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The Role of Work-Based Learning Methodologies in the Development of Life-Long Engineering Education in the 21st Century*

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Education in the 21st Century finds itself having to face many challenges in order to satisfy the expectations of governments, students and industry. Some readily identifiable themes are life-long learning, Continuous Professional Development (CPD), wider access routes for non-traditional students, the development of knowledge workers and the role of tacit knowledge and skills associated with emotional intelligence (EQ-i). The article examines each of these themes in the context of engineering education in the 21st Century and proposes a set of key issues for each theme that reflects its contribution to the development of students and practicing engineers. Using key issues and the basic concepts of Work-Based Learning (WBL), its potential to contribute to the delivery of each theme is assessed. The resulting observations are then used to identify the effectiveness of current WBL methodologies, such as reflective practice, in achieving the educational objectives of each theme. A set of guidelines for the use of WBL in the delivery of different thematic objectives within student and practicing engineer education is suggested and a new operational paradigm for work-based CPD, which integrates tacit knowledge and advanced knowledge skills with explicit knowledge, is proposed.

INTRODUCTION

The 21st Century has already led to many key questions for education. The concept of knowledge, its management, the development of a workforce that has the skills necessary to support a modern knowledge economy are issues that education must now address in terms of developing the correct methodology [1].

One such approach to this has been the development of a life-long learning policy [2]. Life-long learning is a policy and philosophy that is a political response to the need to upskill the working population in order to maintain a competitive advantage in the economy It is now becoming increasingly accepted by organisations that knowledge is the true source of power and will increasingly become so as the 21st Century progresses [3]. Part of the policy is increasingly concerned with social issues, such as inclusion and wider access.

Continuous Professional Development (CPD) is another methodology that has been encouraged by the engineering profession as a means to maintain and enhance engineering skills [4]. At some professional engineering institutions, the maintenance of a continuous professional development record is required to maintain membership. The non-traditional student ie the student who does not attend university in the traditional mode, is now a common feature in many educational systems. In addition to these pressures, the expanding knowledge base and the profile of the skills considered necessary to participate in knowledge production all point to the need to isolate essential and required knowledge. Hence, this also leads to

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avoiding explicit knowledge overload to the detriment of addressing the need for continuous skills updating as a function of careers development for professional engineers.

As we move into the early 21st Century, it has become established that theory has now shifted to support the concept that knowledge is now the primary factor of production, source of wealth and hence the competitive advantage. It is now essential that European companies develop power through relevant knowledge, thereby improving the competitive advantage for Europe, thereby achieving an improved quality of life for its citizens.

How companies react to, and develop knowledge through, life-long learning (CPD) is now a critical dimension to address. Traditional models of on-campus CPD are no longer relevant and much of the learning required is within the implicit environment of the organisation, as opposed to being available on-campus. This is particularly true in relation to tacit knowledge and advanced knowledge skills development, such as emotional intelligence (EQ-i). For companies, this is a new paradigm that they must face if they are to deal effectively with knowledge and gain from its effective use. The acquisition of essential new competences is functionally dependent on developing relevant knowledge within the workplace environment.

WORK-BASED LEARNING

Work-Based Learning (WBL) is a methodology that can be adapted to address undergraduate engineering education at pre-university, university, postgraduate and continuing professional development stages of education [5]. The aims and objectives that are appropriate at the various stages mentioned above clearly require different programme structures. For example, the definition of a programme that is intended to deliver a doctoral award would significantly differ from that intended to deliver a postgraduate certificate or diploma.

Model 1

The first model is one based on a programme of study that is totally associated with activities in the workplace [6]. Programmes using this model are normally based on a three-way partnership, which involves the host organisation, academic institution and student. The programme of study is developed as a series of research goals/modules that include learning goals/modules as appropriate, depending on the level of qualification being sought. The resulting programme is referred to as a learning agreement, learning contract or a learning programme [5][7].

Usually, this defines a programme that leads to a Master or Doctoral level award. This model would be expected at the doctoral level to produce new knowledge that increases the knowledge capital of the organisation with the new knowledge also having transferability within the field of professional practice. The Master level may produce new knowledge, but would place a greater emphasis on acquiring both explicit and tacit knowledge associated with specific areas of study at the leading edge of professional practice.

