	TIEI (113) 1988-89
1989	Brian Noel Sweeney	TIEI (114) 1989-90
1990	John Eugene Wallace	TIEI (115) 1990-91
1991	Michael John Higgins	TIEI (116) 1991-92
1992	Richard Patrick Grainger	TIEI (117 PT 1) 1992-93
1993	William A Fitzgerald	TIEI (117 PT 2) 1993-94
1994	Patrick Owen Jennings	TIEI (118) 1994-95
1995	John Joseph Killeen	TIEI (119) 1995-96
1996	Philip Callery	TIEI (120) 1996-97
1997	Gordon Stopford Millington	TIEI (121) 1997-98
1998	John Anthony Kavanagh	TIEI (122) 1998-99
1999	Jane Barclay Grimson	TIEI (123) 1999-2000
2000	Gerald Byrne	TIEI (124) 2000-2001
2001	Liam Connellan	TIEI (125) 2001-2002
2002	Brian Kearney	TIEI (126) 2002-2003
2003	Peter Langford	AR 2003-2004
2004	Patrick Caffrey	AR 2004-2005

From 2005, copies of the presidential addresses are normally available on request from Engineers Ireland, 22 Clyde Road, Dublin 4 in booklet or electronic format. Many are now web cast and may be found on the Institution's web site at www.engineersireland.ie. For this publication, a number of addresses were also sourced directly from the authors. Abridged versions of the addresses may also be found in *The Engineers Journal*, published online as an e-journal from 2013. All presidential addresses are held on file in pdf format and lodged in the Engineering Archive at 45 Merrion Square, Dublin 2. A Portrait of each President is also held on file in jpg format at the archive.

2005	Anne Butler	Booklet
2006	John McGowan	Pdf File copy
2007	Jack Golden	Pdf File copy
2008	Jim Browne	Pdf File copy
2009	Christopher Horn	Pdf File copy
2010	Martin Lowery	Pdf File copy
2011	P J Rudden	Booklet
2012	Michael Phillips	Pdf File copy
2013	John O'Dea	Pdf File copy
2014	Regina Moran	Pdf File copy
2015	William Grimson	Pdf File copy
2016	Dermot Byrne	Pdf File copy
2017	Kieran Feighan	Pdf File copy
2018	Peter Quinn	Pdf File copy

IEI Presidents 1969-2018

HARBISON, John Henry (1971 – 1975)

LYNN, Michael Anthony (1920 - 1982)

CUFFE, Robert Cormac (1912 - 2003)

DELAP Hugh Alexander (1906 - 1997)

CALLANAN, Patrick Finbar (1931 -)

BARRY, John Denis (1921 - 1979)

DONOVAN, John Healy (1920 - 1994)

WRIGHT, William (1918 - 1985)

COLLINS, Lucas (1917 - 1983)

SHEEHY, Morgan (1936 - 1982)

O'BRIEN, Liam M (1922 - 1984)

O'KEEFFE, Peter Joseph (1927 - 2014)

O CIONNA, Eoin (1921 - 2010)

LYNCH, Patrick Joseph (1936 -)

HAYES, Robert Noel (1926 - 2009)

LANG, John Florence (1921 - 2001)

O'DONNELL, Michael Dominick (1930 - 2006)

PIGOTT, Pierce Thomas (1931 - 2008)

FEIGHAN, Felix Oliver (1931 - 2008)

SWEENEY, Brian Noel (1933 -)

WALLACE, John Eugene (1934 -)

HIGGINS, Michael John (1934 - 2016)

GRAINGER, Richard Patrick (1929 - 2014)

FITZGERALD, William Augustine (1932 -)

JENNINGS, Patrick Owen (1930 – 2016)

KILLEEN, John James (1948 -)

CALLERY, Philip (1944 -)

MILLINGTON, Gordon Stopford (1935 -)

KAVANAGH, John A (1943 -)

GRIMSON, Jane Barclay (1949 -)

BYRNE, Gerald (1952 -)

CONNELLAN, William Patrick (1936 -)

KEARNEY, Brian (1940 -)

LANGFORD, Peter Joseph (1942 -)

CAFFREY, Patrick (1946 -)

BUTLER, Anne Josephine (1955 -)

MCGOWAN, John (1948 -)

GOLDEN, John Daunt (1954 -)

BROWNE, James Joseph (1953 -)

HORN, Christopher John (1956 -)

LOWERY, Martin D (1945 -)

RUDDEN, Patrick Joseph (1954 -)

PHILLIPS, Michael M (1950 -)

O'DEA, John (1963 -)

MORAN, Regina (1962 -)

GRIMSON, William (1947 -)

BYRNE, Dermot (1951 -)

FEIGHAN, Kieran (1961 -)

QUINN, Peter (1953 -)

Part Three

Biographical Sketches of Presidents

HARBISON, John Henry (1921-1975), consulting civil and structural engineer, was born on 19 April 1921 at 81 Lower Baggot Street, Dublin, the only son of Thomas James Stanislaus Harbison, Solicitor, of Cookstown, county Tyrone, and Annie Josephine Beveridge.

Known to his friends and colleagues as 'Jock', he was educated at St Mary's College, Rathmines, Dublin and at University College Dublin, where he studied civil engineering. He received a BE (Civil Engineering) from the National University of Ireland (NUI) in 1942 and a BSc in Geology the following year.

After graduating, he worked for a time in Dublin with Messrs T.J.O'Connor & Co., consulting engineers, before moving to England to work for the Ministry for Fuel and Power. He then worked for the Northern Ireland Railway Company before joining Bord Failte.

In 1953, Jock joined the consulting engineering firm of Ove Arup & Partners and in time became senior Irish partner in charge of the Dublin office at 19 Merrion Square and later in Wellington Road. Projects involving Arup under Jock's leadership included the RTE Campus at Montrose, Musgrave Park Hospital, Belfast, UCD Belfield (Science Buildings, Library, Restaurant and Engineering Buildings), Bank of Ireland HQ, Baggot Street, Dublin, Carrolls Factory, Dundalk, Central Bank and National Currency Centre, Sandyford, Irish Management Institute, Sandyford, and the Asahi Factory, Killala, county Mayo.

Between 1966 and 1970, he was professionally involved in the design of the eight Regional Technical Colleges. His interest in technical education led to him being appointed in April 1972 to the newly established National Council for Educational Awards, becoming its Vice-Chairman and organising the examination procedures when the Council became an Examining Body.

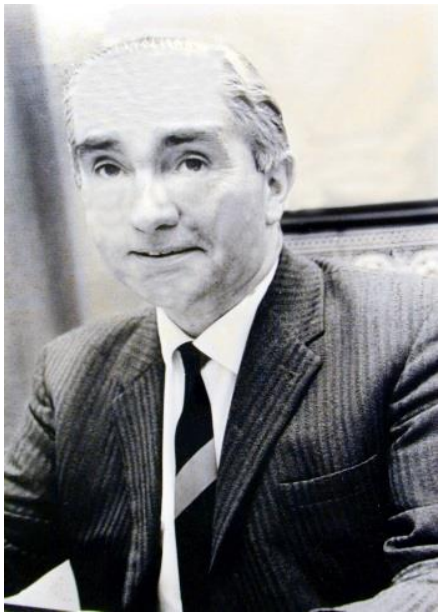
Probably the single professional issue forever linked to Jock's name was the unification of the Engineers' Association (Cumann na nInnealtóiri) with the Institution of Civil Engineers of Ireland to form the Institution of Engineers of Ireland (IEI). He was the driving force behind the idea from its first tentative airing at the Annual Conference of the Engineers' Association in 1966. He was Chairman of the Unification Committee which drafted the final Report and the Articles and Bye Laws of the new institution. It was entirely fitting that he should become the first President of the IEI in November 1969. He had formerly been a Council Member and President of the Engineers' Association 1965-1966. He is regarded as having made the greatest contribution of all to the unification of the Irish engineering profession.

John Harbison was a Chartered Engineer and Fellow of the Institution of Engineers of Ireland (FIEI), a Fellow of the Institution of Civil Engineers (ICE) and a Member of the Association of Consulting Engineers of Ireland (ACEI).

On 14 September, 1954, in Tagoat, county Wexford, Jock married Eleanor, daughter of T.G.O'Connor of Wexford. They had four children, Janet, Harry, Tony and Naomi.

John (Jock) Harbison died on 20 April 1975 in Dublin, and is buried in Glasnevin cemetery.

[Birth and marriage certs; IT 15/09/1954; IT 22/04/1975; IRIS 7 *In Memoriam John H Harbison*, Ove Arup & Partners, Dublin; IE 28 (5) (1975) 5]



LYNN, Michael Anthony (1919 - 1982), civil and hydrological engineer, was born on 31 August 1919 at Keenagh, county Mayo, the son of Hugh Lynn, farmer, and Mary McHale. Lynn was educated at St Muredach's College in Ballina and at University College Galway, where he studied civil engineering. He graduated BE (civil engineering) with first class honours from the NUI in 1942 and BSc the following year.

Known as 'Mick' to his colleagues, he had a distinguished career, firstly with the Hydrometric Section of the Electricity Supply Board (ESB), working on the Erne scheme, and later with the Office of Public Works (OPW).

He joined the OPW in October 1951 as an Engineer Grade II and was posted to the Glyde & Dee arterial drainage scheme works as Assistant Resident Engineer. Returning to HQ in Dublin as an Engineer Grade I, Mick continued to be involved with arterial drainage schemes, notably the Boyne, and with the Shannon flooding problems, following which he produced a joint report with Dermot O'Riordan of the ESB on a summer relief scheme for the catchment.

In 1974/75 Lynn set up a structural design team in the OPW, initially to design bridges that needed to be replaced in the course of arterial drainage works. He later expanded the section to supply structural design services to the Architectural Branch of the OPW.

At about the same time, he set up a research and development unit to study flood hydrology and the effects of arterial drainage works on low and drought flows in rivers. He saw the value of Irish participation in the flood studies of the Environmental Research Council of Great Britain and was invited to join the steering committee for the project. At the time of his death, Lynn was chairman of the Irish Committee for the International Hydrological Programme, which he had established with Professor Kevin Nash of UCG and Professor Jim Dooge of UCD in 1965.

Michael Lynn married Shirley O'Neill. They had three children, Sarah, Hugh and David, two of whom became engineers.

Lynn contributed to the work of the National Council for Educational Awards (NCEA) and his service to the engineering profession in Cumann na nInnealtóiri (CnaI) and the Institution of Engineers (IEI) was widely acknowledged. He gave a great amount of his time to the new Bye-Laws and institutional structures required post-unification. He was Chairman of Central Council of CnaI in 1956-57, a member of Council, and a member of the Board of Irish Engineering Publications. A Chartered Engineer, he was a Fellow of the IEI, a Member of the Institution of Civil Engineers (ICE), and served as President of the IEI in 1971-72.

Lynn had a very deep attachment to his native Mayo, in particular to the people of Crossmolina, where he helped to build a community hall and also a harbour on nearby Lough Conn.

'Mick' Lynn died at his residence, The Palms, Roebuck Road, in Dublin on 18 October 1982 and is buried in Dean's Grange cemetery.

[birth cert; EJ V35 (11) Nov.1982, 14; IT 20 October 1982; personal communications]

CUFFE, Robert Cormac (1912-2003), electrical engineer, was born on 22 May 1912 at 29 St Mary's Road, Dublin, son of Lawrence Cuffe, cattle salesman, and Margaret Little.

Robert was educated at Belvedere College and went on to study engineering and mathematics at University College Dublin (UCD). He graduated from the NUI in 1934 with an honours BE degree in mechanical and electrical engineering. On receiving a Bursary from UCD, he went to England to take up an engineering traineeship position with Metropolitan Vickers Electrical Company in Manchester.

In 1936, Robert (known to his colleagues as 'Bob') joined the ESB in the design department, working on the upgrading of the transmission network until 1946. He completed a doctorate in mathematics at UCD in 1947. In May 1950 he was appointed a Divisional Engineer in the Systems Operations Department. Systems planning and work associated with planning for the construction of new generating stations and plant occupied him until his retirement in 1977. As Overseas Liaison Officer, Bob represented the ESB at many overseas engineering conferences.

Bob Cuffe played an important role in the formation in 1969 of the Institution of Engineers of Ireland (IEI), serving as its President in 1972-73. He was a Chartered Engineer and a Fellow of the IEI, a Member of the Institution of Electrical Engineers, and of the American Institution of Electrical Engineers. He was also an Associate Member of the Institution of Mechanical Engineers. He served for a number of years on the Executive of the Institute of Public Administration. When the Irish national committee of CIGRE (the Council on Large Electric Systems), was formed in 1956, Cuffe acted as Honorary Secretary. In the early 1960s he was a member of the UN Technical Assistance Board advising the UAR government.

On 22 July 1943, Robert married Muriel Imelda, daughter of Lawrence Kelly. They had two sons, Cormac and Christopher, and a daughter Catherine.

Robert Cuffe died at Dun Laoghaire on 14 December 2003 and is buried in Dean's Grange cemetery.

[Birth and marriage certs; *Electrical Mail*, Sept. 1977; *Electric Mail*, March 2008; DVD of the Life of Dr Robert Cormac Cuffe, ESB Archives]

DELAP, Hugh Alexander (1906-1997), civil engineer, was born on 21 October 1906 at 3 Newbay, Rosslare, county Wexford, the third son of Alfred Dover Delap, civil engineer (who was engaged at the time on construction works at Rosslare harbour), and Jeannie Ethel Jefferies.

Educated at Castle Park School in Dalkey and Rugby School in England, Hugh entered the School of Engineering at Trinity College Dublin in 1925, graduating from the University of Dublin in 1928 with the degrees of BA and BAI (civil engineering).

Hugh began his engineering career on projects in counties Sligo and Donegal and for a short period worked abroad. On returning to Ireland, Hugh joined his father's consulting firm, Delap & Waller, and remained there until 1938, when he joined the Office of Public Works (OPW). Early on he worked on the seaplane base at Foynes on the Shannon estuary. Previously, on 27 July 1933, he had married Kathleen Hilda, a daughter of Charles St.George Orpen and Cerise Maria Darley. They had two daughters and two sons, one of whom, Michael, also becoming a civil engineer.

In the OPW, Hugh was promoted Assistant Chief Engineer in 1953, becoming Chief Engineer in 1966 in succession to R.E. (Ernie) Cross, a position he held until his retirement in 1971. He spent much of his time at the OPW on

the development of fishery harbours, jetties and slips around the country, particularly along the West coast and was also engineer in charge of the State harbours. Before retiring, he was involved in the early development of car ferry facilities at Dun Laoghaire. Following his retirement from the OPW, he was retained as a consultant by the state-sponsored agricultural fertilizer industry, Nitrigin Eireann Teo, and by the Department of Defence.

Hugh and Hilda became very involved in philanthropic and humanitarian causes. With his brother-in-law, Paddy Somerville-Large, he established the Mount Street Club, an organisation promoting cooperative enterprise in Ireland.

Hugh was a Chartered Engineer and a Fellow of the Institution of Civil Engineers of Ireland (later the Institution of Engineers of Ireland) (FIEI), serving on the council of the newly formed IEI and serving as President in 1973-74. He was elected a Fellow of the Institution of Civil Engineers in 1967.

Hugh Delap died at 'Ards', his Cabinteely home, on 27 January 1997, leaving his body to medical science.

[1911 census; DIB entry by Patrick Long; DIA; IT 28/01/1997, 18/02/1997]

CALLANAN, Patrick Finbar (1931-), civil engineer, was born on 15 March, 1931 in Cork city, the son of Denis Callanan, railway agent, and Annie Elizabeth Fry. He was educated at Mount Sion CBS, Waterford and University College Cork, where he studied civil engineering, obtaining a BE degree in 1951.

On graduating, Finbar undertook his early training with Westmeath county council before joining the marine section of the Office of Public Works (OPW) in 1953 to survey the coastal regions of Connemara for potential fishery harbours. His interest in harbours continued with Waterford Harbour Commissioners and T J S Mallagh, consulting engineers, before joining Bord na Mona in 1956 as Senior Civil Engineer at the Boora Works, then the largest peat producing works in Western Europe. The varied engineering works were all related to milled peat production for Ferbane power station and for briquette production at Derrinlough.

In 1960, Finbar moved to HQ as Assistant Development Engineer and in 1965 became Project Engineer in charge of forward planning for the expansion of sod peat production and the mechanisation of peat winning processes. As Planning Engineer from 1973 to 1975, he was responsible for the short and long-term planning of the Board's diverse activities, including the future of cutover peat lands. He was appointed Chief Operations Engineer in 1975 and concluded his career with Bord na Mona in 1979 as Chief Civil Engineer heading up the Third Programme of Development, which had as its ultimate objective the doubling of the peat output of the company.

It was at this time that Finbar accepted the invitation of the IEI President, Lucas Collins, to become Director of the Institution (later to become Director-General). The reason for this initiative by the Institution was the necessity to greatly increase its membership and to steer the organisation into a new era with a rapidly expanding engineering and diverse profession, expanding engineering schools, and the need for greater integration of industry and the schools of engineering with the Institution. There was also the need to establish strong overseas relations with the increasing internationalisation of the Irish engineering profession, many of whom were looking abroad for employment and work opportunities.

His involvement in the organisation of the engineering profession had begun as far back as 1960 when he was Secretary of the Midland Region of Cumann na nInnealtóiri (The Engineers Association). He was subsequently the founder of the Dublin Region and the Engineers Club at 22 Clyde Road. He chaired the Joint Executive Committee which coordinated the unification in 1969 of the Cumann and the Institution of Civil Engineers of Ireland to form the Institution of Engineers of Ireland (IEI). A Chartered Engineer and a Fellow of the IEI, he succeeded Hugh Delap as President in 1974-75.

In his role as Director-General, Finbar was intimately involved with the accreditation of Irish engineering courses leading to international agreements, such as the Washington Accord between the United States, Ireland, Australia and New Zealand, later to be joined by the UK and Canada. He also oversaw a major extension to the Clyde Road premises in the form of a highly acclaimed education centre, including a theatre and library. Apart from his commitment to Continuing Engineering Education and involvement in national and international conferences, one of his abiding legacy to the Institution must include the series of policy documents he presented to the Executive and Council over the years, perhaps the most significant being the policy statement "Going for Growth", published in 1993.

Following his retirement from the Directorship of the IEI in 1996, Finbar was the prime instigator in the foundation of the Irish Academy of Engineering (IAE). He was its first Secretary (1996-2004), and its President in 2006. He was made an Honorary Fellow of the IAE in 1997 and also an Honorary Member of the Association of Consulting Engineers in Ireland. In 1995, he was conferred with an honorary doctorate by the National Council for Educational Awards. Dr Callanan received many other awards, including an Honorary MAI from the University of Dublin, and was a fellow of a number of professional bodies, including the Institution of Civil Engineers, and the American and Australian societies.