Model 2

It is not necessary to have a programme wholly defined by workplace activity. Programmes may be a mixture of taught modules and work-based activity. Programmes with this mixture of activities can be used to define programmes that are postgraduate or undergraduate.

Postgraduate awards based on this model will generally be postgraduate certificate or diploma or Master of Science [8]. Undergraduate programmes offer the potential to address wider issues in the engineering curriculum, such as the development of tacit knowledge based on the integration of explicit knowledge from the taught modules with the experience gained from work-based activity. Most undergraduate programmes would tend to follow this model, with taught modules providing the basis of subject explicit knowledge, particularly in the early stages of the programme.

This model will generally address increasing the skills base of an organisation through increasing the explicit knowledge of participants.

Model 3

Model 3 enables the recognition of skills and knowledge gained as a result of workplace activity. Programmes for this purpose will normally involve an element of assessed prior experiential learning and would involve elements of both explicit and tacit knowledge and some study of defined modules [9]. This model will give recognition to explicit knowledge and skills of the individual, thereby allowing an organisation to identify already existing knowledge capital, as well as enabling its growth.

Model 4

Model 4 is not a different model but refers to programme structures that enable WBL to be adapted for groups of students. In this context, the programme level is normally up to Master of Science. The concept used here is the development of a programme that has a core studied by all participants followed by differentiated work-based projects.

An alternative to this is where all participants study the programme, in its entirety, each completing the same modules and work-based assignments. These programmes are often referred to as themed programmes [10]. Although the basis of the programme is a common theme, each student is involved in the delivery of a distinct learning agreement that is specific to the student but within the theme of the programme.

These models offer a range of structures that can be tested against the aims and objectives of life-long learning, Continuous Professional Development (CPD) and wider access provision.

KNOWLEDGE ECONOMY

Drucker and Gibbons have both commented in some depth on the importance of knowledge as a measure of wealth and the development of knowledge workers [10][11]. In particular, Gibbons has pointed out in his review that two forms of education may be identified: mode 1 and mode 2. Mode 1 is stated as being discipline-oriented, delivered in a structured form closely associated with the particular community of practice and mainly concerned with explicit knowledge. Mode 2 is seen as transdisciplinary, involving teams and largely concerned with developing tacit knowledge skills. The characteristics of these two forms are therefore perceived as being quite different as are their relevance to the needs of knowledge driven economies and organisations.

The polarisation implied by Gibbons' model, if in fact true, would seem to imply that these modes are mutually exclusive. Such an observation is difficult to sustain, since some explicit knowledge is necessary to allow the new scientist, engineer and technologist to contribute to mode 2 style projects. Perhaps it is more important to consider the interface between mode 1 and mode 2 rather than concentrate on the differences [12].

Engineering as a profession plays an integral part in supporting wealth creation through the manufacturing of products and, in addition, supports wealth creation through developing and managing infrastructures to support industries such as communications, financial centres, etc. Therefore, the diversity of roles ranges over a significant body of explicit knowledge.

The experience gained from involvement in work-based projects with the original discipline, together with the foundation of explicit knowledge, enables the engineer to develop tacit knowledge skills. The impact of the knowledge economy on the strategic objectives of organisations and how they would wish to engage with developing knowledge-based skills presents another dimension in the strategic choice of employee development options.

LIFE-LONG LEARNING AND THE KNOWLEDGE WORLD

Society has undergone a major transformation from one that is essentially concerned with wealth derived from industrial production to a post-industrial society in which concepts of wealth, society and civilisation have become associated with knowledge and learning. As this transformation has developed, life-long learning has emerged as a core policy of many governments [13][14]. It is seen as fundamental to sustaining economic viability and social change.

The origins of this can be found in the realisation by industrialised societies that the growth of advanced technological methods in wealth production had to be matched with the development of a suitably skilled workforce in order to generate a competitive advantage in developing global markets.

In a modern economy, competitive advantage – and so economic growth – is linked to an organisation's ability to make effective use of its knowledge capital. Knowledge capital is maintained and enhanced by the organisation investing in people so as to develop their skills in line with the organisation's objectives. Organisations that embrace a life-long learning philosophy may do so to address skills deficiencies at a single level or at multiple levels. Part of the overall objective will be to increase the knowledge capital available within the organisation, both in terms of explicit knowledge and recognising the value of implicit tacit knowledge.

The most suitable model for an organisation will depend on its objectives and whether the proposed participants are individuals or groups. Table 1 provides indicators for suitable models.

Table 1: Matching an individual student's objectives with the correct model.

Individual Student s Objective	Model
Knowledge Development	1 (Doctoral)
Skill and knowledge development	2 (MSc)
Skill and explicit knowledge	2 (MSc) (Pg Dip) (Pg Cert)
Undergraduate	No model
Skill recognition	3 (Credit)

Where groups of students are the participants, then model 4 is employed, using the programme structures already defined for models 1, 2 and 3 as a basis.

Work-Based Learning (WBL) offers opportunities for learning that are available, within reason, for potential students at any stage of their career. In this context, WBL meets one of the fundamental criteria of life-long learning, ie to be available when the student is ready to undertake learning. It is noted earlier that WBL programmes can, ideally, form an interface between mode 1 and mode 2 learning and so offer opportunities to address strategic objectives in the development of individuals and knowledge capital, thus underpinning another basic policy related to life-long learning.

A number of institutions in the UK have – and are – developing models that enable work-based experiential learning together with a taught component to qualify students for access to higher education. Thus, WBL can support the wider social issues of a life-long learning policy associated with inclusion in, and access to, the higher education of social groups that are recognised as underrepresented.

All of these options could be applied to most disciplines, and certainly to engineering education, yet one major deficiency is evident: the provision of a work-based option for an undergraduate qualification that is recognised by major engineering institutions as counting for accreditation towards chartered engineer status. The omission of this stage in the context of engineering education in the UK is because accrediting institutions will not recognise a WBL qualification for exemption from the academic requirements for Chartered Engineer recognition.

WBL offers structures that can be accessed at any stage of an individual's career; it can address issues related to knowledge workers and knowledge capital. WBL can also address social inclusion. However, it is so far unable to address the most critical stage of an engineer's professional development in the form of the foundation undergraduate degree, which leads to Chartered Engineer status.

CONTINUOUS PROFESSIONAL DEVELOPMENT

Once upon a time, it was sufficient to gain a degree and go into the workplace and practice as an engineer. The explicit knowledge gained during study for a degree did not change significantly. However, in recent years, that view has had to change radically as the rate of generation of knowledge has increased significantly. Access to knowledge has been greatly improved by the advent of the Internet, as well as the use online technology to access professional and learned journals.

The rapid change in knowledge and the realisation that knowledge and competitive advantage are closely linked has focused ideas of how professionals keep abreast of the knowledge developments within their community of practice. The concept of Continuous Professional Development (CPD) has evolved to provide a mechanism that allows the practicing professional to have access to resources that will enable updating of knowledge and skills.

Engineering institutions have adopted CPD as an important aspect of ensuring that practicing engineers maintain and update their personal knowledge base. Many institutions have a requirement that members complete a certain amount of CPD to retain their status within the institution. Typically, CPD is provided through a number of different paths, such as short courses, attendance at conferences, the presentation of papers, etc. In some instances, professional development may take the form of gaining new qualifications to follow a different career direction. Typically, this might be to transfer from engineering to management or, in other cases, it may be to facilitate a change of direction within engineering to a specialist area, such as health and safety at work.

Typically, the provision of programmes for CPD is short in duration and will involve some form of direction from experts. In the context of WBL, it is unlikely that model 1 would be seen as CPD. Models 2, 3 and 4 might be adapted to CPD in the following ways.

- *Skill conversion and new careers*: Model 2 can be developed to produce programmes that will deliver Masters of Science programmes possible for skills conversion to either different aspects of engineering or to new careers.
- *Skill updating*: Model 2 can be adapted to provide programmes at the postgraduate certificate and diploma levels, which address career development at a less demanding level. Programmes of this type can be, for example, conversion through work practice and supervised learning.
- *Knowledge updating*: Models 2 and 3 can be adapted for this in a way that provides directed study within a specified area for example telecommunications, safety, etc.

Groups of staff can be catered for using model 4 in a way that enables any of the above options.

Continuous professional development is intended to provide routes to maintaining professional standards, providing routes to change career or routes to upgrading skills in new areas. WBL can provide opportunities to address these objectives.