On 17 January 1956, Finbar married civil servant Maureen, daughter of contracts manager Martin Kinsella and Nan Kinsella. They had two sons and two daughters.

[Birth and marriage certs; Career review, IAE; EJ 35 (3) Mar 1982; EJ Mar 1996; EJ 1979]

BARRY, John Denis (1921 - 1979), mechanical engineer, was born on 7 May 1912 at Church Hill, Cobh (Queenstown), county Cork, the son of Richard, general carrier, and Sarah O'Donovan. Known to his colleagues as 'Jack', he began his engineering career in 1935 as a young apprentice with Fords in Cork. He became an instructor at the Crawford Technical Institute and was considered to be a brilliant teacher who inspired successive generations of students. He later enrolled at University College Cork (UCC), where he pursued a science degree course, majoring in mathematics and obtaining a BSc degree. Transferring to Dublin, he completed a BE degree at UCD in mechanical and electrical engineering. He also obtained a first class pass with 'honourable mention' at the examinations of the Institution of Mechanical Engineers. Whilst Head of the Engineering Department of the Crawford Institute, he initiated a three-year training scheme for marine-going engineers. With others, he founded the Irish Welding Association with the aim of raising the standards of welding in the country.

Shortly after becoming Head of the Engineering School at Bolton Street College of Technology in Dublin, he was granted leave of absence to undertake research at the Massachusetts Institute of Technology which led to the award of a PhD degree.

It was in the field of technological education that Jack Barry made his greatest contribution. He began in the early 1950s by reorganising and developing a part-time system of higher technological courses and played a prominent part in updating the Department of Education technological syllabi.

He then introduced full-time engineering courses at both professional and technician levels. These laid the foundation for similar courses in regional colleges and the success of the courses and the interaction with industry and the professions established clearly the need for major developments in technological education outside of the universities.

He was responsible for the development of the many engineering courses at the college, the diplomas in time becoming recognised by the IEI as equivalent to a university degree and entitling holders to become Ordinary

Members (MIEI). The engineering courses were geared to the needs of the Irish economy and Jack was proud of the fact that, in the 1970s, only around one percent of his students found the need to emigrate.

Dr Barry served with distinction as Principal of DIT Bolton Street from 1973 until his retirement in 1979 due to ill health. He was a Chartered Engineer and a Fellow of the IEI and of the Institution of Mechanical Engineers (IMechE).

On 19 June 1946, Jack married Norah Patricia, daughter of John O'Leary, at the Honan Chapel in UCC.

Dr Barry died of cancer on 6 September 1979, within a week of his retirement, having dedicated his life to the cause of technical and technological education in Ireland.

[Birth, marriage and death certs; IE, 28 (8) (1975)]

DONOVAN, John Healy (1920-1994), engineer, was born on 2 February 1920 in Cork city, the son of Daniel Michael Donovan, a medical doctor, and Margaret Philomena Healy.

John studied engineering at University College Cork, graduating in 1941 with a BE degree from the NUI. He later in his career found time to complete management training at MIT in Boston, USA. After graduating, he joined the Irish Army, was commissioned, and served throughout the 'Emergency', retiring in 1946.

John joined the multi-national petroleum company, Esso Teo. in 1946 as a sales representative and worked his way up through the organisation, ultimately becoming Chief Executive in 1976. He filled many key posts in the company and at one time headed up its strategic planning team based in London. He became a director of the company in 1961 and managing director in 1965, resigning as CEO in June 1975. He was chairman of many organisations, including the Confederation of Irish Industries (CII), the Industrial Development Association (IDA), Dublin Port, and IBM. He held directorships at any one time in more than a dozen companies.

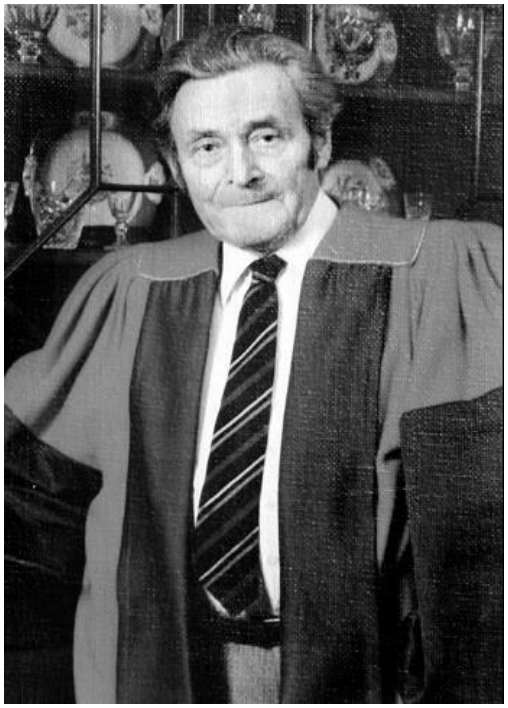
In December 1970, following an invitation from the Government, John was appointed Chairman of an expanding IDA. He presided over that organisation as it raised its sights from relatively small projects to attracting major multinational high-tech industries to locate large-scale projects in Ireland. Initially this policy was applied with success to the pharmaceutical industry and subsequently paved the way for the introduction of the many large electronic organisations that followed.

On 17 July 1945, in St Finbarr's Collegiate Chapel, John married Eileen Mary, daughter of Thomas Joseph Fitzgerald, whom he had met in college. They had a son Gerald and two daughters, Barbara and Eleanor.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), John served as President 1976-77. In 1969, he was invited to lead a group involved in a study of the problems occurring at the time in the Local Authorities which led to the 1970 Donovan Report that formed the basis for the reorganisation of technical staff in the area.

John Donovan died suddenly in Dublin on 29 July 1994 and is buried in Dean's Grange cemetery.

[Birth cert; marriage cert; IT 30 July 1994; IT 25 October 1994; EJ 47 (8) October 1994]



WRIGHT, William (1918 – 1985), civil engineer, was born on 3 December 1918 at Stewarton, Ayrshire, the son of Rev. James Wright and Jean Robb Thomson. William was educated at Inverness Royal Academy and George Watson's College, Edinburgh. He entered the University of Glasgow in 1938 to study civil engineering. Having served with the Royal Engineers during WW2, he resumed his studies at university, graduating BSc with a first-class degree in civil engineering in 1949.

From 1946 to 1949, during his time at college, Wright acted as a consultant and on graduation was appointed as a lecturer at Aberdeen University on the staff of Professor Jack Allen, an international authority on the use of scale models for solving problems in hydraulic engineering. He became involved in projects covering the flood relief of the Great Ouse, harbour studies of ports and spillway investigations for hydro-electric schemes. He completed his PhD at Aberdeen, his topic being numerical methods of structural analysis. In 1954, he was appointed a senior lecturer and Head of the Department of Civil Engineering at Southampton University, where he developed the department and continued his work on hydraulic models.

In 1957, Bill Wright was appointed to the foundation Chair of Civil Engineering 1842 at Trinity College Dublin (TCD), remaining as Professor of Engineering and Head of the School of Engineering until his death from cancer in 1985. Professor Wright's main professional interests, apart from hydraulic models, were in structures and engineering education. He was an enthusiastic promoter of the then new technologies of microelectronics and computers, the first computer being installed in the School as early as 1961. Elected a Fellow of TCD in 1959, Bill became in time a Senior Fellow and served on the Board of the College. Elected a Fellow of the Royal Society of Edinburgh in 1961, he was awarded a degree of ScD by the University of Dublin the following year.

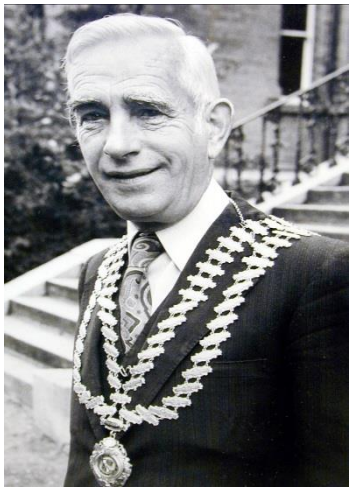
In 1963, Bill was appointed the founder Director of the Graduate School of Engineering Studies at TCD and was responsible for the development of a wide range of diploma courses in technology, particularly in the areas of system analysis and computer programming, in addition to courses in continuing engineering education (now known as continuing professional development or CPD). The developments during his tenure of the Chair were substantial, the numbers of engineering students in the School of Engineering rising from around 100 to over 500, and the academic staff increasing seven-fold.

Bill was a Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), and a Fellow of both the Institution of Civil Engineers (ICE) and of the Institution of Production Engineers (IProdE). He was Chairman of the Membership & Examinations Committee of the IEI for many years and became its President in 1977. He served as a Vice-President of FEANI, the Federation of Engineering Institutions.

In 1944, Bill married Mildred Anderson Robertson and had sons David and Peter, and a daughter Jane. Following the death of his first wife, he married Barbara Robinson and had a son Jonathan.

William Wright died on 8 February 1985 in Dublin and is buried in Enniskerry, county Wicklow.

[EJ Vol 38 (4) April 1985; *Roy.Soc.Edin.Year Book*, 1986]



COLLINS, Lucas (1917 – 1983), mechanical engineer, was born on 13 February 1917, at 23 Summer Hill, Dun Laoghaire, the son of Edmund Collins, civil servant, and Margaret Creedon. He entered University College Dublin in 1934, where he studied mechanical and electrical engineering, graduating BE, BSc from the NUI in 1938. His initial training was with British Thomson-Houston in Rugby.

Lucas then joined Bord na Mona and in time became Chief Mechanical Engineer. He was foremost amongst a team of young engineers in the peat industry and the value of his early work in machine design, construction and maintenance, formed a sound base on which so much was later achieved.

He left Bord na Mona in 1954 to take up the position of Assistant Chief Mechanical Engineer with Córas Iompair Éireann (CIE), where he worked with the noted locomotive engineer, Oliver Bulleid. Lucas was prominently involved with the change over from steam to diesel locomotion in the 1950s and early 1960s. He became Chief Mechanical Engineer, and later Assistant General Manager (Mechanical), a position that he occupied until his retirement in 1978. In his later career with CIE he directed the early studies and was involved in the early stages of the project to electrify the Dublin Bay suburban line, which morphed into the Dublin Area Rapid Transit system (DART).

On retirement, Lucas agreed to assist the National Council for Educational Awards (NCEA) as Assistant Registrar and, with his wide knowledge and ability, soon became an indispensable member of the NCEA team.

He was a Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (FIEI), serving as President 1978-79. He was particularly concerned with engineering education, and his work on technician education in particular was nationally important. One of his most significant tasks was to Chair the Accreditation Group which drew up the guidelines for the accreditation of engineering courses, adopted by the Council of the Institution in October 1982, and which formed the basis for the Institution's Accreditation Programme. He was a Member of the Institution of Mechanical Engineers and also a Member of the Institution of Electrical Engineers.

On 2 June 1948, Lucas married Margaret, daughter of Maurice Foley, a civil servant, and had a son and daughter.

Lucas Collins died suddenly on 19 January 1983 whilst on holiday in Spain, and is buried in Dean's Grange cemetery.

[Birth and marriage certs; EJ 36, May 1983]

SHEEHY, Morgan (1937 – 1992), civil engineer, was born at McCurtin Hill, Clonakilty, county Cork, on 18 August 1937, the son of Morgan Sheehy, merchant, and Catherine Murphy. Morgan was educated by the Presentation Brothers in Kinsale, at the Capuchin Fransciscan College in Rochestown, county Cork, and by the Presentation Brothers in Cork.

Morgan entered University College Cork in 1955 to study civil engineering. Following graduation from the NUI in 1959 with a BE (civil engineering), he worked as a graduate engineer with Oscar Faber & Partners in London on the design and development of a number of multi-storey buildings in London and West Africa, including schools, universities, hospitals and airport terminals.

In 1961, Morgan joined Ove Arup & Partners (Ireland), where he was successively Design Engineer and Senior Engineer, responsible for a variety of projects. In 1967 he was appointed Associate Partner and in 1975 succeeded the late Jock Harbison as Managing Director. Projects during his time at Arups (Ireland) included the Dublin Financial Services Centre, Cork University Hospital

and Dental School, UCD Belfield, Library and Restaurant Buildings, Setanta Centre, Dublin, St Stephens Green Shopping Centre, Liffey Valley Bridge (M50), Shannon Crossing, Athlone, and Newbridge Bypass bridges.

In 1991, Morgan became chairman of the Irish branch of the Institute of Directors and a director of the Worldwide Arup Partnerships. He was a Trustee of The Arup Partnership. He was also a member of the governing board of the Centre for Development of Industry in Brussels.

Morgan was a Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), a Fellow of the Institution of Structural Engineers, a Fellow of the Institution of Civil Engineers, and a Member of the American Society of Civil Engineers. He was also a Member of the Association of Consulting Engineers of Ireland. He became active in the Dublin Region of the then Institution of Civil Engineers of Ireland in 1966 and contributed significantly to the growth of the Institution of Engineers of Ireland.

In 1977, Morgan married Olivia Las Seinas (Libby) and had three sons and three daughters.

Morgan Sheehy died suddenly on 3 March 1992 at Celbridge, county Kildare, and is buried in Donacomper cemetery.

[Birth cert; IE 32 (5,6) 1979; IT 7 June 1991; IT 4 March 1992]

O'BRIEN, Liam M (1922 – 1984), civil engineer, was born in 1922 at Cooltomin, Shanagolden, county Limerick, the son of William O'Brien, a Land Commissioner. Liam was educated at Blackrock College in Dublin and at University College Cork, where he studied civil engineering.

Graduating with a BE in 1944, Liam spent some time with consultants before working for Bord na Mona on some of the earliest peat developments. He also worked for a while with Wexford County Council and with John Sisk & Sons. In 1956, Liam joined Roadstone and remained with the company until 1961 when he returned to Galway to take up the post of General Manager at Cold Chon (Galway) Ltd., and with the Galway Tile Company. He became Managing Director of both companies within a year, subsequently becoming Chairman and Director of the Coyle Group of companies.

Liam was a president of the Western branch of the Federated Union of Employers (FUE), and president of Galway Chamber of Commerce 1971/72. He was appointed to the board of CIE in December 1980, was a member of the Road Construction Advisory Group of An Foras Forbartha, and chairman of the Roads Policy Group of the Confederation of Irish Industry. He was prominently associated with the arrangements for the reception of Pope John Paul II to Galway in 1979.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), he served on Council, Executive and many committees in Cumann na nInnealtóiri (the Cumann) and the Institution, becoming President 1980-81. In particular, his service to the West Region, not only of the Cumann, but later of the IEI, was considerable. As a dynamic businessman, he sought the best for the region, to which he devoted his professional career. He served for a time as chairman of Irish Engineering Publications.

On 26 April 1950, at Nenagh, county Tipperary, Liam married Bridget, daughter of James Mackey, and they had a son and three daughters.

Liam O'Brien died on 18 July 1984 and is buried in Rahoon cemetery in Galway.

[EJ 32 Sept/Oct. 1979; EJ 1984]

O'KEEFFE, Peter Joseph (1927 – 2014), civil engineer, was born on 13 May 1927 in Borris-in-Ossory, county Laois, the son of Robert O'Keeffe, national school teacher, and Norah Kennedy. He was educated at St Kieran's College in Kilkenny and at University College Dublin, where he graduated BE (civil engineering) in 1947.

Having worked as an Assistant Engineer with Wicklow and Dublin county councils, he joined the Department of Local Government in 1964 as an Engineering Inspector (Roads). In 1967 he joined An Foras County Forbartha (The National Institute for Physical Planning and Construction Research) as Head of the Roads Division and from 1968 represented Ireland on the OECD Steering Committee for Road Research. During his forty years in the public service, he wrote many papers on roads and road transportation.

Following his retirement from An Foras Forbartha in 1988, Peter spent much of his time in historical research, particularly in the areas of Irish roads and bridges. The results of his research were recorded in a number of publications, including *Irish Stone Bridges: History and Heritage*, which he co-authored with Tom Simington in 1991. Other publications included *Ireland's Principal Roads 123 - 1608* (2001), *Ireland's Principal Roads 1608 - 1898* (2003), *Ireland's Principal Roads 1899 – 1979* (2004), and *Alexander Taylor's Roadworks in Ireland, 1780 – 1827* (1996).

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Peter was very active in the Institution, and previously in the Cumann, throughout his professional career and served on the Local Authority Sub-Committee, the Board of Irish Engineering Publications, the Archives Committee, as well as the Councils of both organisations. He was President of IEI in 1981-1982. He was awarded a Mullins Medal for his paper 'Economic aspects of road improvement in Ireland' and the Institution Prize for '*The development of Ireland's road network'*.

On 18 February 1952 in Tullow, county Carlow, Peter married Teresa Mary (Terry), daughter of Michael Lennon, a hotelier. They had two sons and three daughters.

Peter O'Keeffe died peacefully on 14 April 2014 at Newtownpark Avenue, Blackrock, and is buried in Shanganagh cemetery, Shankill, county Dublin.

[Birth and marriage certs; rip.ie; EJ 32 Sept/Oct 1979; EJ 34 (9) Sept 1981]

O CIONNA, Eoin (1921 – 2010), mechanical engineer, was born in Dublin in 1921, the eldest son of Sean O Cionna (Kenny), electrical engineer. Eoin was educated at Scoil Cholmcille in Ballybrack and at Colaiste Mhuire in Dublin and entered University College Dublin (UCD) in 1939 to study mechanical and electrical engineering. He graduated BE (Mech & Elec) in 1943. At UCD he was deeply involved in the promotion and business management of various publications in Irish which led to the setting up of *'Comhar'*, the inter-University Irish monthly. Another of his interests was archaeology and he was a founder member of the UCD Archaeological Society.

Following graduation, Eoin worked for a time with his father, J.A.Kenny and his cousin J.V.Tierney, in a mechanical and electrical consultancy practice before spending two years in London with a leading contractor and on a boiler plant site in Manchester. Returning to Dublin in 1948 he joined his father in J.A.Kenny & Partners (Tierney having left to set up his own practice), later becoming the Senior Partner. The first major drive and other developments commenced around 1948 and led to a considerable expansion in consultancy activity. Eoin became involved in much of the development of combustion systems and mechanical handling of peat in large institutional boiler houses, and in

the burning of low volatile Arigna coal and the lower grades of Irish anthracites. During this period he designed a 300KW combined heat and power plant for Maynooth College. The firm obtained their first overseas assignment in 1973 in Tanzania and later worked on assignments in many other countries, including Saudia Arabia and Papua New Guinea. The practice was always much involved in energy utilisation and consumption. Energy assignments included a four-year study of fluidised bed combustion for the 55% ash Arigna coals in a 40MW power station. Eoin's firm was involved in the engineering design for the Joint Venture Contractors building of the Cork-Dublin natural gas pipeline, as well as feasibility studies for bringing natural gas to a number of Irish towns.