CPD AND TACIT KNOWLEDGE

Tacit knowledge cannot remain hidden within an organisation, when often it is the most valuable knowledge required in an organisation. It cannot be developed like explicit knowledge, demanding the workplace environment as the place for effective knowledge transfer through work-based action and social learning. Educators and company professionals now need to investigate how to deal effectively with tacit knowledge release and how to integrate it effectively with specific and relevant explicit knowledge.

While WBL is now accepted as an efficient way of achieving life-long learning (CPD) in the workplace environment, the process is not well understood in terms of learning attributes achieved through the workplace. So far, little has been achieved in developing interrelationships between tacit knowledge within the workplace environment and explicit knowledge. The interrelationship between these forms of knowledge and the range of skills associated with emotional intelligence (EQ-i) is little understood, yet within the workplace environment, skills associated with emotional intelligence development have been shown to dominate career development [15].

There is a need for an investigation of how more useful CPD can be taken forward by developing a model that facilitates the integration of tacit knowledge within the organisation with relevant explicit knowledge and knowledge skills derived from emotional intelligence (EQ-i) leading to a new CPD model for life-long learning in the workplace.

The advantage of this approach to a CPD model is as follows:

- It provides highly relevant knowledge to employees, as opposed to wasting valuable time attending traditional on-campus learning.
- It integrates knowledge development such that it relates to employees' job role and company objectives.
- Through the WBL model, it achieves the development of a desired portfolio of competences related to organisational strategy.
- It develops and integrates tacit knowledge with customised explicit knowledge, alongside establishing a range of competences based on the attributes of emotional intelligence (EQ-i).
- It shows tacit knowledge is more valuable to companies and the development can only be achieved through WBL.
- It shows that the CPD developed with companies, customised to the needs of employees and the company, gives a highly efficient learning capacity.

In order to achieve this, the following approach is required:

- Define and develop a range of operational tools to address tacit knowledge production.
- Define and develop a range of operational tools to optimise the integration of tacit knowledge with relevant explicit knowledge.
- Develop models to manage the interaction between tacit knowledge, explicit knowledge and advanced knowledge skills.
- Establish a best practice model between the university and the company that takes account of the integration of tacit knowledge production alongside relevant explicit knowledge and knowledge skills.
- Develop the knowledge transfer model as a strategic CPD alliance between the company and the university.
- Facilitate a learning agreement whereby the goals have tacit and relevant explicit knowledge built in alongside the knowledge skills associated with the attributes of emotional intelligence.
- Put in place and use appropriate tools in order to identify those critical drivers that underpin the work-based methods.

To achieve this new approach action, research and development is needed, such as:

- Investigate the nature of knowledge within organisational competences, particularly the factors that relate to the role of tacit knowledge and its interaction with explicit knowledge, to achieve enhanced delivery of CPD.
- Analyse those factors that affect tacit knowledge, nucleation and growth within organisations, as well as the conservation of the tacit knowledge portfolio and its sustainability through a WBL model.
- Deliver new work-based models and mechanisms for CPD learning-based alliances between organisations and knowledge providers/consultants.
- Establish work-based knowledge transfer strategy for CPD, which integrates explicit and tacit knowledge with advanced knowledge skills.

This will need the following approach if a successful development is to be achieved:

- Understand within a WBL model the main factors that affect tacit knowledge transfer within the work-based environment.
- Show that the work-based model is the optimal

one to provide effective knowledge transfer within organisations.
- Improve the learning capacity of companies through the development of efficient mechanisms of knowledge transfer.
- Assess factors that relate to the interaction between the knowledge-based provider and the organisation in terms of achieving effective CPD.
- Investigate the primary elements needed within organisations to facilitate effective learning capacity and hence improved work-based CPD.

So how can this approach best be taken forward in order to achieve successful outcomes? One method is to put a set of experimental methodologies in place to investigate the basis on which tacit knowledge can be identified and articulated. This includes the following:

- Optimise the capture of tacit knowledge.
- Elucidate the rate controlling factors.
- Develop mapping techniques to understand tacit knowledge flows and tacit knowledge transfer.

Models can then be developed using the results from such investigations and these models tested for effectiveness in acquiring and applying conceptualised tacit knowledge as a new paradigm for CPD by WBL. Thereafter, it would be useful to test the interaction of the tacit knowledge with relevant explicit knowledge alongside testing the value of integrating emotional intelligence attributes.

The key will be the methodologies that reveal how best to identify and measure tacit knowledge and how best to achieve tacit knowledge transfer. The process will involve learning agreements that, via WBL goals, allow the effective integration of tacit knowledge, explicit knowledge and the range of knowledge skills related to emotional intelligence.

This type of approach should lead to those outcomes that are needed to facilitate a new approach to CPD by WBL, such as:

- A new operational paradigm for work-based CPD, which is based on an interaction of explicit and tacit knowledge alongside advanced knowledge-based skills.
- CPD that gives organisations a competitive advantage through the power of knowledge.
- The conversion of tacit knowledge to explicit knowledge through CPD within the work-based environment of organisations.
- Expansion of the portfolio of enhanced organisational competences through work-based knowledge development and hence extension of the innovative and creative capacity of the organisation.
- Clear demonstration of the improvements to be achieved in CPD through the integration of relevant explicit knowledge with tacit knowledge within the work-based environment.
- Formalisation of the importance and variance of tacit knowledge among employees and the identification of effective transfer mechanisms.
- Provision of a CPD model with the capability to build a dynamic internal cohesiveness that will enhance company performance.
- Demonstration that the most valuable knowledge in an organisation is tacit and, more importantly, show how it can be captured through a work-based CPD model.

Wider Access

It has long been recognised that the representation in higher education of certain social groups has been low. Wider access is a philosophy that has, as its basic precept, finding routes and support mechanisms to address this under representation. WBL can offer a mechanism to support this through model 3.

Model 3 enables the recognition of skills acquired from work practice and adds an element of taught provision that will provide the basic explicit knowledge underpinning to enable the student to start on a university programme with the necessary basic skill set.

REVIEW

WBL has been described for convenience using four basic models, but it should be noted that many variations of these models are possible, depending on the operating procedures of a particular institution. The models described represent a basic methodology and it is this that is now assessed against the criteria that have emerged.

In the case of life-long learning, the major themes incorporate the provision of routes to provide new skills to the workforce, availability to the learner at a time suitable to them, addressing social issues of inclusion and wider access to higher education, as well as enabling industry to embrace the skills necessary to compete in the knowledge-led global economy. The analysis presented demonstrates that this can be achieved through WBL, with the exception of engineering education undergraduate provision.

Continuous professional development can be achieved using WBL programmes, provided that they are structured to reflect the objectives of this particular policy.

Wider access is practical using WBL to provide routes to support wider access and, consequently, social inclusion.

The development of WBL in the engineering context depends on how a particular programme is structured. A number of models are currently in use that utilise quite different methodologies. The following examples are illustrative, rather than exhaustive.

LEARNING CONTRACT/PROGRAMME

A number of institutions use the development of a specifically defined programme in order to set out the learning objectives [16][17]. In this model, strategic objectives of the host organisation are utilised to form the basis of programme development. A series of learning goals are defined, each of which identify the goal objective, learning objectives, activities to address the learning, assessment criteria, assessment methods and resources necessary to deliver the programme.

In this model, the series of learning goals are expected to form a coherent programme. Usually in this process, the student will be guided through a series of directed readings to deliver the explicit knowledge base followed by either a single large project or a number of smaller projects that are based in the workplace.

An alternative approach is a programme that is based on a mixture of taught modules and projects where participants are encouraged to reflect on their experience to identify learning that has taken place [18]. In this model, assessment criteria tend to be defined in terms of reflected submission, portfolio evidence and project reports.

As can be seen, these methodologies differ in how they seek to establish the educational objectives. Both methods offer routes to qualifications that involve students in developing their skills and knowledge. It is not apparent that any one model is correct, but it must also be noted, as referred to earlier, that the understanding of the interface between mode 1 and mode 2 knowledge requires further research, particularly in relation to assessment criteria.

WORK-BASED LEARNING AND THE 21ST CENTURY

WBL has been identified as being able to deliver programmes that are able to address many of the social and educational objectives of modern governmental, education and professional bodies' polices in relation to the provision of education opportunities. The development of WBL and its place in the methodologies to be adopted will depend on the willingness of professional bodies to acknowledge the validity of the process in delivering an appropriate education, especially at the undergraduate level.

In the case of higher education institutions, the resourcing of these programmes is a matter of concern. The methodologies are new, the manner of supervision is not exactly the same as that of the traditional student, nor is the delivery of undergraduate programmes as straightforward as traditional university programmes.