Eoin joined Cumann na nInnealtóiri in 1945 and the Institution of Civil Engineers of Ireland in 1955. He served on the Central Council of the Cumann and on many committees in both institutions. He served for six years on the board of Irish Engineering Publications. A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Eoin became President in 1982-83. He was President of the Association of Consulting Engineers of Ireland 1966-68, having served as its Honorary Secretary for the previous sixteen years. He served for four years on the board of the Building Advisory Council and was an extern examiner for the NCEA in environmental engineering.

In 1953 Eoin married Eibhlin O'Malley. They had seven children, of whom two daughters and three sons became engineers.

Eoin O Cionna died at Clonskeagh, Dublin on 9 January 2010, and is buried in Shanganagh cemetery, Shankill.

[EJ Vol 35 (10) Oct 1982; rip.ie]

LYNCH, Patrick Joseph (1936 -), civil engineer, was born in Galway on 8 September 1936, son of Bartholomew Lynch, Garda Siochana, and Nora Healy. He was educated at St Joseph's College, Galway and entered University College Galway in 1954, where he studied civil engineering, graduating BE in 1957. He obtained an International Road Federation Fellowship in 1969 and studied at Northwestern University in the USA, where he obtained an MS degree in Traffic Engineering and Transportation Planning. In 1974 he obtained a MIE in Industrial Engineering from the NUI for studies at University College Dublin.

Patrick worked for a number of local authorities, being successively County Engineer of Limerick and Galway, and also worked for J.B.Barry & Partners, consulting engineers and for the Department of the Environment. As County Engineer, he had responsibility for the planning, organisation and delivery of the full range of services provided by Local Authorities at that time, including Physical Planning, Roads and Transportation, Environmental Services and Housing. In February 1979 he was appointed Programme Director with the National Board for Science and Technology, where he had responsibility for the national programmes. In 1982, he took up the position of Chief Executive of COLAS Roads and Building Services Ltd., part of the Shell Group. Following a period in London with Shell International and Shell (UK), he returned to Ireland in 1990 as Managing Director of Irish Shell, with responsibility for all Shell interests in Ireland. Lynch retired as Chairman and MD of Irish Shell in late 1996.

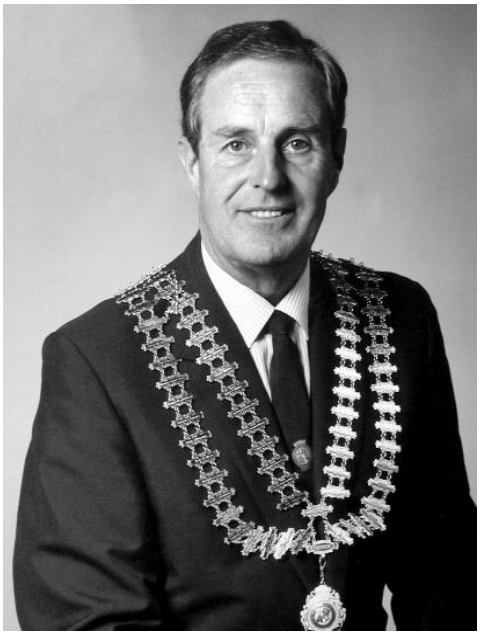
Patrick has been Chairman of FAS and is currently Chairman of the Irish Association for the Social Integration of Offenders (IASIO Ltd.). He has been a non-executive director of a number of companies, including CIE, Irish Rail, Aughinish Alumina, Stafford Holdings and WEEE (Waste Electrical, Electronic Equipment Ireland Ltd). He was Chairman of the Transport Council of IBEC for a number of years, Chairman of the Linkage Programme for Business in the Community (Ireland), and Chairman of the Dublin City Enterprise Board.

Patrick Lynch is a Chartered Engineer and a Fellow of the Institution of Engineers of Ireland (FIEI) and of the Irish Academy of Engineering (FIAE), where since 1997 he has served as Treasurer. He was President of the IEI in 1983-84 and President of the IAE in 2005. Patrick was active in the Dublin Region of Cumann na nInnealtóirí and, following amalgamation in 1969, served the IEI in many ways. He was particularly actively associated with the

advancement of engineering in the local authority service and was a prominent member of the Engineers' Working Party 1975-1978. He became Chairman of the IEI Accreditation Board in succession to Lucas Collins. He was a member of the IEI Ethics Appeal Board until 2018.

In 1963, Patrick married Mary Phelan, and they have three boys and two girls.

[EJ 1983; personal communications]



HAYES, Robert Noel (1926 – 2009), civil engineer, was born on 15 December 1926, at 29 South Terrace, Cork, the son of Liam Hayes, a major-general in the Irish Free State army, and Kathleen Walsh. He was educated at Belvedere College, Dublin and at University College Dublin, from where he graduated BE in civil engineering in 1947.

Following graduation Bob worked with consulting engineers and civil engineering contractors in the Dublin area before joining Dublin Corporation where he was engaged in the design and construction of major drainage, bridge and roadworks schemes. He left Dublin Corporation in 1960 to become Engineering Inspector at the then Department of Local Government carrying out transportation studies, and working in traffic and highway projects and bridges. In 1963 he obtained a Fellowship from the International Road Federation to study transportation and management at Ohio State University in the USA, where he obtained an MSc degree.

In 1967, Bob was appointed County Engineer in Cavan before moving in 1970 to become County Manager for Tipperary (SR) in Clonmel, where he remained for five years.

In 1975, Bob was appointed General Manager and subsequently Chief Executive of Dublin Port. It was a time of significant change for the port, Ireland having joined the EEC, and the advent of container traffic and other new technology. During his tenure the port moved offices from the Ballast Office in Westmoreland Street to a new purpose-built Port Centre at the junction of East Wall and Alexandra roads. He saw the creation of Dublin Cargo Handling Ltd. as a sole stevedoring company in the deep-sea section of the port, which helped enormously to rationalise dock working.

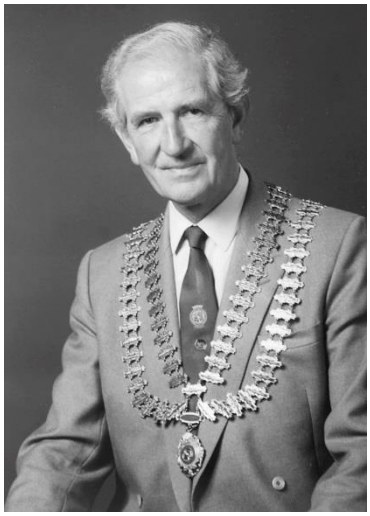
Bob retired in 1990 and enjoyed several years as a private consultant. He became executive chairman of McCarthy & Partners, consulting engineers, where he applied his wide experience to many significant and varied civil engineering projects.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Bob Hayes was also a Fellow of the Institution of Civil Engineers and of the Chartered Institute of Transport. Having been active in the Cumann, he continued his commitment to the profession in the IEI, becoming President 1985-86. He made a major contribution to the 150th anniversary celebrations of the founding of the Institution, chairing a special meeting of the IEI Executive in the Custom House to mark the first meeting of the Institution on 6 August 1835. Bob was a founding Fellow of the Irish Academy of Engineering.

In 1954, Bob married Alice, daughter of Dan McMenamin from Donegal. They had daughters Catharine and Barbra and a son Liam.

Robert Hayes died on 9 July 2009 at Blackrock, county Dublin and is buried in Dean's Grange cemetery.

[Birth cert; EJ 38 (7&8) July/August 1985; IT 25 July 2009; EJ 63 (9) Nov/Dec 2009]



LANG, John Florence (1921 - 2001), mechanical and electrical engineer, was born on 10 March 1921 at 5 Mount Street Crescent, Dublin, the son of Martin Aloysius Lang, a civil servant, and Margaret Catherine Deegan. He was educated at CBS Synge Street, Dublin, Belvedere College, and University College Dublin, where he studied mechanical and electrical engineering. He graduated BE in 1943 and ME in 1964.

On graduation he acted as a demonstrator in UCD before joining the ESB in 1944 as a trainee engineer. In 1948, John was appointed Test & Efficiency Engineer in the Generation Department and in 1954 became Station Manager at the Marina power station in Cork.

In 1960, John was appointed Regional Manager, Midland Generation Region (peat-fired power stations) and in 1966 became Head of the Generation Department. In 1971, he was appointed Chief Generation Engineer, a post he filled until he became Director Energy Resources in 1979. His emphasis on efficiency control and his astute fuel purchasing were major factors in the keeping of Irish electricity prices well within European norms. John retired from the ESB in March 1986.

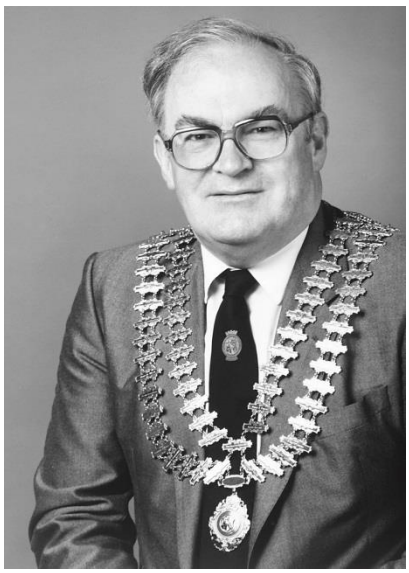
Following retirement, John became an energy consultant. He was a director of the Irish National Petroleum Corporation and of the Irish Refining Company. He was also a Director of Bantry Terminals Ltd. He was a member of the Coal Industry Advisory Board of the International Energy Agency.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), John served as President in 1986-87. The IEI London Region was founded during his term of office and he addressed the inaugural meeting in the Irish Club in Eaton Square. He was also a Fellow of the Institution of Mechanical Engineers, a Member of the Institution of Electrical Engineers, and a Member of the Institute of Fuel. During his career he presented many papers at home and abroad on the subjects of coal, oil and peat combustion and on the world's primary energy resources with special reference to Ireland.

On 12 June 1958, John married Mary A T (Marion), daughter of Francis Keane and Jane O'Connell.

John Lang died at home in Blackrock, county Dublin on 21 December 2001 and is buried in Shanganagh cemetery in Shankill.

[Birth cert; marriage cert; EJ July/August 1986; IT 22 December 2001]



O'DONNELL, Michael Dominick (1930 – 2006), mechanical engineer, was born in The Kerries, Tralee, county Kerry on 30 July 1930, the son of Alexander O'Donnell, farmer, and Margaret Dillane. He was educated at Tralee CBS and at University College Dublin, where he studied mechanical and electrical engineering, graduating BE in 1955. Through further study at UCD he gained a B.Comm DPA and an M.EconSc. He spent some time in Columbia University in New York on an exchange scholarship.

Following graduation, he joined the staff of the College of Technology at Bolton Street to lecture in mechanical engineering and he quickly established himself as a conscientious tutor to students, a brilliant innovator, and a national leader in the development of engineering programmes, including the development of programmes to allow apprentices and part-time and evening students to advance their careers and maximise their potential. He established the criteria and set up structures to enable students to advance from one level to a higher level.

Michael became Principal of the College of Technology Bolton Street and later Director of the central body, the Dublin Institute of Technology (DIT). He was a member of the senate of the National University of Ireland and of the governing body of the National Institute for Higher Education. He was a director of An Foras Forbartha and a member of the council of the NCEA and of the NCEA Board of Engineering. During his twenty years with the NCEA, he played a significant and national role in engineering education. Michael received an Honorary Fellowship from DIT in December 2004, the citation duly paying tribute to his distinguished contributions to education and engineering at DIT.

In the period 1993 to his retirement in 1995, Michael helped advance two highly significant developments; the introduction of a formalised quality assurance procedure for the DIT, which led to many of its courses being recognised for the award of diplomas and degrees from the University of Dublin, and the notion of a central campus (later realised at Grangegorman in the north city). Even after his retirement, he continued to be involved with the former project, which ultimately resulted in the DIT obtaining its own independent degree-awarding powers in 1997.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Michael served on Council and Executive for many years and became President 1987-88. He also served on the Membership and Examinations Committee, where his extensive knowledge of national and international qualifications, and their appropriateness for membership grades, made him an authoritative reference for the work of the committee. He played a prominent role on the Accreditation Board and the Professional Development Council. He represented the IEI on the Engineering Sciences Committee of the Royal Irish Academy. He was one of the first three Irish representatives to be awarded Eur Ing in 1987.

In 1966, Michael married Lolo Reilly, a biochemist, who predeceased him by six months.

Michael O'Donnell died suddenly in Dublin on 1 February 2006.

[Birth cert; EJ 40, August 1987; EJ 60 (2) March 2006]

PIGOTT, Pierce Thomas (1931 – 2008), civil engineer, was born on 27 January 1931 at 195 Griffith Avenue, Dublin, the son of John Joseph Pigott, a professor of education, and Nora O'Looney. He was educated at Colaiste Mhuire, Dublin and University College Dublin, where he studied civil engineering. Having received his BE degree in 1952 he went on to gain a Masters degree at Stanford University in California.

He commenced his engineering career with Dublin County Council before joining the Civil Aviation Division of the Department of Industry and Commerce, where he was mainly engaged in the design and construction of airport works. He left the department in 1956 to join Sir Hugh Moloney Consulting Engineers and in 1961 moved to the Irish Sugar Company where, for the next five years, he had responsibility for the design and construction of major installations in Carlow and Mallow.

In 1966 he joined An Foras Forbartha (AFF) as Senior Research Officer in the Construction Division, later becoming Principal Research Officer. In 1977, he was appointed Head of the Construction Division, and in 1985 appointed Chief Technical Advisor and Deputy Chief Executive. Following the abolition of AFF, Pierce became Deputy Director and Head of Construction in the new Environmental Research Unit established by the Department of the Environment.

In 1989, Pierce was appointed Director of Engineering Services in the Office of Public Works (OPW), where he oversaw a number of major engineering projects, including the Ballinamore-Ballyconnell canal reconstruction, which reopened in 1994 as the Shannon-Erne Waterway. Pierce retired from the OPW in 1996 and continued his engineering career from 1996 to 1997 as Project Director for the Dublin Docklands Authority and from 1998

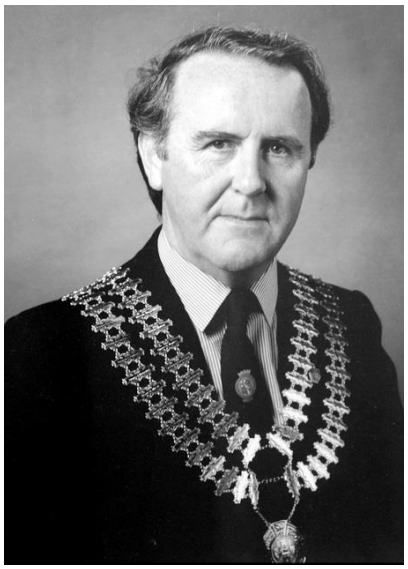
to 1999 as Project Manager to the National Heritage Council. He was for many years a Visiting Professor at the University of Ulster.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Pierce served on the Council and Executive and became President 1988-89. He gave generously of his time to the Civil Division and was a member of the Accreditation Board and first Chairman of the Continuing Engineering Education Committee. He was a founding Fellow of the Irish Academy of Engineering in 1997 and, as a member of various working groups, made a significant contribution to its growth. He was also a Member of the American Society of Civil Engineers.

On 11 September 1957, Pierce married Joan, a biochemist, daughter of John Denneny and Margaret McCarthy. They had a son John and daughters Helen and Catherine.

Pierce Pigott died on 12 February 2008 at Clonskeagh, Dublin, and is buried at Shanganagh cemetery in Shankill.

[Birth cert; marriage cert; EJ July/August 1988; EJ 62 (4) May 2008]



FEIGHAN, Felix Oliver (1931 – 2008), civil engineer, was born on 17 July 1931 at Tubbercurry, County Sligo, the son of Felix Feighan, baker, and Margaret Mary Mullins. He was educated at St Joseph's Garbally College, Ballinasloe and won a scholarship to University College Galway, where he studied civil engineering. Graduating BE in 1953, Oliver commenced his career in Ireland with the Department of Industry and Commerce, working on airport projects at Dublin and Shannon. For the remainder of his career, he was to work within the local authority system. Having been a temporary engineer in county in Kerry in the mid 1950's, he was confined to Merlin Park Hospital in Galway for two years under treatment for tuberculosis. Upon release from hospital, he held positions with Sligo, Leitrim, Laois and Roscommon County Councils before joining Mayo County Council in 1967 as Chief Assistant County Engineer. He led the road design team in many national road projects in Roscommon and Mayo, placing a heavy emphasis on improved sight distance and sympathetic road alignment with the natural terrain.

Oliver was appointed Carlow County Engineer in 1977 and served there with great distinction, playing a very influential role in the development of large-scale infrastructure in the county, including major realignments of the N9 and N80 national roads, the Barrow crossing at Leighlinbridge and the river Slaney water abstraction and water treatment schemes. He was also a key driving force in the application of spatial planning and development principles in Carlow town. Oliver was an inspirational figure who had a great affinity with the outdoor workforce of the county council. On the completion of the new bridge at Leighlinbridge, he had the names of all the workmen involved in the building of the bridge engraved on its parapet. After retiring in 1994, he was appointed as An Bord Pleanala inspector for a number of key infrastructure hearings.

Oliver devoted much of his spare time to community affairs and was deeply involved in the development of soccer and rugby in Castlebar and Carlow, serving as President of County Carlow Football Club in 1992, and later as Chairman of the club. He served a number of terms as Chairman of the Board of Management of Carlow CBS and was a member of the Board of Carlow Institute of Technology (IT). Oliver also served for many years as External Examiner to the Civil Engineering programmes offered at Sligo IT, Letterkenny IT and Dundalk IT.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Oliver held many important positions in the Institution, being active in the West Region and South East Region, and subsequently at Council and Executive levels. He served as IEI President in 1984-85. Subsequently, he served for many years as Chair and as a member of the Ethics and Disciplinary Board in IEI. He was also a founder Fellow of the Irish Academy of Engineering.

In 1959, Oliver married Mairin, daughter of Matthew and Nora Dillane. They had four children – Mairin, Kieran, Anne and Aidan. Kieran is scheduled to serve as President of Engineers Ireland for the 2017-18 term.

Oliver Feighan died suddenly on 4 December 2008 at the Mater PH in Dublin and is buried in St Mary's cemetery in Carlow.