In summary, both professional institutions and higher education institutions will need to be prepared to acknowledge the challenges of WBL, as well as the potential advantages through forming strategic alliances with other knowledge producing organisations.

CONCLUSIONS

Work-Based Learning (WBL) provides a philosophy and related methodologies that enable the interface between mode 1 and mode 2 knowledge to be explored and exploited. Methodologies are available to provide programmes of study that can support lifelong learning, continuous professional development and wider access and social inclusion.

The future development of WBL will require research into the interface between mode 1 and mode 2, how assessment within transdisciplinary programmes should be conducted and how programmes should be structured.

Particularly in the domain of engineering education, it will be essential to address the position of WBL undergraduate provision. For a science-based discipline, such as engineering, research needs to be completed to reveal the best equation for the effective delivery of undergraduate WBL. This will involve matching the specific requirements for explicit alongside matching and profiling what can best be achieved through WBL.

As the knowledge economy grows, the demand for graduate engineers who already have knowledge skills will increase. This means researching and finding the correct balance of knowledge skills, explicit knowledge and tacit knowledge and the appropriate amounts of WBL needed to facilitate delivery of the tacit knowledge and knowledge skills. Also needed is a more fundamental understanding of the tacit to explicit cycle and the associated skills profile development.

If engineering institutions do not at least recognise this and take steps to address the issues so generated, then it is entirely possible that industry will disregard their role in the accreditation of engineering qualifications.

The integration of tacit knowledge and advanced skills associated with emotional intelligence with explicit knowledge provides for a new operational paradigm for work-based CPD. This will facilitate competitive advantage for organisations, the conversion of tacit to explicit knowledge, and show clearly that the most valuable knowledge in an organisation is tacit.

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BIOGRAPHIES

George R. Burns has a first degree in Applied Physics from Strathclyde University and a Doctor of Philosophy from the Department of Electrical and Electronic Engineering at Strathclyde University gained for thesis-based research into low frequency conduction properties of insulating liquids. Since leaving University, he has followed a career in education starting by teaching physics and mathematics in high school, then physics in the Life Sciences Department of a local College. He left there to take up a lectureship at The Scottish School of Non-Destructive Testing (SSNDT) at Paisley University where he stayed for six years. During this period, his research interests were in computer data management systems. He left there to become senior lecturer in the Department of Engineering at Glasgow Caledonian University, where he continued with his research interests in computer-based data management and the use of artificial intelligence software (neural networks and genetic algorithms) to model business and manufacturing systems, as well as developing an interest in work based learning. During the same period, he was the University Project Manager responsible for establishing the Caledonian College of Engineering in the Sultanate of Oman.

The interest in engineering education and work based learning led to him being appointed Coordinator of the Caledonian Centre for Engineering Education (CCEE), the first satellite centre of the UNESCO International Centre for Engineering Education (UICEE). He left Glasgow Caledonian University in May 2000 after 14 years to take up an appointment as Director of the Executive Doctoral Programme at the University of Glasgow Business School. As Director, he is responsible for the development and operation of this postgraduate work based learning programme on a local, national and global scale. His current research interests are related to quality assurance and knowledge management processes associated with Work-Based Learning (WBL).

During his career, he has had over 80 papers published in conference proceedings and journals, as well as two books.

Colin Urquhart Chisholm graduated with a BSc Hons in Metallurgy from Strathclyde University and with a Doctor of Philosophy from St Andrews/Dundee University in 1962 and 1968 respectively. From 1963 to 1965, he was a lecturer at Wolverhampton and Staffordshire College of Technology (now Wolverhampton University). From 1965 to 1971, he was a lecturer in materials science at Dundee Institute of Art and Technology (now Abertay University) where he researched in processes for alloy electrodeposition and the study of the structure of the deposited alloys. After spending a period as a senior lecturer at Robert Gordons Institute of Technology (now Robert Gordons University), he became Associate Head of Engineering at Paisley College of Technology (now Paisley University) and thereafter Head of School of Engineering at Glasgow College of Technology (now Glasgow Caledonian University) where he was awarded a professorship. He was Dean of the Faculty of Science and Technology at Glasgow Caledonian University (GCU) from 1993 to 2002, and, since 2002, he has taken up the position of Dean of Development. He has also been a member of the Executive Management team and is the Director of the Scottish Centre for Work-Based Learning (SCWBL), a satellite centre of the UICEE.

Prof. Chisholm is also a Deputy Chairman of the UICEE Academic Advisory Committee.

Prof. Chisholm is an acknowledged international researcher in the field of electrodeposition of alloys and leads collaboration as Chairman of Surface Technology International, which involves a group of European universities. Since 1985, he has maintained a major collaboration with a team of researchers at Eotvos Lorand University in Budapest, Hungary.

For the last decade, he has led action research and development relating to work-based learning and, at GCU, has developed an innovative Postgraduate Learning Contract Framework for work-based learning, which has been operational since 1992.

More recently, he negotiated on behalf of GCU with the UNESCO International Centre for Engineering Education (UICEE) leading to the establishment in 1998 of the first satellite centre of the UICEE, named the Caledonian Centre for Engineering Education (CCEE) at the GCU.

He was awarded the UICEE Silver Badge of Honour for Distinguished Contributions to Engineering Education at the *Global Congress on Engineering Education* in Krakow, Poland, in September 1998, and more recently at the *2nd Global Congress on Engineering Education* in Wismar, Germany, in July 2000, he was also awarded the UICEE Gold Badge of Honour.

He has published over 200 scientific papers in refereed journals and conference proceedings and supervised over 35 PhD students. More recently, Professor Chisholm, in collaboration with the team for Surface Technology International, published the first paper regarding the successful deposition of tin-chromium and tin-zinc chromium alloys. Prof. Chisholm has also received a number of awards for published papers presented at international conferences.

World Transactions on Engineering and Technology Education

A Call for Papers

Current events have impacted upon the arena of international conferences and academic travel, impinging on the freedom of intellectual movement to conferences and the like that are so important for the advancement of engineering education internationally and regionally and, indeed, the development of humankind now and into the future. Wars, threats and diseases affect the physical presentation of ideas at conferences, fora and seminars; however, the liberty of thought and the exchange of educational ideas cannot be bordered, blasted and subdued. To this end, the UNESCO International Centre for Engineering Education (UICEE) has established the *World Transactions on Engineering and Technology Education* (WTE&TE), which is open to everyone around the world who is interested in the progression of engineering and technology education. Current unfortunate circumstances have meant that the *World Transactions* offers a safer and cost-effective alternative to conference participation.

The first volume of the WTE&TE presented a range of papers from across the spectrum of engineering education and from around the world, including over 50 very interesting and insightful representations from many countries worldwide. From this, it can be seen that the WTE&TE contribute strongly to the publication of engineering and technology education papers globally, which is essential for academic life and the continued growth and evolution in humanity s store of knowledge and understanding across nations, cultures and continents. Work is underway on Vol.2, No.2 of the WTE&TE, with the objective to release the issue in early August.

Therefore, a call for papers is made for the next issue of the WTE&TE, **Vol.2, No.3**. The very nature of the *World Transactions* is open to every facet of engineering and technology education and is not confined to traditional views about science, engineering and technology. As such, there are no overriding engineering or technology themes, but rather the overarching principle of the globalised expansion of engineering and technology education that is not confined to borders or regions; instead the WTE&TE seeks to benefit all those involved in the engineering and technology through the wider dissemination of knowledge.

The deadline for this issue is **30 September 2003**. Authors should indicate their interest as soon as possible. Additional information can be found at the UICEE s homepage under *World Transactions* at http://www.eng.monash.edu.au/uicee/

Interested persons should submit their original, previously unpublished papers to the UICEE for consideration to be included in the WTE&TE. Authors should be aware of the standard formatting structure, which will essentially be the same as for other UICEE publications. Papers are to be submitted in MS Word format in 10pt font, single-spaced, double column, and a **maximum of 4 pages** in total, including abstract and figures (additional fees will apply for extra pages). Fees are based on cost recovery for editorial and publishing work, and every submitted paper will cost $A450. Also, within the cost structure is the delivery of one copy of the WTE&TE per paper submission by airmail postage to anywhere in the world.

The electronic kit for authors, incorporating standard formatting details and submission forms, covering copyright, will be supplied on request. Potential authors should notify their intention of submitting a paper at their earliest convenience and earlier submissions than **30 September 2003** will be particularly welcome. Further correspondence via e-mail should be directed to Mr Marc Riemer on marc.riemer@eng.monash.edu.au