[EJ 37 (6) June 1984; obit EJ 63 (3) April 2009]

SWEENEY, Brian Noel (1933 -), mechanical and electrical engineer, was born on 29 December 1933 at Cappoquin, county Waterford, the son of Michael Sweeney, farmer and shopkeeper, and Margaret Landers. He was educated at Rockwell College and at University College Dublin, where he studied mechanical and electrical engineering, graduating BE in 1956. He received an MBA in 1975.

Brian worked in the R&D Department of Allied Iron Founders before joining Siemens Ltd., where he trained in the design, construction and commissioning of turbo-alternators. He subsequently studied computerisation and automatic control at post-graduate level with Siemens in Germany.

He was involved as Project Engineer with a number of major developments, including Irish Steel Holdings, NET, Turlough Hill pumped storage station, and major telecommunication and computer automation projects.

In 1980, Brian became Managing Director and CEO of Siemens (Ireland) Ltd. Brian chaired the governmental Technology Foresight Study, the findings of which led to the establishment of Science Foundation Ireland, of which he was first chairman. Following his retirement, he served as chairman of a number of companies with diverse interests, and farms some 110 acres in county Wicklow.

A Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), and a Eur Ing, Brian was a long-serving member of Council and the Executive and served as President 1989-90. He was a director of Irish Engineering Publications and was the first chairman in 1987 of the board of the combined Electrical, Electronic and Computer Division. He served as President of the MBA Association and of the German-Irish Chamber of Industry and Commerce, both of which he is an Honorary Life Member. He is also an Honorary Life Member of the Royal Dublin Society.

He served on the NCEA board of engineering studies and on the National Council of the Confederation of Irish Industries. He became a Fellow of the Irish Academy of Engineering in 1998. He received an Honorary MAI from the University of Dublin in 1991 and a DSc from the National University of Ireland. He was awarded the Cross of Merit First Class and the Great Officers Cross with Ribbon by the President of Germany for services to German industry.

In 1958, Brian married Marie O'Reilly, and they have four children.

[EJ June/July 1986; EJ 1985]

WALLACE, John Eugene (1934 -), civil engineer, was born on 19 August 1934 in Derry, the son of John Wallace and Aileen Micell. He grew up in Drogheda and attended St Joseph's CBS, before entering University College Dublin, where he studied civil engineering.

Graduating in 1955 with a BE (Civil Engineering), John (known to his friends and colleagues as Séan) continued his studies on a DAAD scholarship at the Technische Hochschule in Aachen, Germany, studying soil mechanics.

Séan commenced his career as a graduate trainee from 1956 to 1958 with British Railways (Western Region) in London. In 1959, he joined the Federal Ministry of Works & Surveys in Lagos, Nigeria, working on direct labour road projects. From 1961 to 1963, he was Executive Engineer (Laboratories) at the ministry's HQ dealing with aspects of the soil mechanics of roads.

Returning to Ireland in 1963, Séan was employed as Engineering Agent for Irishenco Ltd. on the civil works for the NET Ireland fertilizer at Arklow, remaining there until 1967, when he transferred to head office as Marine Engineering Contracts Manager. He worked on various marine engineering projects, including jetties at Dublin (Gouldings), Tarbert (ESB), and Whiddy Island (Gulf Oil).

In 1969 he was appointed Deputy Project Manager on the underground works for the ESB pumped-storage scheme at Turlough Hill in county Wicklow, reporting to the German project manager (The works were undertaken by a joint-venture of Irishenco and four major German civil and tunnelling construction companies).

From 1973 to 1978, Séan was Managing Director of Priority Construction Ltd. In 1978, he returned to Irishenco as Managing Director, supervising work in Ireland, UK (Enco Civil Engineering), Middle East (Abu Dhabi and Dubai), Africa (Nigeria, Zambia and Gambia), and various other locations further afield.

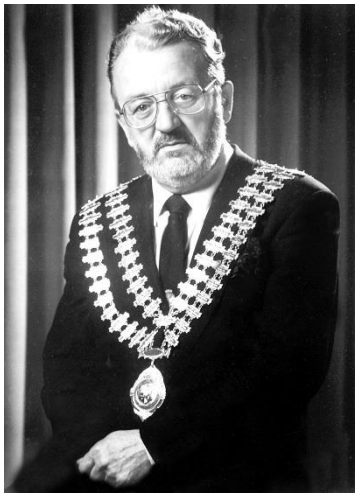
Projects in Ireland included the Howth Harbour development, the Cork-Dublin gas pipeline, the M50 West Link bridge and motorway, the East Link toll bridge, the Liffey Aqueduct from Ballymore Eustace to Dublin. On his retirement in 1995, he joined the board of Irishenco.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Séan is also a Eur Ing and a founding Fellow of the Irish Academy of Engineering (IAE). He is a Fellow of the Institution of Civil Engineers and a Member of the American Society of Civil Engineers. He served on the Council and Executive of the IEI and became President 1990-91.

He was a director of Irish Engineering Publications and chairman of the Institution Premises Committee, which oversaw the construction of the Education Centre at 22 Clyde Road. He was Chairman of the Irish branch of PIG (Pipeline Industries Guild) and served as chairman of the Dublin branch of the Lighthouse Club. For many years, he was a member of the ruling body of the Construction Industry Federation (CIF).

In 1960, Séan married Colette Curley (died 2014) and they had a son John and a daughter Elizabeth.

[EJ June/July 1989; personal communication]



HIGGINS, Michael John (1934 - 2016), mechanical and electrical engineer, was born on 8 June 1934 in Galway, son of John Higgins of Ardrahan and Anna Silver. He was educated at St Mary's College, Galway, and at University College Dublin, where he studied mechanical and electrical engineering. He graduated BE in 1957. In 1963, he obtained a BComm degree and in 1977 an MBA.

Having worked in the electrical engineering department in UCD for twelve months, and with the ESB for two years, he worked for the next fourteen years with a number of companies in the oil industry, including Irish Shell and BP in Dublin and Shell MEX and BP in London.

In 1974, Michael joined Calor, becoming Business Development Manager and later Director of Calor International Services Ltd. From 1975, he was a member of the Confederation of Irish Industries (CII) Energy Policy Group and was a joint author of the CII publication, *Saving Energy.* He was involved in the promotion of a major new natural gas service industry in Ireland and the UK, France, Germany, Belgium and The Netherlands.

A Chartered Engineer, Fellow of the Institution of Engineers of Ireland (IEI), and a Eur Ing, Michael served on Council and the Executive and was President of the IEI 1991-1992. He is a founding Fellow of the Irish Academy of Engineering (1997) and for many years served as its Honorary Secretary. He served for a time as Chairman of Irish Engineering Publications. He was a founder member of the IEI Energy Division in 1979 and was its chairman from 1981 to 1987. He was President, Honorary Treasurer and Secretary of The Engineering and Scientific Association of Ireland and served as President of the MBA Association. He also served as President of the Association of Advertisers in Ireland.

Michael was devoted to his partner Iseult McCarthy. He had a daughter Helen, and three sons, Paul, Hugh and Eoin.

Michael Higgins died suddenly on 14 November 2016 in Copenhagen, while attending a Euro-CASE meeting. He is buried in Labane cemetery, Ardrahan, county Galway.

[Birth cert; EJ June/July 1989; death notice 2016]

GRAINGER, Richard Patrick (1929 – 2014), mechanical engineer, was born on 12 March 1929 at Mountain View House, Kimmage Road, Dublin, the son of Joseph Grainger, publican, and Bridget O'Sullivan. He was educated at the CBS Synge Street and at University College Dublin, where he graduated BE, BSc in 1950.

Known as 'Dick' to his colleagues, he joined the staff in the mechanical engineering department of Córas Iompair Éireann (CIE) and served two years as a graduate trainee in the Inchicore railway workshops. After a period of further training in Switzerland working on diesel engine design and maintenance and electric locomotive design, he returned in 1953 to Ireland to work at Inchicore and in 1975 became Chief Mechanical Engineer of Irish Rail. He witnessed the evolution in railway traction from steam to diesel to electric and was closely involved in rolling stock design, operation, maintenance and workshop management. He was involved in railway consultancy assignments in Africa and in Eastern Europe on behalf of the World Bank and the EEC.

Dick was a Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), and a Eur Ing. In his early career, he served as Honorary Secretary of Cumann na nInnealtóiri, while devoting himself to the growth of the Mechanical Division of the IEI, as well as the Energy Division, of which he was Chairman. He was also a founding

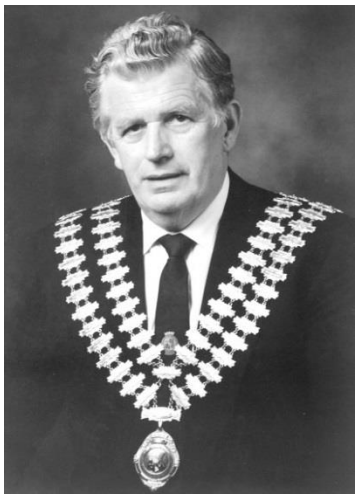
Fellow of the Irish Academy of Engineering (1997). He was a diligent, wise and articulate contributor to Academy discussion and reports, particularly in relation to transport.

He served as Chairman of the Membership & Examinations Committee and as a member of the Accreditation Board, being recognised as an expert in engineering qualifications. He was a Fellow of the Institution of Mechanical Engineers and a Fellow of the Chartered Institute of Transport. He served as Chairman of the National Committee for Engineering Sciences of the Royal Irish Academy.

In 1964, Dick married Ursula and they had a son Richard and daughters Paula and Carol.

Richard (Dick) Grainger died on 1 August 2014 at Glenageary, county Dublin and is buried at Shanganagh Cemetery, Shankill, county Dublin.

[Birth cert; EJ July/August 1992; rip.ie; EJ 63 (9) Nov/Dec 2009]



FITZGERALD, William Augustine (1932 -), civil engineer, was born on 28 May 1932 at Harpur's Island, Cork, the son of Patrick Fitzgerald, farmer, and Hannah Twomey. He was educated in Capuchin College, Rochestown, Cork, and at University College Cork, from where he graduated BE in civil engineering in 1954.

Following graduation, Liam took up an appointment with Kilkenny county council, involved with main road design and construction. Emigrating to the UK, he spent some time as a site engineer in Northumberland and Durham before moving to the Ministry of Works and Surveys in Nigeria.

He spent some time on the construction of roads and bridges in Northern Nigeria before returning to Lagos to plan the urban infrastructure put in place for the independence celebrations in 1960. For his final two years in Nigeria, he was Senior Engineer (Projects) at the ministry.

Returning to Ireland, Liam was appointed on 1 February 1965 Assistant City Engineer to Cork Corporation. Initially he worked in the Traffic Section but later transferred to the Water Section, ultimately becoming Chief Assistant City Engineer. In 1972, Liam moved to Offaly county council as Chief Assistant Engineer in charge of sanitary services and also served as Town Engineer for Tullamore and Birr. On his return to Cork Corporation in 1974, he took charge of the Drainage Section, prior to being appointed Senior Engineer (Roads Division) the following year.

In 1981, Liam became City Engineer in Cork, initiating and directing many of the infrastructural and environmental programmes envisaged in the Cork Land Use / Transportation Plan, such as the Jack Lynch Tunnel, new and refurbished bridges, quay walls, new by-pass roads, and major interceptor sewers. Liam retired in 1998.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Liam was a Chairman of the Cork/Kerry Region of the IEI, served on Council and the Executive, and was elected President in 1993.

In 1958, Liam married Noreen, daughter of Eugene and Phyllis Neill of Kilkenny, had six children, and settled in Glounthane, county Cork.

[Birth cert; EJ July/August 1993; IEI Annual Report 1993; personal communication]

JENNINGS, Patrick Owen (1930 – 2016), civil engineer, was born on 15 March 1930 at Liskelly near Ballinasloe, the son of John Jennings, farmer, and Mary Burke. He was educated at Garbally Park, Ballinasloe, and at University College Galway, where he studied civil engineering, graduating BE in 1951.

Following graduation, Pat spent a short time with the Office of Public Works before moving to London to work for Sir William Halcrow, consulting engineers. In 1953 he joined the tunnelling and construction firm of A Waddington & Son working on the remodelling of the Northern Line connections at Kings Cross underground station.

Having worked on the foundations of Rogerstone power station in South Wales, Pat returned to Ireland in late 1956 to work for the Irish Construction Company on the building of the new graving dock at Dublin Port. He then worked on drainage schemes in north county Dublin and on the Mourne / Stoneyford water supply scheme in county Down.

Pat joined Córas Iompair Éireann (CIE) on 29 August 1960 as a Senior Assistant Engineer in the New Works Section and in late 1966 became New Works Engineer responsible for a number of important projects, including the Silvermines and Ballinacourty branches. In May 1971 he was promoted to Area Civil Engineer, Dublin and in late 1975, following reorganisation of the civil engineering department, was appointed Assistant Chief Civil Engineer (Maintenance of Way). In this role, he developed and implemented a fully mechanised system of track maintenance, specified and procured a track-recording car and strengthened the fleet of on-track maintenance machines. He perfected a mechanised system for track renewals and set up an advanced automated factory at Portlaoise for the manufacture of pre-stressed concrete sleepers.

On 1 April 1980, Pat was appointed Chief Civil Engineer in CIE and during 1980-84 organised and directed the project team that carried out the civil engineering and permanent way works associated with the Dublin Area Rapid Transit system (DART). From 1987 until his retirement in 1995, he served on the Executive Board of Iarnród Éireann.

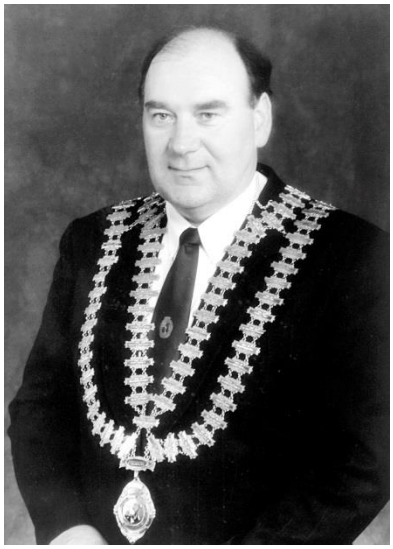
In 1988 he was a member of an International Bank for Reconstruction and Development mission to Ugandan Railways and, in 1994, joined the World Bank mission to Albanian Railways. He continued his consultancy assignments following his retirement, directing and providing specialist advice for railway projects in Eastern Europe, Africa and Pakistan. At home, he was consulted on the project for quadruple-tracking the Cork mainline from Heuston Station, Dublin to Kildare.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Pat served as President in 1994-95. He was Chairman of the Civil Division and Chairman of the Continuing Engineering Education Committee. He was also a founding Fellow of the Irish Academy of Engineering (1997). He was a Fellow of the Permanent Way Institution, serving as its President 1989-91. Pat was a vice-president of the Union of European Railway Engineering Associations and was a long-serving member of both the International Union of Railways and the Railway Engineers Association.

In 1955 Pat married Molly O'Brien, and they had four daughters, Anita, Lelia, Paddi, and Mary.

Pat Jennings died on 19 January 2016 at St Vincent's Hospital, Dublin and is buried in Killimordaly cemetery in county Galway.

[Birth cert; IEI Annual Report 1994; rip.ie; obit IAE 18th Annual Report]



KILLEEN, John James (1948 -), civil engineer, was born on 25 May 1948 in Roscommon, the son of John Killeen, a farmer of Taughmaconnell, and Mary Kennedy. He was educated at the Marist College in Athlone and at University College Dublin, from where he graduated with a BE (Civil Engineering) in 1971. In 1978 he gained a Masters in Industrial Engineering (MIE) from University College Galway.

Commencing his engineering career with Stanislaus Kenny & Partners, Consulting Engineers, John then worked for C. V. Buchan & Co. as an Assistant Project Manager on Ireland's first large-scale tunneling project, the Grand Canal Drainage Tunnel.

He then worked for five years with Roscommon County Council before returning to the private sector in 1979 when he joined Liam O'Brien at Cold Chon Ltd. in Galway.

In 1983, John became Managing Director of Cold Chon and of Roadbinders Ltd. of Mallow. In 1986, he became Managing Director of Colfix (Dublin) Ltd. and Road Maintenance Services Ltd. The group then became Colas Teo. – a subsidiary of Shell International, and it was subsequently acquired by Colas S.A., when he became Group CEO.

During his time as CEO, one of the group companies – Chemoran Ltd, a producer of chemical additives for the bitumen emulsion industry, innovated sixteen new products and moved to number three in the world in this niche sector, while another arm, Atlantic Bitumen, which supplies bitumen to many of the major projects in Ireland, was acquired from Shell Ireland. John retired in 2013, but remains a board member. John was actively involved in the Confederation of Irish Industry's efforts to highlight the need for road infrastructural development in Ireland.

A Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), and a Eur Ing., John is also a Fellow of the Institution of Civil Engineers and a Member of the American Society of Civil Engineers. He was a founder member of the Irish Academy of Engineering (1997) and its first President. He is a former Chairman of the IEI West Region, where he helped to initiate a series of highly successful professional training courses for members based in the Region. John served on Council and the Executive, and was President of IEI in 1995-96. He was a founder member of the Irish branch of the Institute of Asphalt Technology.

In 2009 John was awarded an Honorary PhD (Law) by NUI Galway for his contribution to engineering and, in 2012, received a Lifetime Achievement Award from Engineers Ireland for similar reasons. In 2009 and 2012, he led the teams, which brought the *Volvo Ocean Races* to Ireland, and, to mark his leadership in bringing these two world-class events to the City of Galway, he was made a Freeman of the City.

He was appointed Chairman of the Marine Institute in 2013. In 2010 he, along with a number of business people from the North and South of Ireland, set up the Timoney Institute for advanced leadership training for CEO's and senior Public Servants on an all-Ireland basis. He has been its first President since 2012. John was appointed chairman of the Saolta University Health Care Group for the period 2015-2019, which consists of seven major hospitals from Letterkenny to Galway.

John has four adult children, Erin, Jonathon, Clodagh and Mark, and is married to Mary Coyle.

[Birth cert; EJ July/August 1993; EJ July/August 1996; IEI Annual Report 1995; personal communication]

CALLERY, Philip (1944 -), civil engineer, was born on 30 July 1944 at Ballinasloe, county Galway, the son of John Kevin Callery, storekeeper, and Catherine Bridget Kelly. He was educated at St Joseph's College, Garbally in Ballinasloe and later at University College Galway, where he studied civil engineering. He received his BE in civil engineering in 1966 and later in 1995 an ME degree.

Phil commenced his engineering career in 1966 with Somerset county council, working as an assistant engineer in the County Surveyor's Department on road and bridge design and construction. On his return to Ireland in 1971, he worked with Carlow county council as Assistant County Engineer, Chief Assistant County Engineer, and later Senior Executive Engineer, under three successive county engineers, involved with roads, sanitary and environmental services, housing and planning.

Between 1982 and 1984, Phil joined the Department of Foreign Affairs on a Bilateral Aid Programme with Lesotho, being appointed Town Engineer of the capital, Maseru, where he assisted with the setting up of a local government engineering organisation.

In 1986, Phil was appointed County Engineer for Wexford, having overall responsibility for the provision and maintenance of infrastructure in the county. This involved the implementation of a major sanitary services programme and major main road improvements.

Coastal erosion was one of his greatest headaches because ofthe soft sandy Wexford coastline. He was chairman of the National Coastal Erosion Committee of the County & City Engineers Association, which in 1991, together with the IEI and Eolas produced the report *Coastal Zone Management – a Case for Action.*

Phil is a Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI) and a founding Fellow of the Irish Academy of Engineering (IAE) in 1997. He has been active in institution affairs, serving as Chairman of the South-East Region and on the Executive, becoming President in 1996-97. He was President of the IAE in 1999.

Whilst Chairman of the IEI Transportation Policy Group from 1991 to 1993, the group made a number of important submissions to government. He was Chairman of the County & City Engineers Planning Subcommittee from 1986 to 1993.

On his retirement from Wexford county council in 2001, Phil established CVS Consulting, a civil engineering and planning consultancy based in Rosslare and continues as principal of the practice. In recent years he became involved in community issues and served as chairman of Rosslare Community Development Association Ltd., and continues as a director of the company.

In 1966 Phil married Fionnuala, daughter of Capt. Patsy Kennedy and Margaret Ogle of Ballinasloe. They live in Rosslare, county Wexford and have six children.

[Birth cert; IEI Annual Review 1996]

MILLINGTON, Gordon Stopford (1935 -), civil engineer, was born on 29 June 1935 in Belfast, son of Percival Richard Millington. He was educated at Campbell College and The Queen's University Belfast (QUB), where he studied civil engineering.

Graduating in 1957 with a BSc, he joined Sir William Halcrow & Partners in London as an assistant engineer on the design of a dual-fuelled power station in Buenos Aires, and in 1959 joined Kirk McClure Morton, becoming a partner in 1966 and the senior partner from 1988 until 1998.

During Gordon's time with the firm, projects included the Ashby Institute at QUB, a 2 GW wave energy power station for UKAEC, road projects in Nigeria, mini hydro-electric plants in Sri Lanka, bridges on the M2 in Northern Ireland (NI), and the Waterfront Hall in Belfast.

In 1970, NI saw many terrorist attacks, and Gordon became involved in restoration work on damaged buildings, including two very high-profile structures, The Europa Hotel and The Grand Opera House in Belfast. He was thus in demand to lecture on the subject in the USA and also, as Chairman of the ICE Buildings and Structures Board, to commission a book entitled *Blast Effects on Buildings*.

In 1997 Gordon was appointed to the Standing Committee on Structural Safety (SCOSS) in London. He was able to make important contributions to the dynamic response of buildings, including the Cardiff Grandstand and the Millennium Bridge in London. His knowledge of the Twin Towers disaster in New York was an important contribution to the work of SCOSS.

Also in the 1970's, he developed many computer programmes for the structural analysis of buildings. He later developed a complete set of programmes for the specific requirements for the financial management of a firm of consulting engineers.

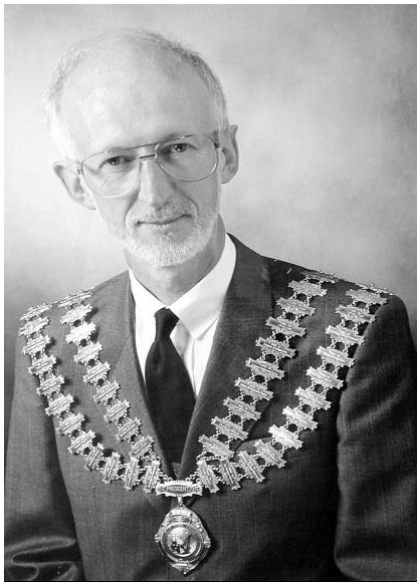
Gordon is a Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), a Fellow of the Institution of Civil Engineers ICE), a Fellow of the Institution of Structural Engineers and an Honorary Fellow of the Irish Academy of Engineering (IAE). He served on the Executive committee of the ICE, was chairman of its Ethics committee, and Vice-President in 1995-6.

He served as President of the IEI 1997-98 and as President of the IAE in 2000 and 2001. He was also a Fellow of the Institute of Highway Engineers, a member of the American Society of Civil Engineers and a Senior member of the Chinese Mechanical Engineering Society. He is founder member of the IEI Northern Region.

On 13 April 1960, Gordon married Margaret Jean, daughter of Leslie Pegler. Their children were Mark Stopford, Kathryn Margaret, and Gavin Paul. Following Margaret's death in 1999, Gordon married Norma Joan Stevenson.

Gordon received a DSc from QUB in 2001, and an OBE in 1995 for services to civil engineering. He was appointed an Honorary Fellow of the Institution of Civil Engineers in 1997. He has been a Director of the Ulster Orchestra Society, Chairman of the Ormeau Baths Art Gallery, NI200, an environmental quango, Chairman of Grosvenor Grammar School, and external examiner at Cork IT and Sligo IT. He is an investor in Business start-ups through Halo.

[personal communication 2016]



KAVANAGH, John A (1943 -), civil/structural engineer, was born on 5 July 1943 in Dun Laoghaire, the son of John W Kavanagh and Sarah Byrne. He was educated at CBS Dun Laoghaire and at University College Dublin, where he studied civil engineering.

Jack graduated BE (Civil Engineering) in 1964 and in 1966 gained an MEngSc degree. He trained and practiced in several consultancies before becoming a founder and the managing director of Kavanagh Mansfield & Partners (KMP) in 1988. KMP is a privately owned practice of structural and civil consulting engineers, providing design and advisory services to public and private sector clients on a wide variety of construction projects. In 2000 Jack ceased managing but remained a consultant to the practice.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Jack is also a founding Fellow of the Irish Academy of Engineering, a Fellow of the Institution of Structural Engineers, and a Fellow of the Institution of Civil Engineers. He served as President of the IEI in 1998-1999.

As President of the IEI he initiated the Institution's campaign to encourage chartered members to routinely use the statutorily protected title Chartered Engineer - rather than its abbreviation CEng - with the aim of increasing public awareness of the professional engineer. Jack also served as President of the Association of Consulting Engineers of Ireland and was twice chairman of the Construction Industry Council.

Of particular interest to Jack was the subject of accidental loadings on structures. His involvement included: chairing the professional bodies' joint committee which evaluated the significance for general design practice of the tragic gas explosion in Raglan House, Dublin, in 1987 (for which work he received the IEI's premier annual award, the Institution Prize); and engagement on a panel of European experts commissioned in 1995 to prepare the first draft of the relevant Eurocode, 1991-2-7.

Another issue of special interest has been the practical implementation by designers of construction health and safety regulations. Jack played a particularly active role in respect of the professional bodies' approach to the legislation, including chairing the group drafting a manual for designers, '*Designing for Safety in Construction*', which was published in 2003 jointly by the IEI and the ACEI and endorsed by the RIAI. With some modifications, this manual later became a European guidance manual of the same name published by EFCA (European Federation of Consulting Engineers) and ACE (Architects Council of Europe).

Following a major revision in 2005 of the Safety, Health and Welfare at Work Act, and of the related construction regulations, Jack was commissioned by IEI and ACEI to write an updated *'Designing for Safety in Construction*' manual to provide practical guidance for designers and this was published in 2010; this manual became the standard reference for Irish consulting engineers and is the basis of the popular 'DSC Course' run by both IEI and ACEI in partnership with DIT.

In 1969, Jack married Felicity, daughter of John and Mabel O'Donoghue and they have four children, Aoife, Ciara, Paul and Jill.

[Birth cert; IEI Annual Report 1998]

GRIMSON, Jane Barclay (1949 -), computer engineer, was born on 28 August 1949 in Inverness, the daughter of William Wright, engineer and former IEI President, and Mildred Robertson. Jane was educated at Alexandra College, Dublin and at Trinity College Dublin (TCD), where she studied engineering.

She was the first female to graduate in engineering from the University of Dublin, obtaining a first class honours BAI degree and gold medal in 1970. She received Masters and PhD degrees in Computer Science in 1971 and 1981 from the Universities of Toronto and Edinburgh, respectively.

In 1980, Jane was appointed to a Lectureship in Computer Science at TCD where she was to spend her entire academic career. She served as Dean of Engineering & Systems Sciences from 1996-1999, as pro-Dean of Research in 2001 and as Vice-Provost from 2001-2005. She is a Fellow Emeritus of TCD and held a Personal Chair in Health Informatics. She was appointed a Pro-Chancellor of the University of Dublin in 2016.

Her major research interests are in Health Informatics, which is concerned with the application of Information and Communications Technology to improving the quality and safety of healthcare. She was awarded the O'Moore Medal in 2007 in recognition of her contribution to the field. She was Principal Investigator and project manager of several national and EU-funded research grants and has published widely.

Jane has a passionate interest in promoting more broadly the recruitment, retention and advancement of women in engineering and in research more broadly. She helped to establish WiSER (the Centre for Women in Science and Engineering Research) at TCD in 2006 with funding from Science Foundation Ireland. She also chaired the Gender Equality Task Force at NUI Galway from 2015-2016.

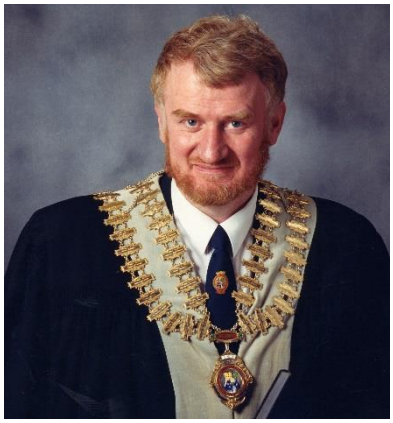
A Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), and a Eur Ing, Jane served as President of the IEI from 1999-2000. She was largely instrumental in giving chartered engineering status to holders of accredited degrees in Computer Science. She is a Fellow and Past-President (2002) of the Irish Academy of Engineering and of the Irish Computer Society (2000-2004). She was President of the Healthcare Informatics Society of Ireland from 1999-2006 and in 2007 was awarded the O'Moore Medal by the Health Informatics Society of Ireland in recognition of her outstanding contribution to the development of healthcare Informatics in Ireland and throughout the world. She is a member of the Royal Irish Academy and served as its Vice President. Jane is also a Fellow of the Royal Academy of Engineering.

Jane has served on a number of boards including Science Foundation Ireland, the Health Research Board (which she chairs) and the Mary Robinson Foundation for Climate Justice. She was a member of the Irish Research Council for Science, Technology and Innovation (ICSTI), chaired the Technology Foresight Panel on Materials and Manufacturing Processes and also served as chair of the Irish Research Council for Science, Engineering and Technology. At European level, she was a member of the European Research Advisory Board, where she played a key role in the development of European policy for open access to research publications. She also served on the Executive of the European Science Foundation and as a member of an expert panel for the European Research Council.

In 2006, she was partially seconded to the newly established Health Information and Quality Authority (HIQA) as its first Director of Health Information, where she led the development of national standards for health information. In 2014, she was appointed Acting Chief Executive of the Authority. She retired from TCD and the HIQA in 2014.

In 1971, Jane married William Grimson, President of Engineers Ireland 2015-2016, and they have two children, Andrew and Sarah.

[IEI Annual Report; personal communications]



BYRNE, Gerald (1952 -), mechanical engineer, was born on 17 April 1952 in 'Westerton', Dundrum, Dublin, the son of John Byrne, farmer, and Martha White. He received his early education at Synge Street Christian Brothers School and Dundrum Vocational School.

Known to his colleagues as 'Gerry', he began his engineering career as an apprentice draughtsman with Ove Arup & Partners and then with the Electricity Supply Board (ESB), where he trained as a mechanical engineering technician in power plant technology.

He graduated BSc in mechanical engineering from the Dublin Institute of Technology (DIT Bolton Street) in 1975. Following graduation, and a short period as a junior project engineer at Donnelly Mirrors Ltd., Gerry spent five years as a mechanical engineer with Córas Iompair Éireann. In 1980 he became a lecturer at DIT Bolton Street and spent three years there before moving to Germany. He gained an MA and MSc from the University of Dublin in 1983.

From 1983 to 1990, Gerry was Research Scientist and then Chief Engineer IWF at the Technical University in Berlin and from 1990 to 1993 Head of Division (Corporate Research) for Manufacturing Processes at Daimler Benz in Ulm. He received a Dr-Ing degree from the Technical University Berlin in 1989.

Returning to Ireland in 1993, Gerry was appointed Head of the Department of Mechanical Engineering at University College Dublin (UCD) and served in that position until 2005, when he became Dean of Engineering until 2007. From 1993 he was Professor of Mechanical Engineering and founder and Director of the Advanced Manufacturing Science Research Centre at UCD. The research centre covers the area of advanced manufacturing processes with an emphasis on machining technology and surface engineering, energy efficiency and embodied energy. He is an internationally renowned expert in advanced manufacturing and has published widely in this field.

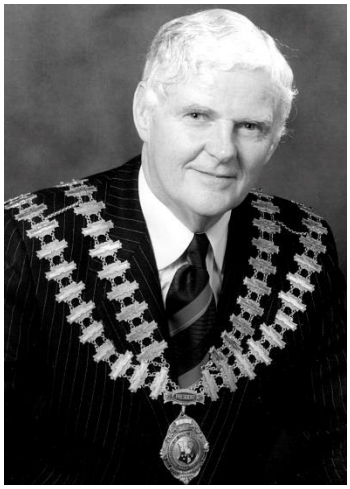
In 2005, Professor Byrne was awarded an Honorary Doctorate from the DIT and in 2013 became an Honorary Professor of Tianjin University, PR China. In 2002, Gerry published a book entitled *Engineering as a Career*, which has run to a number of editions. The book is recognised as the definitive guide to engineering careers in Ireland. Until 2013, Dr Byrne was Director of the OpenHydro Group, a world leader in Tidal Stream Turbine Arrays and has acted as an international consultant to a number of multinational, SME and start-up companies.

A Chartered Engineer, Fellow of the Institution of Engineers of Ireland (IEI) and a Eur Ing, Professor Byrne served as President of the IEI 2000-2001, is a founding Fellow of the Irish Academy of Engineering (IAE) and its President 2003-2004. He is also a Fellow of the Society of Manufacturing Engineers (USA), an International Foreign Fellow of the Royal Academy of Engineering (UK), and a Fellow of the International Academy of Production Engineering, serving as President 2009-2010. He is a Fellow of the Institution of Mechanical Engineers (UK) and of the Institute of Materials (UK). He is an International Fellow of the German Academy for Science and Engineering (acatech) and a Member of the American Society of Mechanical Engineers.

He is a senior advisor to the President of the Fraunhofer Society, Munich, Germany and a member of the German high-level commission overseeing the university excellence initiative (2016-2020). He established GB Innovation Ltd. in 2014 and is developing products and processes for the assessment of excellence in industrial R&D.

In 1979, Gerry married Gisela from Bremen, Germany, and they have a son and three daughters.

[cv; personal communication]



CONNELLAN, William Patrick (1936 -), production engineer, was born on 19 May 1936 in Longford, the son of James Austin Connellan, solicitor, and Annie Frances Hughes, dentist, both practicing in Roscommon, where Liam grew up. He was educated at Garbally College in Ballinasloe, CBS Roscommon, and at University College Dublin (UCD), where he studied mechanical and electrical engineering.

Graduating BE (Mech & Elec) in 1957, Liam trained with STAL, the steam turbine manufacturing division of ASEA in Sweden and then with British Thomson Houston (BTH) in Rugby. Returning to Ireland in 1960, he joined ACEC Electrical Manufacturers in Waterford as Divisional Engineer, with responsibility for the manufacture of electric motors. In 1965, and before Ireland joined the European Common Market (EEC), Liam joined the Irish Management Institute as a specialist in production management, lecturing in the subject, and in time becoming Head of the Small Business Division.

Following the tragic loss on 18 June 1972 of the President and Director-General of the Confederation of Irish Industry (CII) in the Staines plane crash, Liam was invited to become Director-General of the CII, which he was to fill with distinction for the next two decades.

Liam became a powerful advocate for the business community and for the establishment of a climate within the State in which Irish business could survive and expand. The CII prospered during the time that Liam was at the helm and its reputation and stature made it a significant voice in national policy making. Before leaving the CII in 1992, Liam steered through the merger of the CII with the Federation of Irish Employers (FIE) to form IBEC.

Liam was a member of the National Economic and Social Council from 1975 to 1992 and participated in the seminal 1986 report on the economy, which was subsequently adopted by the Irish government. In 1994, Liam was appointed first chairman of the National Roads Authority. From 1990 to 1995, he was a member of the influential Economic and Social Committee of the European Communities, being elected chairman of the Industry Section in 1994.

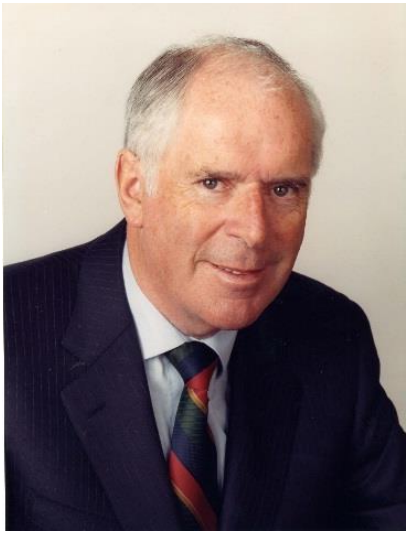
A Chartered Engineer, Fellow of the Institution of Engineers of Ireland (IEI) and a Eur Ing, Liam served as President 2001-2002, and in 1997 was a founding Fellow of the Irish Academy of Engineering (IAE). He was chairman of the IAE's working party on a national Spatial Strategy.

He was elected in 1995 to a three-year term as President of the Royal Dublin Society (RDS), having been involved in the science and industry activities of the Society since 1980. In that year he was involved in setting up the German-Irish Chamber of Industry and Commerce, and was its President 1995-1998. Liam has been a director of a number of companies and was the Chairman in Ireland of the French-owned Veolia Environment, one of the largest companies in Europe.

In 1998, Liam received Knight Commander's Cross of the Order of Merit of the Federal Republic of Germany and 2004, a Chevalier of the National Order of Merit of the French Republic. Liam was awarded an Honorary LL.D by NUI Galway in 2009 and an Honorary DSc by UCD in 2014.

In 1966, Liam married Marie (d.7 Jan 2017), daughter of Mattias Crehan, and they have a daughter Rachel and four sons, Paul, Brendan, Liam and David. Three of the children are chemical engineering graduates.

[Birth cert; IEI Annual Report 2001; EJ Sept 2001; Profile in *Forma 21*, 2000]



KEARNEY, Brian (1940 -), electrical engineer, was born on 28 May 1940 in Upper Pembroke Street, Dublin, the son of Peter Kearney, asphalt manager (SIAC), and Mary Margaret Hennigan. He was educated at Belvedere College and from 1957 at University College Dublin (UCD), where he studied electrical engineering.

Graduating BE (Elec) in 1961, Brian joined Irish Cement and was sent to Copenhagen to spend three years in the design offices of F.L.Smidth & Co., and also commissioning cement plants in Jutland and Norway.

Having returned to Ireland in 1965, Brian was Company Electrical Engineer for Irish Cement from 1967 to 1969, during which time he obtained the degree of Master of Industrial Engineering (MIE) at UCD. In 1969, Brian joined the construction management team at the new Platin Cement works near Drogheda and, in 1971, became Plant Manager at Platin.

In 1973, he and a colleague, Jim Walsh, left Irish Cement to establish their own company: Project Management Ltd. (PM). PM started in Ranelagh with three staff. By 1980, following PM's work with the Marathon Kinsale Head gas platforms, the staff had risen to 50 and an office opened in Cork. During the 1980s, PM branched out from project and construction management into process, mechanical and electrical design, and subsequently added civil, structural and architectural capabilities. In 1987, Brian became Chairman and Chief Executive.

Over the next 23 years PM grew its capability in the biopharmaceutical sector and became a global leader, adding further expertise in associated sectors of medical technologies and research and development. By 1995 the staff had grown to 400 and to 1000 by 2000, having established offices in the UK (1997) and Poland (1998).

In May 2000, as a result of a planned change of management of the company, Brian resigned as Chief Executive and remained on for three years as a non-executive director. In October 2000, Brian published *The Celtic Tiger at your Service – Professional Services to Multinationals*, which provided a history of the founding and growth of PM and detailed the key elements of leadership, management and service needed to run a company providing engineering and management services.

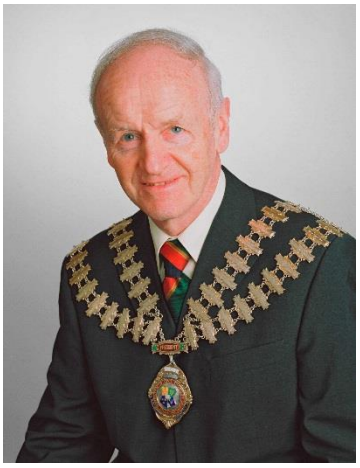
Further expansion of PM followed with offices opening in Singapore (2007), San Jose (2010), Shanghai (2011), Belgium and India. To reflect this international expansion strategy and growing organisation, PM changed its name in 2006 to PM Group.

A Chartered Engineer and Fellow of the Institution of Engineers of Ireland (IEI), Brian served as President 2002-2003. He was elected a Fellow of the Irish Academy of Engineering in 2001, and is an Honorary Fellow of the Irish Management Institute, and a member of the Chartered Institute of Arbitrators.

Brian was a member of the Board of Management of Belvedere College from 1998 to 2004, and Chairman of the Board from 2001 to 2004. In that period, he oversaw the construction of the Science and Technology Building at the college. Brian was President of the Belvedere Union from 2008-2009. He was a board member of Irish National Petroleum from 1990-1995 and a board member of Enterprise Ireland from 1998 to 2007.

In 1964, Brian married Patricia O'Neill (died July 2016), and has four children.

[birth cert; EJ July/August 2002; IEI Annual Report 2002]



LANGFORD, Peter Joseph (1942 -), civil engineer, was born on 25 March 1942, in Waterford city, the son of Aeneas Langford, draper, and Bridget Doyle. He was educated at De La Salle College, Waterford and at University College Cork, where he studied civil engineering, graduating BE (Civil Engineering) in 1964, and gaining an MEngSc the following year for a thesis on finite element structural analysis. Following graduation, Peter worked in London with consultants Harris & Sutherland.

Returning to Ireland in 1969, he joined Ove Arup & Partners in Dublin before moving to Cork in 1976 to open their Cork office. In March 1992, as Managing Director, he assumed overall responsibility for the management of the Irish practice until 2001, continuing as a Director of Arup Ireland until 2005. He was a consultant to the company from 2005 to 2013. He was the non-resident partner in Arup Nigeria and a Board Member of Arup Africa from 1994 to 2002.

With his wide range of experience in civil engineering, infrastructural, industrial and commercial projects, he acted for Arup as director or project sponsor on a number of major projects. These include the Dublin Port Tunnel, the Arklow By-Pass, Broadmeadow estuary crossing on the M1, renewal of the Quay walls in Cork city, and various industrial projects. These included the Novartis Pharmaceutical Project at Ringaskiddy and major green-field accelerated projects in the Dublin area for Hewlett-Packard and IBM. His recording of some of these projects in the IEI Transactions earned him a number of awards, notably the Presidents Prize in 1970 and a Mullins Silver Medal in 1994.

A Chartered Engineer, a Fellow of the Institution of Engineers of Ireland (IEI), and a Eur Ing. Peter served as IEI President 2003-2004. He is also a founding Fellow of the Irish Academy of Engineering (IAE) and a Fellow of the Institution of Civil Engineers (ICE). A member of the IEI Council and Executive for many years, Peter was Chairman of the Cork/Kerry Region in 1980, a director of Irish Engineering Publications, and a member of the Accreditation Board. He served on the board of An Foras Forbartha and was a member of the National Roads Authority. A member of the engineering board of the National Council for Educational Awards and IEI liaison member. Peter was also an external examiner at the Dublin Institute of Technology (DIT).

Since retiring in 2013, Peter has been very active on project work for the Irish Academy of Engineering as well as serving on the Council, Executive and a number of Committees. He is Chairman of the Ethics Appeal Board of Engineers Ireland.

In 1970, Peter married Marguerita McElligott and they have three children.

[cv December 1997; EJ June 2003]

CAFFREY, Patrick (1946 -), electrical engineer, was born on 20 September 1946, at Lifford, County Donegal, the son of Jack and Katherine Caffrey. He was educated at St Columb's College in Derry and at University College Dublin, where he studied electrical engineering, graduating BE with first class honours in 1968. He was awarded an Honorary Doctorate of Laws (DL) in 2006.

On graduating, he spent five years with the Distribution Department of the Electricity Supply Board (ESB) before joining the pharmaceutical company, Pfizer, in 1973 as Electrical Engineer at their Ringaskiddy plant near Cork. He rapidly moved into project and people management, being promoted to Engineering Director, then Production Director, and in 1993 Managing Director.

Paddy Caffrey was a key figure in the success of Pfizer in Ireland, which saw production capacity increase seven-fold and the workforce more than double at the Cork site. In 2000, Pfizer merged with Warner Lambert and, following the merger, Paddy became Vice-President and Managing Director of the expanded Pfizer Pharmaceutical Ireland and team leader of the four active pharmaceutical ingredient (API) plants in Ireland.

A Chartered Engineer, and a Fellow of the Institution of Engineers of Ireland (IEI), Caffrey served as President 2004-2005. He is also a Fellow of the Irish Academy of Engineering (2004). He served as chairman of the governing body of Cork Institute of Technology (2006 to 2011). He is a past-chairman of the International Society for Pharmaceutical Engineering (Irish Branch) and the Irish Pharmaceutical and Chemical Manufacturers Federation. He served on IBEC's National Executive Council. He has participated as a member of the IAE Southern Branch.

Following early retirement from Pfizer in 2003, however, Caffrey remained active in the industry as a non-executive director with Proscon Ltd and Seabrook Ltd, as well as providing consultancy services to Pfizer Healthcare Ireland. He undertook several mentoring projects under the Enterprise Ireland mentoring programme with particular interest in Life Sciences start-ups. From 2008, he has been Chairman of the Board of Seabrook Technology Group.

From 2011, he has been on the Board of Good Shepherd Cork, who provide emergency accommodation and support for vulnerable women and their children. Since 2012 he has been a Board member of the Bon Secours Health System, the largest private hospital group in Ireland.

In 1968, Paddy married Ann O'Connor, and they have four daughters.

[IEI Annual Report 2004; personal communication]

BUTLER, Anne Josephine (1955 -), environmental engineer, was born in 1955 in county Mayo, daughter of Joe Butler, national teacher, and Lola Nyland. She was educated at St Louis Secondary School, Kiltimagh and at University College Galway, where she studied civil engineering, obtaining a BE (Civil Engineering) in 1976. She went on to Trinity College Dublin (TCD), where she gained an MSc in Structural Engineering in 1977. Later in her career, in 1990, she obtained a post-graduate Diploma in Environmental Engineering from TCD.

She commenced her career with Joseph McCullough & Partners, working as a structural consultant engineer. This was followed by a period as a local authority engineer with Dublin County Council and then with Dublin Corporation (now Dublin City Council). She was Water Distribution engineer for Dublin City and also acted as Project Manager for the Dublin Water Supply Telemetry Project in the early 1990s. (She was awarded an IEI Smith Testimonial in 1992 for her paper on the project).

Anne was a founding Director of the Environmental Protection Agency in 1993 and served on the Board for ten years. She headed up the (EPA) Environmental Management and Planning Division, which for the first time, regulated water and waste facilities in Ireland. Anne subsequently worked as an environmental consultant.

Anne served as Chair of the National GMO Advisory Committee, was a member of the Government Interdepartmental Group on Modern Biotechnology and Chair of the Inter Agency Implementation Group for the Rehabilitation of Silvermines. She served on the Forfas Waste Committee, the NCEA Board of Engineering and Technology Studies and on the National Sanitary Services Training Committee.

Anne was a board member of the ESB, Repak Ltd, the National Paediatric Hospital Development Board, the Governing Body of Dublin Institute of Technology, the National Roads Authority, Ordnance Survey Ireland, Dublin Docklands Development Council and other bodies.

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), Anne served on Council and Executive and as Vice-President (elected 2003), serving as President 2005-2006. She was elected a Fellow of the Irish Academy of Engineering in 2005. Anne participated in the task force that formulated the Engineers Ireland 2003-2006 Corporate Plan which oversaw the completion of the development of the Clyde Road headquarters and the operational name change to Engineers Ireland. In 2005, she received an NUIG TBD Award for Engineering, IT and Mathematics.

In 1978, Anne married Paul Sweeney and they have three children.

[EI Annual Report 2005; personal communication]

MCGOWAN, John, civil engineer, was born on 18 July 1948 at Holles Street, Dublin, the son of Jim (Tot) McGowan and Maire O'Reilly. He was educated at Franciscan College, Gormanston and at University College Galway, where he studied civil engineering, graduating BE (Civil Engineering) in 1970. After two years with Tipperary (SR) County Council, he went on to Trinity College Dublin in 1972, where he obtained an MSc in Structural Engineering in 1974.

He spent a major part of his early career working with Jacobs International, initially as a civil / structural engineer, and subsequently as a project manager, on the design and construction of multiple pharma-chem process plants in Jordan, UK and Ireland. He ultimately was appointed Manager of Projects in the Dublin office. His final project with Jacobs was leading the design and construction of Intel's Fab 10 facility at Leixlip, county Kildare.

John joined Intel in 1993, taking over as General Site Services Manager the following year. From 1997, he spent eighteen months in the USA learning Intel's integrated circuit manufacturing processes, WIP and yield management systems. He was appointed General Manager of Intel Ireland in late 1998, becoming a Vice-President of the Technology and Manufacturing Group the following year. In 2001 he was appointed the Co-Director of the Corporate Services Group for Intel Corporation worldwide, based in Phoenix AZ. This Group managed all facility management, construction, safety, security and public relations worldwide.

He retired from Intel in 2006 to join Michael McNamara Construction as Managing Director, with a brief to introduce modern management practices. The collapse of the property market dictated a focus on leading a right-sizing of the company, including his own departure.

In 2010, he established Tualatin Ltd., a business and management consultancy. He has acted as a non-executive director of various engineering services companies, including DPS Engineering Ltd, the Chris Mee Group, and of the Construction IT Alliance, the latter promoting the usage of Building Information Management (BIM) within the construction industry. He also served terms as a member of the Advisory Council on Science and Technology, and on the management board of IT Sligo.

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), John was elected a Fellow of the Irish Academy of Engineering (IAE) in 2002. He is also a member of the Institute of Directors. He served as President of Engineers Ireland in 2006/7 and as President of the IAE in 2015/6.

In 2000 he received the Engineer of the Year Award from the Association of Consulting Engineers in Ireland and, in 2003, an NUIG NTL Award for Engineering, IT and Mathematics. In 2005, the Corporate Services organisation which he co-led in Intel won the prestigious annual Intel Quality Award.

In December 1971, John married Louise Kirk and they have three sons.

[IEI Annual Report 2005; personal communication]

GOLDEN, John Daunt (1954 -), mechanical engineer, was born on 28 May 1954 at Wexford, the son of John Daunt Golden and Anna Mary Lucking. He was educated at Presentation College, Bray, county Wicklow, and at University College Dublin, where he studied mechanical engineering. John (known to his colleagues as Jack) received his BE (Mechanical Engineering) in 1976 and an MEngSc in Metallurgy in 1980. In 2012, he received a Doctorate in International Business Leadership.

Jack began his career as a process engineer in the metal industry with Penn Aluminium in the USA and in 1979 joined Braun A.G., initially as a manufacturing engineer, then becoming operations manager at Braun Ireland in Carlow. In 1984, he was transferred to the company's head office in Kronberg, Germany to manage a technology transfer project.

In 1986 he became General Manager at Melchert Electronics before joining the Irish Management Institute the following year as a Senior Specialist (Operations Management). In 1989 he became Human Resources Director at the Agra Group and two years later became Managing Director at Thermal Heat Exchangers and in July 1993 Managing Director at Semperit Ireland, part of the Continental A.G. Group, specialising in tyre manufacture. In April 1997, Jack moved to Continental Pneus SNC at Sarreguemines in France, where he again served as Managing Director.

Jack returned to Ireland in 1999 on being appointed Group Human Resources Director at CRH plc (formerly known as Cement Roadstone Holdings), one of the world's top building materials companies employing around 90,000 people in 35 countries, mainly in Europe and North America. For the last two years with CRH, he was Organisational Development Director. Following his retirement from CRH at the end of 2015, Jack became a Director at Hitower Investments, management consultants.

Jack served three years as President of the German-Irish Chamber of Industry and Commerce and was a member and currently (2018) President of the Kuratorium (Board of Trustees). He represented CRH on the Council of the Dublin Chamber of Commerce. He served on the Board of the Eisenhower Fellowships and as Chairman of the International Committee of the British-Irish Chamber of Commerce. He is currently (2018) President of the European Chamber of Commerce in Ireland, chairman of the Centre for Effective Services (CES) and a director of the Naitonal Chemical Company (NCC).

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), Jack served as President 2007-2008. He was elected a Fellow of the Irish Academy of Engineering in 2007 and served as President in 2010. He represented Engineers Ireland on the Expert Group on Future Skills Needs.

On 28 July 1978, Jack married Ellen Linda Looney, and they have three sons, Aidan, Darragh, and Colm.

[birth and marriage certs; EI Annual Report 2006; personal communication]

BROWNE, James Joseph (1953 -), production engineer, was born on 3 January 1953 at Athlone, county Westmeath, the son of James Browne and Kathleen Richardson. He was educated at Summerhill College Sligo and at University College Galway, now NUI Galway, from where he graduated in 1974 with a BE degree in industrial engineering. He obtained an MEngSc in 1978.

Having worked with Northern Electric in Ireland and with Nortel Networks in Canada, Jim joined the research staff of the University of Manchester Institute of Science & Technology (UMIST) in 1978. There he completed research for a PhD in Mechanical Engineering, which was awarded in 1980, and in 1990 was awarded a DSc from UMIST for published works.

Returning to his alma mater in 1981 as a Senior Lecturer in Production Engineering, he was appointed Professor of Production Engineering in 1990 and served as Dean of the School of Engineering & Informatics 1996-2001.

He was founder Director of the Computer Integrated Manufacturing (CIM) Research Unit. Professor Browne was elected Registrar and Deputy President of NUI Galway in 2001 and served as President of the University from March 2008 to January 2018.

During his tenure as Dean of Engineering, Jim helped to develop a new suite of undergraduate engineering programmes in areas such as biomedical engineering, electronic and computer engineering, as well as being involved in the planning and commissioning of a new engineering building on the campus. He has served on the advisory committees of many national, international and EU R&D programmes and has been a participant and evaluator of many of these programmes. He served on the EPSRC Review Group on Engineering Research Centres in the UK.

Dr Browne is a member of the NUI Senate and served on the board of the Dublin Institute of Advanced Studies, as a member of the Irish Council for Science, Technology & Innovation, and as Chairman of the Galway Science & Technology Festival. He is a former Chairman of the Central Applications Office (CAO) and a member of the Irish Universities Quality Board. He is a member of the board of Galway University Foundation. In April 2013, Dr Browne was appointed Chair of the Children's Hospital Group Board, the remit of the group being to oversee the operational integration of Ireland's three children's hospitals in advance of the move to a new hospital.

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), Jim served as President 2008-2009. He was elected a Fellow of the Irish Academy of Engineering (IAE) in 2008. He is a Member of the Royal Irish Academy (MRIA) since 2005. He served on the editorial boards of a number of international academic journals.

He has been a partner and project leader in international R&D projects, including EU-USA and EU-China projects. He is the author or editor of 15 Books on topics such as CAD/CAM and Production Planning and Control, and over 200 academic papers. In November 2013, Jim received the IEI Outstanding Contribution to Engineering Award.

In 1979, Jim married Maeve O'Rourke and they have four sons, all graduate engineers.

[EI Annual Report 2008; NUIG press release 15 August 2013; personal communication]

HORN, Christopher John (1956 -), was born on 30 November 1956 in Surrey, the son of John Horn and Angela Mitson. He was educated at Newpark Comprehensive School in Blackrock, county Dublin and at Trinity College Dublin (TCD), where he studied electronic engineering and computer science. He received his BA and BAI degrees from the University of Dublin in 1978 and a PhD in Computer Science in 1983. Chris then spent a year working as a civil servant in Brussels for the European Commission's ESPRIT programme.

Returning to Ireland, he joined the staff of the Department of Computer Science at TCD as a lecturer and became involved in many pan-European IT research projects. He remained in TCD until 1991, at which point he co-founded IONA Technologies, with Sean Baker and Annrai O'Toole.

Chris was CEO and Chairman of IONA until he retired in 2000, having taken the company public on Nasdaq in 1997. He returned as CEO from 2003 to rebuild the company after the dotcom collapse. The company was sold in 2008. Chris has served on the boards of a wide range of technology companies. He has also served on the board of TCD and the college's Foundation board.

Chris was the founding chair of the Ireland-China Association. He was chair of UNICEF Ireland for seven years until 2008. A former chair for three years of the Irish Brain Research Foundation, Chris oversaw its merger into the Irish Institute of Clinical Neuroscience in 2005.

He was chair of the Irish Management Institute for six years. He was a former chair of the Community Foundation of Ireland, chair of the Dublin Chamber of Commerce e-City working group, and founding chair of the Government's Expert Group on Future Skills. He also served on the IBEC national council, and on the board of Science Foundation Ireland.

In 2012, Chris was a board director and advisor to the World Irish initiative. He was the founding chair of the Science Gallery based in TCD. He served as Chair of the Northern Ireland Science Park Connect Initiative in Belfast from 2012-2016. He is chair of Science Gallery International, aiming to bring the Science Gallery concept to a number of other cities around the world.

He is currently a member of the board of Hypergrid in California. He has served as an advisor to Atlantic Bridge, a venture capital firm, since 2012 and is now a partner at the firm. He also writes regularly for the *Irish Times*.

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), Chris served on Council and Executive and as President 2009-2010. He was elected a Fellow of the Irish Academy of Engineering in 2003. In 2001, Chris received an Honorary Doctorate from the University of Dublin. In the same year, he was the recipient of the RDS Gold Medal for Industry.

[EI Annual Report 2008; personal communication]

LOWERY, Martin D (1945 -), civil engineer, was born on 5 August 1945 at Galway, the son of John Lowery and Mary Hanly. He was educated at St Joseph's College, Galway, and at University College Galway, where he graduated in 1967 with a BE (Civil Engineering) and obtained an MEngSc in Hydrology the following year.

Following graduation, Martin joined the Institute of Hydrology at Wallingford (UK) as a Scientific Officer researching into methods of analysing flood statistics, the research forming the basis of his MEngSc thesis.

In 1969, he joined Aer Lingus as an operations research analyst. This involved the mathematical modelling of commercial systems. His major project was the automation of the airline's inventory control system.

Martin joined the Industrial Development Authority (IDA) in 1971 and was Executive Director from 1984 until 1989. From 1971 to 1975 he had responsibilities in Planning and Chemicals/Heavy Industries. This included negotiations for the establishment of the Aughinish Alumina plant on the Shannon Estuary.

From 1975 until 1982 he was, in succession, Manager Heavy Industries, and Manager Overseas Industries Division (Electronics and Healthcare/Pharmaceuticals). During 1982 and 1983 he was Manager Planning and Accounts Division which included responsibility for preparing the IDA's Strategic Plan for the 1980s.

Martin was an Executive Director of the IDA from January 1984 to January 1989 and a member of the IDA Board (as distinct from the Authority). The Board decided on grant applications and was the principal decision-making forum of the Authority. He had executive responsibility for the Electronics Division, the Natural Resources Division (including food), Irish Industries Division, Company Development Division, and the International Services Division. He was also Chairman of the International Services Committee during this period.

Martin joined Coillte Teoranta in January 1989 as its first Chief Executive, when it was established as a commercial state company, taking over the assets and staff of the former Forest Service. He led the transformation of Coillte from a civil service organisation to a successful state company. He also led the acquisition by Coillte of two major wood processing plants, Smartply Europe and Medite Europe. He retired in 2006.

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), Martin served on Council and Executive and served as President 2010-2011. He was elected a Fellow of the Irish Academy of Engineering (IAE) in 2000.

In 1972, John married Aileen Blighe, and they have a son and three daughters.

[IEI Annual Report 2009; personal communication]

RUDDEN, Patrick Joseph (P.J.) (1954 -), civil engineer, was born on 7 August 1954 in Cavan, son of Peter Rudden and Elizabeth Gallagher. He was educated at St. Patricks College Cavan and at University College Dublin, where he graduated BE (Hons) Civil Engineering in 1975.

PJ began his career as a Graduate Engineer with Dublin Corporation at Ballymore Eustace Water Treatment Plant serving Dublin city and Dublin and Kildare counties. In 1978 he joined M C O'Sullivan Consulting Engineers (MCOS) at Mullingar for Westmeath County Council as Resident Engineer on water supply, wastewater, housing, roads and bridge projects. In 1982, PJ was seconded to Bord Gais as project engineer on the Dublin end of the Cork-Dublin gas pipeline and the North Eastern gas pipeline in north county Dublin.

PJ returned to MCOS in 1985 and helped to build the new Dublin office in water/wastewater services and motorways into the early 1990s. He then led MCOS's diversification into energy, waste management and environmental projects, including the formulation and communication of Ireland's first regional waste management plans, for which he received an Inaugural UCD EGA Distinguished Graduate Award in 2002. He became a partner and director in MCOS in 1999 and in 2001 was responsible for opening their Galway office. He is a Director of RPS Group Ltd (who acquired MCOS in 2002). Projects include the Dublin Waste to Energy project at Poolbeg, for which RPS won the 2015 Public Sector Planning and Environment Award.

In the late 1990s, PJ was consultant project director for Bord Gais for the Gas 2025 study, which was the national strategy for gas supply up to horizon year 2025 recommending the Second UK Gas Interconnector, Gas Pipeline to the West, South-North Pipeline, an LNG terminal in the south-west, and connection to then emerging Corrib gas field. Since 2007, he was RPS Project Director for Shell for planning, routing, EIS and construction supervision of the modified Corrib onshore pipeline route in county Mayo. He served as Chairman of the National Gas Transmission Standards (TC5) Committee for NSAI (2003-2018), Project Director, Irish Scottish Links Energy Study (ISLES) for the three governments of Scotland, Ireland, and Northern Ireland (2011-2013) and Project Director for Gas to the West in Northern Ireland. He is also Director of the EU Commission Secretariat for the European Green Capital Award (2010-2018).

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), PJ served as President 2011-2012 and was elected a Fellow of the Irish Academy of Engineering (FIAE) in 2012. He is a Fellow of the Institution of Civil Engineers (FICE) and of the Association of Consulting Engineers of Ireland (FConsEI). He is also a Fellow of the Chartered Institute of Waste Management (FCIWM), the Institution of Gas Engineering and Management (FIGEM), and a Chartered Member of the Institution of Water and Environmental Management (MCIWEM).

PJ has been the recipient of three Mullins Medals and a Smith Testimonial for outstanding papers. He was chairman of the Engineers Ireland Task Force on Mathematics and Science Education at Second Level. He served as President of the UCD Engineering Graduates Association (2012-2016).

He received the ICE 2016 Outstanding Achievement Award for his 'pioneering work on infrastructure and waste planning in Ireland.' In 2018, he was appointed Chair of the Editorial Advisory Board of the Engineers Journal and to the Royal Irish Academy (RIA) Engineering and Science Committee.

In 1982, PJ married Celia and they have three children, Mark, Neil and Jennifer.

[personal communications; EI Annual Report 2010]

PHILLIPS, Michael M (1950 -), civil engineer, was born on 29 September 1950 at Kilrush, county Clare, the son of Martin Phillips, and Brigid Dunphy. He was educated at Kilrush CBS, St. Clements College, Limerick and at University College Dublin, where he studied civil engineering, graduating BE (Civil Engineering) in 1972 and receiving an MEngSc in 1974.

He began his career in 1974 as an Assistant Resident Engineer on the Grand Canal Tunnel Scheme in Dublin. After spending approximately two years in Calabar, Nigeria working on all aspects of civil engineering for a major harbour complex on a greenfield site, Michael returned to Ireland in 1978 to work for Irishenco Ltd, a major Irish civil engineering contractor, on infrastructure, where he was in charge of bridge projects, including the Frank Sherwin Bridge over the Liffey and Rice Bridge over the Suir in Waterford City.

From 1987 until 1998, Michael worked with a number of local authorities including Bray UDC, Dublin County Council, Dun Laoghaire Rathdown County Council and Dublin City Council.

In 1998, he was appointed City Engineer for Dublin with responsibility for all engineering infrastructure and services. Projects included the Dublin Port Tunnel and Ringsend Wastewater Treatment Works. Michael was also Director of Traffic from 2006 with additional responsibilities, including coordination of Transport 21 projects such as planning for the construction of Metro North and Dart underground. He retired in 2015.

In 2015, Michael was awarded the inaugural Engineer of the Year Award for outstanding achievement and contribution to the civil engineering industry in Ireland by the Institution of Civil Engineers (ICE), Republic of Ireland Region. He was honoured by his civil engineering peers for his outstanding contribution to civil engineering in Ireland and, in particular, his significant achievements as Dublin City Engineer.

Projects such as the two iconic Santiago Calatrava bridges spanning the Liffey – the James Joyce Bridge built in 2003 and the Samuel Beckett Bridge built in 2009 – were championed by Michael and now grace Dublin's city centre. He has co-authored papers on bridges and geotechnics. Michael was also responsible for the launch of the website www.bridgesofdublin.ie that showcases Dublin's bridges through photos, videos, stories and the history of the city and a number of publications on the history of engineering in Dublin City. In November 2016, as part of the Engineers Ireland annual excellence awards, he was awarded the Outstanding Contribution to Engineering Award.

A Chartered Engineer, Michael was elected a Fellow of Engineers Ireland (FIEI) in 2003, and a Fellow of the Irish Academy of Engineering (IAE) in 2005. He was elected a Fellow of the Institution of Civil Engineers (London) in 2004. He served on the Council and Executive of Engineers Ireland and was President in 2012-2013. He has been a member of the Board of Eureau, the Water Suppliers Association of Europe since 1998 and was its President in 2003.

[EI Annual Report 2011; private communications]

O'DEA, John (1962 -), electronic engineer, was born on 29 November 1962 in Dublin, the son of Vincent and Margaret O'Dea. He was educated at St Pauls College, Raheny, Dublin and at University College Dublin, where he studied mechanical engineering. He graduated BE (Mechanical Engineering) in 1984 and obtained a Masters in Engineering Design in 1988. He received a PhD in 1993 for the study of microwave frequency characterization of integrated circuit packaging and in 2012 completed an MSc in Clinical Research at NUI Galway. In 2016 he was awarded an Honorary Doctorate of Engineering by NUI Galway for his contributions to the Irish medical device industry.

John spent the first six years of his career in the electronics industry with Dataproducts in Dublin and Digital Equipment Corporation in Galway. In 1991 he moved into the medical devices industry, where, after a period of two years in San Diego, he established a ventilator R&D facility in Galway for Puritan Bennett (now a subsidiary of Medtronic), a world leader in mechanical critical care ventilation.

In 1997, John co-founded Caradyne, a Galway-based respiratory care device company, which focussed on non-invasive respiratory support in the pre-hospital and neo-natal areas. The company was acquired by Pittsburgh-based Respironics Inc. in 2004, and John served for two and a half years as Managing Director of their Irish subsidiary.

At the end of 2006, John founded Crospon, a medical device company which designed and is manufacturing and marketing a novel imaging technology to assist diagnosis and surgery of motility disorders of the oesophagus and stomach. The company was acquired by Minneapolis-based Medtronic Inc. in 2017.

John is Chairman of Janisys, a spinout from Crospon, which is developing a novel micro-needle-based active transdermal drug delivery technology, and Palliare, a second spinout from Crospon, which is developing insufflation technology for endoscopic surgery. John is also a director on the board of a number of other medical device startup companies.

John is an Adjunct Professor at the School of Engineering and Informatics at NUI Galway where he is Chairman of the External Advisory Board of BioInnovate Ireland and Special Advisor to the SFI CURAM Centre for Research in Medical Devices. He has served as Chairman of the Irish Medical Devices Association and as Chairman of the External Advisory Board of the Irish Regenerative Medicine Institute (REMEDI) at NUI Galway.

He has represented Ireland on the working group responsible for developing the European standard for electromagnetic compatibility requirements for medical devices (EN60601-1-2). John is a named author on eighteen US patents.

A Chartered Engineer, a Fellow of Engineers Ireland (FIEI), and a Fellow of the Irish Academy of Engineering (FIAE), John served as President of the former 2013-2014.

In 1996, John married Caroline, daughter of Thomas and Mary Sherlock, and they have a daughter Aoife

[http://www.engineersireland.ie/about/governance/council/john-o-dea.aspx 27/11/14]

MORAN, Regina, electronic engineer, was born on 7 September, 1962 in Islington, London, the daughter of Thomas Leavy and Catherine Lawless She was educated at Presentation Convent, Clonmel and at a number of third-level institutions. Regina first obtained a Certificate in Engineering from Waterford RTC (now Waterford IT), with Distinction, which led to a Diploma in Electronic Engineering from Cork RTC (now Cork IT), also with Distinction. She then completed Certificates in Finance and Business Organisation, which enabled her to complete an MBA at Dublin City University, achieving first class honours in the degree examination. She was awarded the 'Sir Charles Harvey Award' for outstanding contribution in her post-graduate studies.

Regina began her career as an electronics engineer with Amdahl, a computer mainframe manufacturer, progressing to become a co-founder of their services and consulting group. In 1997, she co-founded DMR Consulting Ireland, where she held the role of Director of Operations responsible for Project Delivery. From there she moved to DMR Consulting, which became Fujitsu Consulting, subsequently merging with Fujitsu Services in April 2004. She was appointed CEO of Fujitsu Services Ireland in August 2006 and CEO of Fujitsu Ireland in May 2009. In June 2015, Regina became CEO of Fujitsu UK & Ireland. In April 2018, Regina became Enterprise Director at Vodafone.

A Chartered Engineer, a Fellow of Engineers Ireland (FIEI), and a Fellow of the Irish Academy of Engineering, Regina served on the Council and Executive of Engineers Ireland and was President 2014-2015, during which time she promoted STEM and the role of women in engineering. In 2015 she was awarded the Cork Institute of Technology STEM Graduate Achievement Award. In 2014 she was awarded Technology Person of the Year. She was a member of the board of the Irish BusiQness Employers' Confederation (IBEC), and in 2011 was appointed a member of the Dublin City University governing authority. She was Chair of ICT Ireland and served as a Non-Executive Director of EirGrid from November 2011 to 2015. Regina is a former elected member of the Dublin Chamber of Commerce. In 2014, she was appointed to the National Paediatric Hospital Development Board. A subsequent role in London prompted her resignation from the board.

In 1990, Regina married Jim Moran and they have three children, Conor, Maeve and Eoghan.

[EI Annual Report 2013; personal communication]

GRIMSON, William (1947 -), electronic engineer, was born on 5 December 1947 in Dublin, the son of Christina Isabella Jones and William James Grimson. He was educated at The King's Hospital school and at Trinity College Dublin, where he studied engineering. Graduating in 1970 with a BA and a BAI in electronic engineering, Bill continued his studies in the Department of Electrical & Computer Engineering at the University of Toronto, studying electromagnetic theory as well as researching the behaviour of antennas in the ionosphere, gaining a MASc degree in 1973.

Bill then worked for three years as a research and development engineer with Ferranti Ltd. in Edinburgh, in their Laser Systems Group, working on electro-optic laser receivers. He then returned to Ireland to take up a position as a Lecturer in what was to become DIT (Kevin Street), where in time he was to become Head of the Department of Control Systems Engineering.

Bill's lecturing duties were focussed primarily in the areas of digital signal processing, image processing, in addition to field and circuit theory. His research activities were centred mostly on the application of engineering paradigms to health informatics and he participated in a number of major European projects. Towards the end of his career in DIT he was attached to the Directorate of Academic Affairs heading a special unit charged with

changing the academic programme delivery model to one that was both semesterised and modularised. Nearing the end of his career in DIT Bill chose to remain in academic affairs where for a time he was Academic Registrar before retiring in 2012.

Bill has published over 80 journal papers, reports and book chapters in the area of Health Informatics and Engineering Education. He was the Chair of the Health Informatics Standards Consultative Committee of the National Standards Authority of Ireland (NSAI) and in 2006 was awarded the O'Moore Medal for his work in the area of health informatics. He acted as sponsor for the working group, comprising members of the Biomedical Engineering Division of Engineers Ireland, which developed 'A Proposal for a Protocol for Professional Formation and Development of Clinical Engineers in Ireland' and subsequently brought the proposal to the International Federation for Medical and Biological Engineering (IFMBE) where it was substantially adopted.

A Chartered Engineer and a Fellow of Engineers Ireland (FIEI), Bill is also a Eur Ing. He is a past-chairman of the Membership and Qualifications Board and was a member of the Board of Examiners. He served on the Council and Executive and was President 2015-2016. As Vice President. and then President, he chaired the CPD committee. He served two terms as the Irish representative on the European Membership Monitoring Committee of FEANI (Fédération Européenne d'Associations Nationales d'Ingénieurs). He was elected a Fellow of the Irish Academy of Engineering in 2017.

Towards the end of his career and more recently, Bill has collaborated with both engineers and non-engineers in Europe and North America reflecting on what constitutes the philosophy of engineering, the education of engineering undergraduates and the subsequent development of the professional engineer: he has authored and co-authored a number of book chapters and articles in this area.

In May 1971, Bill married Jane, daughter of William Wright and Mildred Anderson Robertson. Jane was IEI President 1999-2000. They have two children, Andrew and Sarah.

[EI Annual Report 2013; personal communications]

BYRNE, Dermot (1951-), electrical engineer, was born in 1951 in Dublin, the son of Padraic and Eileen Byrne. Educated at Drimnagh Castle CBS, Dermot entered University College Dublin in 1968, graduating BE in Electrical Engineering in 1972 and MEng in Electrical Engineering in 1974. He was awarded an MBA in 1982.

He joined ESB System Operations in 1973. In 2000, he was appointed as the first Head of ESB Networks where he oversaw the ramping up of investment in transmission and distribution infrastructure in Ireland, with particular focus on the network renewal programme. In July 2005, Dermot was appointed Chief Executive of EirGrid – the transmission system operator for Ireland. In his role as Chief Executive and Managing Director, Dermot developed EirGrid into a group structure with responsibilities in Ireland and Northern Ireland, comprising EirGrid TSO, System Operator Northern Ireland (SONI Ltd.), and the Single Electricity Market Operator (SEMO). Key initiatives overseen by Dermot include the successful completion of the €600m East-West Interconnector in September 2012, the development and implementation of the Grid25 network investment strategy and the establishment of EirGrid as a world leader in the integration of wind power into the power system.

Following his retirement from EirGrid in 2012, Dermot became active as a non-executive director and utility consultant. Dermot chairs the Board of Vita, a not-for-profit NGO working to improve the livelihoods of households and communities in East Africa, principally in rural Ethiopia and Eritrea. On behalf of the Department of Communications, Climate Change and Natural Resources Dermot chairs an expert group developing an Energy Research Strategy and Implementation Plan for Ireland.

Dermot is a Chartered Engineer, a Fellow of Engineers Ireland (FIEI), a Chartered Director of the Institute of Directors in Ireland, and a Distinguished Member of the international electricity body CIGRE. He was President of Engineers Ireland in 2016/17. In 1978 Dermot married Máire Cassin and they have two daughters, Catherine and Órla, and three sons, Rory, Seán and Ciarán.

[Engineers Ireland Annual Report 2016, personal communication]

FEIGHAN, Kieran John (1961-), civil engineer, was born on 16 December 1961 at Ballymote, county Sligo, the son of Felix Oliver Feighan and Mairin Dillane. Educated at St. Gerard's College, Castlebar and St. Mary's Academy, Carlow, Kieran entered University College Galway in 1979, graduating BE in Civil Engineering in 1983 with first class honours and was awarded the NUI National Bursary in Civil Engineering in 1983, which enabled him to continue his studies at Purdue University in the USA.

He obtained there a Master's degree in Civil Engineering in 1985 and a PhD in Transportation Engineering in 1988. Kieran also holds a postgraduate Diploma in Construction Law and Contract Administration from the University of Dublin. Prior to returning to Ireland, he worked with the US Army Corps of Engineers Research Laboratory and with a specialised pavement engineering firm in Champaign, Illinois.

Kieran is the founder and Managing Director of PMS Pavement Management Services Ltd., an Irish-owned Consulting Engineering company with offices in Galway and Dublin. The company has carried out pavement design, evaluation and management on a wide range of roads, airports and ports projects in Ireland since its foundation in 1992. PMS has also carried out international pavement-related projects in the UK and Europe, the United States, Kazakhstan, Tanzania, and the Caribbean.

He has been a leader and innovator in the introduction of many new pavement evaluation technologies in Ireland and abroad. In addition, he has acted as specialist technical advisor for a number of public bodies in Ireland including Transportation Infrastructure Ireland, the Department of Transport, Tourism and Sport, Dublin Airport Authority, Office of Public Works, Commission for Aviation Regulation, Coillte and the Department of Defence.

Kieran is recognised through his work, professional activities and publications, as a leading international expert in the areas of pavement evaluation, pavement management and asset management of road networks. He has published over 40 papers in academic journals and conference proceedings in the pavements area. He has held various editorial roles with the ASCE Journal of Transportation Engineering and both chair and committee roles over many years with the U.S. Transportation Research Board. Kieran has lectured for many years to undergraduate and postgraduate students at University College Dublin, Trinity College Dublin and NUI Galway in engineering and business.

Kieran is a Chartered Engineer, a Fellow of Engineers Ireland (EI) by presidential invitation, and a Member of the American Society of Civil Engineers. He was President of Engineers Ireland in 2017-18. He is a past-Chair of the Civil Division and a long-standing committee member of the Roads and Transportation Society. Kieran's father, Oliver, was President of the Institution of Engineers of Ireland in 1984/85. Kieran is married to Prof. Aisling Reynolds, a transport economist in UCD. They have three children.

[Engineers Ireland Annual Report 2014, personal communication]

Quinn, Peter (1953 -), civil engineer, was born in 1953 in Clonoe, County Tyrone, the son of Patrick and Teresa Quinn. Peter was educated at St Patrick's Academy in Dungannon and at Queen's University, Belfast, where he studied civil engineering, obtaining a BSc degree in civil engineering in 1977 and an MSc in 1985 following part-time study.

He commenced his professional career with Charles Brand & Sons, Ltd. in Belfast, where he worked as a site engineer on heavy marine construction at Cloghan Point Jetty, on Whiteabbey Shore Road, and on urban motorway construction on Belfast's West Link.

From 1980 to 1982, Peter worked for J.V.Duffy of Shankill, County Dublin, managing earthworks and bridge construction teams on a road project in northern Nigeria. On returning to Ireland in 1982, he joined Monaghan County Council, where he worked until 2000 on water, wastewater, housing and national roads projects as designer, resident engineer, and latterly as project manager on group water supply schemes.

Since 2000, Peter has been a director of PG Quinn Ltd, a civil/structural engineering consultancy in County Tyrone.

Peter became a Chartered Engineer in 1985 and is also a Eur Ing. He became a Fellow of Engineers Ireland (FIEI) in 2007. He is a Chartered Member of the Institution of Civil Engineers and a Member of the Chartered Institution of Highways and Transportation. He served as President of Engineers Ireland in 2018-2019.

Peter is married to Anne and they have three sons; John is a Senior IT team leader in Sydney, Australia, whilst David and Aidan are both structural engineers working on the Earthquake Recovery Programme in Christchurch, New Zealand.

[EI Presidents acceptance speech, personal communication]

Appendix

THE INSTITUTION OF CIVIL ENGINEERS OF IRELAND (CHARTER AMENDMENT) ACT, 1969

AN ACT TO AMEND FURTHER THE CHARTER UNDER WHICH THE INSTITUTION OF CIVIL ENGINEERS OF IRELAND IS INCORPORATED (AS AMENDED BY THE INSTITUTION OF CIVIL ENGINEERS OF IRELAND (CHARTER AMENDMENT) ACT, 1960) SO AS TO ALTER THE NAME AND EXTEND THE OBJECTS OF THE INSTITUTION AND TO ALTER THE PROVISIONS RELATING TO THE MEMBERSHIP THEREOF AND IN PARTICULAR SO AS TO PROVIDE FOR ADMISSION TO MEMBERSHIP THEREOF OF EXISTING MEMBERS OF CUMANN NA nINNEALTÓIRÍ AND TO PROVIDE FOR THE USE BY FULLY QUALIFIED PERSONS OF THE DESCRIPTION "CHARTERED ENGINEER" AND TO PROVIDE FOR OTHER MATTERS CONNECTED WITH THE MATTERS AFORESAID.

WHEREAS the Institution of Civil Engineers of Ireland was founded in the year 1835 for promoting the acquisition of knowledge appertaining to the professions of Civil and Mechanical Engineers and for the advancement of Engineering and Mechanical Science:

AND WHEREAS by a Charter or Letters Patent under the Great Seal of Ireland dated the 15th day of October 1877 and granted by Her Late Majesty Queen Victoria certain persons therein named and such other persons as then were or should thereafter become members of the said Institution were incorporated into one body politic and corporate under the name "The Institution of Civil Engineers of Ireland" and by such Charter certain powers were conferred upon such Corporation and certain provisions were made for the regulation of its affairs:

AND WHEREAS by a private Act of the Oireachtas namely The Institution of Civil Engineers of Ireland (Charter Amendment) Act, 1960 (No.1 (Private) of 1960) the said Charter was amended so as to be read as providing that the purposes of the said Institution should be the promoting of the acquisition of knowledge appertaining to the profession of Engineering and the special advancement of Engineering Sciences and it was by the said Act provided that the Bye-laws of the said Institution might from time to time prescribe a maximum number of members of the Council (other than and exclusive of the President, the Vice-President and the Secretary) and that the number of such members should not thereafter exceed such maximum nor be less than twenty-one and the said Act contained other provisions as to the constitution of such Council and provided that such Council should have the direction and management of the concerns of the said Institution:

AND WHEREAS there has been a great growth in the development of special branches of engineering in recent years and no provision is made in the said Charter or amending Act for recognition or organisation of such special branches or for their representation on the Council of the said Institution:

AND WHEREAS an association of Irish engineers was founded in or about the year 1928 and was incorporated under the Companies Acts, 1908 to 1924, as a Company limited by guarantee under the name Cumann na nInnealtóirí (hereinafter referred to as "The Cumann") having for its principal object the furtherance of the interests of the engineering profession in Ireland:

AND WHEREAS there is considerable duplication and overlapping of functions between the said Institution and the Cumann, many engineers being members of both of those bodies, and an amalgamation of the two bodies would be advantageous to the engineering profession and in the public interest:

AND WHEREAS by reason of the growth of specialised branches of the engineering profession the present name of the said Institution is unduly restrictive and it is desirable to adopt a name applicable to the profession generally:

AND WHEREAS provision for the representation of such specialised branches on the Council of the said Institution and the increase in membership resulting from an amalgamation with the Cumann will render necessary or desirable changes in the provisions of the said Charter and the amending Act relating to the constitution and mode of election of the Council of the said Institution:

AND WHEREAS it is desirable that provisions be made for more than one category of membership of the said Institution and that a category of members to be known as Chartered Members should be created and that those members possessing the necessary professional qualifications and experience to be admitted to such category should be entitled to use some distinctive description of themselves which may be readily understood to have such significance:

AND WHEREAS a resolution authorising the application for this Act was duly passed at a Special General Meeting of the said Institution held on the 24th day of April 1968 and a resolution approving of the objects of this Act was duly passed at an Extraordinary General Meeting of the Cumann held on the 16th day of May 1968:

AND WHEREAS it is expedient that the provisions in this Act contained should be enacted and the purposes aforesaid cannot be effected without the authority of the Oireachtas.

BE IT THEREFORE ENACTED BY THE OIREACHTAS AS FOLLOWS:

I.- In this Act unless the context otherwise requires "The Charter" means the Royal Charter of Incorporation of the Institution of the Civil Engineers of Ireland granted on 15th day of October 1877;
"The amending Act" means The Institution of Civil Engineers of Ireland (Charter Amendment) Act, 1960;
"The Institution" means the body corporate constituted by the Charter;
"The Cumann" means the body incorporated under the Companies Acts, 1908 to 1924, under the name Cumann na nInnealtóirí ;
"The Council" means the Council of the Institution;
"The Bye-laws" means the bye-laws, rules and regulations of the Institution for the time being in force;
"The Secretary" means the Secretary of the Institution;
" The Profession" means the engineering profession and includes specialised branches of that profession.

2.- The name of the Institution shall henceforth be "The Institution of Engineers of Ireland" or "Cumann na nInnealtóirí ".

3.- The Charter shall henceforth be construed as providing that the purposes of the Institution shall include:
(a) promoting the acquisition of that species of knowledge which appertains to the profession of engineering and advancing engineering science and furthering by all legitimate means the interests of the said profession and of its members,
(b) setting up and maintaining proper standards of professional and general education and training for admission to membership or to any category of membership of the Institution, with power to provide and prescribe instruction and courses of study and to conduct examinations for the purpose of maintaining such standards,
(c) ensuring that the description “Chartered Engineer" or the use of initials or letters having a similar significance is confined to a category of engineers who have satisfied the Council of their professional competence and experience, or who are authorised so to describe themselves by a professional body recognised by the Council in that behalf,
(d) maintaining a proper standard of professional ethics and conduct.

4.-The Institution shall have power to organise and make provision for specialised divisions of membership, corresponding to specialised branches of engineering science, or to particular sections of employment, or otherwise, and to provide by its Bye-laws for representation of such specialised divisions on the Council.

5.-Membership of the Institution shall be open to all persons who establish to the satisfaction of the Council that they are qualified for membership in a manner required by the Bye-laws.

6.-There shall be two categories of members, namely Chartered member and Ordinary member. Chartered membership shall be confined to persons of not less than 25 years of age who, in addition to having the qualifications required for membership of the Institution, have such further qualifications as may by the Bye-laws be required for admission to Chartered membership.

7.-Chartered members of the Institution shall be known as "Chartered Engineers" and shall have the right so to describe themselves and to use after their names the abbreviation "C.Eng.". Such right shall be confined to such Chartered Members and to persons within the State in respect of whom the Council is satisfied that they are authorised to describe themselves as Chartered Engineers by a professional body recognised by the Council in that behalf. The Council shall keep a register of such persons and the Bye-laws may provide for payment of fees

for such registration.

8.- The Chartered members and Ordinary members of the Institution shall together constitute the corporate body but provision may be made by the Bye-laws for admitting other persons to honorary membership and for admitting as associates, students of engineering, engineering technicians not qualified for membership, and such other persons as may be provided for.

9.-Notwithstanding anything to the contrary contained in the Charter or in the amending Act, the Bye-laws may provide for all or any of the following matters:

(a) the setting up and organization within the Institution of several divisions of members to cater for the needs of the profession,

(b) the constitution of divisional boards of control or committees and the method of election to such boards,

(c) the formation of some or all of such divisions into divisional groups and the provision of committees or executive bodies to manage the affairs of such groups,

(d) the constitution, number and method of election of the Council,

(e) the election and method of election of a President and other officers in lieu of the officers mentioned in the Charter and the amending Act,

(f) the conditions subject to which students, engineering technicians or other persons may be associated with the Institution,

(g) the qualifications required for Ordinary membership and Chartered membership respectively,

(h) the conferring of the title "Fellow of the Institution of Engineers of Ireland" or other title of distinction on any of the Chartered members and the conditions governing the conferring and use of such title,

(i) the affiliation or association of the Institution with other professional bodies, within the State or elsewhere, and the granting of any reciprocal rights to members of any such bodies,

(j) the appointment by the Council and the remuneration out of the funds of the Institution of a Secretary and other officers (who need not be members),

(k) the holding of a postal ballot in relation to any matter.

10.-Notwithstanding anything contained in *section 5* of this Act all persons who are at the date of passing of this Act members of the Cumann shall be entitled to membership of the Institution and shall (unless they serve notice in writing to the contrary on the Secretary within three months after such date) at the expiration of three months after such date become and be members of the Institution.

11.-(1) At the expiration of three months after the date of passing of this Act the Cumann shall be by virtue of this section dissolved.

(2) All property whether real and personal (including choses-in-action) which immediately before the dissolution of the Cumann was vested in, belonged to, or was held in trust for, the dissolved Cumann, subject however, to any incumbrances, rights or liabilities affecting the property immediately before such dissolution, and all rights, powers and privileges relating to or connected with any such property shall, on the dissolution of the Cumann and without any conveyance or assignment but subject where necessary to transfer in the books of any bank, corporation, or company, become and be vested in or the property of or held in trust for (as the case may require) the Institution for all the estate, term or interest for which the same immediately before such dissolution was vested in or belonged to or was held in trust for the dissolved Cumann.

(3) All property transferred by this section which, immediately before the dissolution of the Cumann, was standing in the books of any bank or was registered in the books of any bank, corporation, or company shall, upon the request of the Institution made on or at any time after the dissolution of the Cumann, be transferred in such

books by such bank, corporation, or company into the name of the Institution.

(4) On and after the dissolution of the Cumann every chose-in-action transferred by this section to the Institution may be sued upon, recovered, or enforced by the Institution in its own name and it shall not be necessary for the Institution to give notice to the person bound by such choses-in-action of the transfer effected by this section.

(5) Section 12 of the Finance Act 1895 shall not operate so as to require the Institution to deliver to the Revenue Commissioners a copy of the Act or to pay any Stamp Duty under that section on any copy of the Act.

12.-(1) Pending the adoption of new Bye-laws and the election of a new Council pursuant thereto, the affairs of the Institution shall be managed by a Provisional Council consisting of all persons who were at the passing of this Act members of the Council of the Institution together with all persons who were then members of the Central Council of the Cumann. Such Provisional Council shall draft new Bye-laws for the Institution and shall arrange for the convening of a General Meeting of the members of the Institution in Dublin not later than one year after the passing of this Act. Not less than twenty-one days' notice in writing of such meeting, specifying the time and place of the meeting, shall be sent to all members by prepaid post addressed to them at their last known place of address, and a copy of the draft new Bye-laws shall be sent with each such notice but the non-receipt of any such notice or copy of the draft new Bye-laws by, or the accidental omission to give notice or copy to, any member shall not invalidate the proceedings at such meeting.

(2) Any proposed amendment to such draft Bye-laws shall be in writing, signed by not less than ten members, and sent by prepaid post to the Secretary so as to reach him not less than seven days before the date of the said General Meeting. At such meeting the draft Bye-laws and any such proposed amendments shall be put to the vote and, if they are not approved by a majority of those present and voting, the meeting shall be adjourned to a date to be announced by the Chairman and the Provisional Council shall in the meantime revise the draft Bye-laws, which as so revised shall be again put to the vote: and if necessary there shall be further adjournments until the draft Bye-laws are so approved.

(3) When draft Bye-laws have been approved at a General Meeting they shall be circulated by post to all members where addresses are known for acceptance or rejection *en bloc* by postal vote, such votes to reach the Secretary on or before a specified date to be fixed by the Provisional Council. In the event of a majority of the postal votes cast being in favour of acceptance, the Provisional Council shall declare the draft Bye-laws to be accepted and they shall thereupon become and be the Bye-laws of the Institution.

(4) If there shall not be a majority of such postal votes in favour of acceptance, the Provisional Council shall convene a further General Meeting to consider objections and any further proposed amendments, and if necessary such meeting shall be adjourned from time to time until draft Bye-laws are approved by a majority of the votes cast at such meeting. When such approval has been obtained the draft Bye-laws so approved shall thereupon become and be the Bye-laws of the Institution.

(5) The Provisional Council shall nominate the person to act as Chairman at such General Meetings and in the case of equality of votes such Chairman shall have an additional or casting vote.

(6) The Provisional Council shall have all the powers now vested in the Council and may appoint and payout of the funds of the Institution reasonable remuneration to a Secretary or to joint secretaries, or other officials.

13. -Save as hereby amended the Charter and the amending Act shall be and remain in full force and effect.

14.-(1) The Institution shall deliver to the Registrar of Companies a printed copy of this Act and he shall retain and register the same and if such a copy of this Act is not delivered within six months from the passing of this Act the Institution shall incur a penalty not exceeding two pounds for every day after the expiration of those six months during which the default continues. Every penalty under this section shall be recoverable summarily. .

(2) On receipt of a printed copy of this Act, the Registrar of Companies shall thereupon strike the Cumann from the Register of Companies.

15. -The costs, charges and expenses preliminary to and of and incidental to the preparing, obtaining and passing of this Act shall be paid by and out of the funds of the Institution.

16.-This Act may be cited as The Institution of Civil Engineers of Ireland (Charter Amendment) Act, 1969.

Past Presidents of the Institution of Engineers of Ireland (IEI) have interpreted their role in a variety of ways, including chairing meetings of the council and executive, presiding at the presentation of technical papers, and representing the Institution and the engineering profession, both nationally and internationally.

The tradition of presenting a presidential address during the term of office of each president was begun in 1856 by George Willoughby Hemans. Since that time, with few exceptions, each president has addressed the membership in their own individual style, often drawing on the experiences gained during their respective careers.

In this book (the follow up to Called to Serve, 2014), the presidential addresses from the time of unification of the engineering profession in Ireland in 1969 up to 2018 are presented in an historical context. Abstracts from the addresses are preceded by a continuation of the brief history of the IEI from 1969 to 2018 in order to provide a framework within which the addresses may be considered.

A major portion of Called to Serve Two is devoted to biographical sketches of each of the presidents – from Jock Harbison in 1969 to Peter Quinn in 2018.

The sponsorship of the Electricity Supply Board is gratefully acknowledged