A Developing Joint Educational Framework for Incorporating Employability and Enterprise in the Engineering Curriculum

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Abstract *— Imagination, innovation and an entrepreneurial mind-set are the keys to overcoming the myriad of challenges facing engineers in today's complex and changing global arena. The response of higher education to the forces for change within the global economy, and in particular the inclusion of issues such as employability and entrepreneurship in the curriculum, will play a significant part in providing graduates with an effective preparation for working in the real world. This paper describes ongoing work within a new collaborative project between the University of Central Lancashire, UK (UCLan), and Xiamen University of Technology, PR China (XMUT). We have recognised that there are considerable synergies between the two institutions, especially in relation to enterprise education and incubating business ventures. Both institutions share a passion for developing graduates who are well prepared to operate in a global labour market, and have invested heavily to address their development needs. This has resulted in excellent, but different, practices in each institution, as we help students to prepare for their future careers. Each institution has independently developed a model for addressing employability issues with undergraduate students. The XMUT model focuses on inventive problem solving, enterprise, professional ethics and a live project, whilst the UCLan 'CareerEDGE' model incorporates career development learning, experience, specialist and generic skills, and emotional intelligence. The shared goal of our partnership is to design a joint educational framework for the development of enterprising engineers using these two models. Funding for this project covers two years, commencing in January 2010. Initial discussions between the teams have compared and contrasted the two separate approaches, with a view to developing the framework for a new joint model. The new framework will incorporate key elements of the research findings and teaching and learning methodologies from both universities, enabling evaluation and implementation across institutions and across cultures. This will provide a conceptual model to assist in strategic decision-making, and it will also facilitate operational improvements in course delivery. Initial activities focus on undergraduate courses in electronic engineering and related areas, but we shall draw upon experiences from colleagues in other areas of engineering as the project progresses. This paper describes the project framework and goals, and also discusses some initial developments within the project.*

Index Terms *— Employability, Engineering curriculum, Enterprise, International cooperation.*

INTRODUCTION

Traditionally, engineering degree courses tend to focus the majority of the teaching, learning, and assessment on technical areas relevant to the degree title, resulting in graduates with good technical skills in a range of subject-specific areas. Thus, graduates from courses such as 'BEng (Hons) Electronic Engineering', 'BEng (Hons) Computer Engineering', 'BEng (Hons) Digital Communications', 'BEng (Hons) Mechanical Engineering', etc., have good skills and abilities in those specific areas, but this may be at the expense of a good level of the more generic, 'softer' skills, required or expected by potential employers. In many cases these skills are not directly or thoroughly addressed, and it is left to the students to recognise and address this themselves. Some guidance and structure may be provided, for example using personal development planning programmes or similar schemes, or through addressing particular aspects of the generic skills within modules addressing areas such as Project Management etc.

This paper explores ways in which such skills can be directly addressed and introduced into engineering curricula, with the focus on two particular models of employability used at the two different institutions concerned. A brief overview of each of the partner institutions for this international collaborative project is provided, followed by a

discussion of the meaning and definitions of the terms 'employability', 'enterprise', and 'entrepreneurship'. The two separate models are presented and discussed, with some further comments describing the background and intentions of this project, and progress to date.

SHARED GOAL FOR UCLAN / XMUT PARTNERSHIP

The shared goal of the partnership between UCLan and XMUT is to design a joint educational framework for the development of enterprising engineers using XMUT's model (incorporating inventive problem-solving) and UCLan's CareerEDGE model (incorporating Emotional Intelligence). The new framework will therefore incorporate key elements of the research findings and teaching and learning methodologies from both universities, enabling evaluation and implementation across cultures. This will provide a conceptual model to assist in strategic decision-making and it will also facilitate operational improvements in course delivery. Initially, activities will focus upon undergraduate courses in electronic engineering but subsequently the intention will be to draw upon experiences from colleagues in other areas of engineering.

INSTITUTIONAL OVERVIEWS

This section gives an overview of each of the two institutions involved in the collaborative project, with emphasis on their experience and activity in engineering and development of their curricula to incorporate employability and enterprise.

University of Central Lancashire (UCLan)

With its main campus situated in Preston in the north-west of England, UCLan is a large, modern University which is at the leading edge in developing student employability and enterprise in the UK. UCLan was the first university to establish an academic Centre for Employability, with a remit covering course delivery, curriculum and staff development. In 2006, UCLan's Academic Board approved a new strategy for Employability and Enterprise to form the cornerstone of the Corporate Plan until 2017. Under this strategy, Employability and Enterprise activities are being dramatically extended through a new organisational unit, known as 'Futures', comprising over 50 dedicated staff. Futures is mainstreaming enterprise and presenting self-employment as a potential career option for all.

UCLan's employability-related work has been recognised for its excellence over many years: UCLan was awarded £1 million under the Enterprise in Higher Education initiative in 1991, and more recently in 2005 UCLan was awarded nearly £5 million and designated a National Centre for Excellence in Teaching and Learning (CETL) for Employability in the Humanities. UCLan is now the lead in the University Enterprise Network (Nuclear) supported by the National Council for Graduate Entrepreneurship (NCGE) and is a national leader in supporting graduates' new business start-ups.

According to the recent Higher Education – Business and Community Interaction Survey (HEBCIS), UCLan is the top University in the North West and among the top five in the UK for assisting and nurturing student start-up businesses. In the past twelve months over 125 student businesses have started trading and it is estimated that ventures set up by UCLan alumni account for more than £17 million within the local economy. UCLan's strategy is to encourage students to develop their understanding of Business Enterprise and Entrepreneurship in order to enhance their future career options and opportunities.

UCLan was the first university to offer a named award in Career Management and now offers a wide range of qualifications in Employability and Enterprise, including two by distance e-learning. Three Employability and Enterprise projects have recently been completed in collaboration with Higher Education Academy (HEA) Subject Centres and UCLan leads a major National Teaching Fellows' project on the theme of Employability and Numeracy.

UCLan has a long established and extremely successful record of partnerships in China which began in the 1980s under the British Council's Academic Links with China Scheme. The first links were established with Guangdong University of Foreign Studies in 1986, and soon after with Shenzhen University. A structured programme of teaching staff exchanges and secondments started in the early 1990s and to-date over 120 staff have participated in such exchanges. The School of Computing, Engineering and Physical Sciences (CEPS) pioneered joint courses in China, starting with Shenzhen University (BSc (Hons) Electronics) in the early 1990s. The School now runs a number of China joint courses in Engineering, running at institutions in Shenzhen and Beijing, as well as courses in Computing and Physics. Some of the UCLan staff involved in these courses are also involved in this collaborative project with XMUT.

UCLan is currently one of the leading British universities in China in terms of the number of students, with over 1700 students studying on a variety of joint programmes. UCLan has University partners in Beijing, Shanghai, Guangzhou, Shenzhen, Wuxi and Chengdu and is now developing a collaborative relationship with XMUT, initially by means of this project. The normal UCLan arrangement is to support partner institutions in the local delivery of programmes with UCLan academic and administrative staff based in China, as well as Preston-based UCLan staff making regular visits to the partner institutions in China.

The UK Project Manager for the project described in this paper is David Bagley, Head of Student Employability and Enterprise at UCLan. His previous posts include Head of Enterprise, Head of the Centre for Employability and Director of the Centre for Employability through the Humanities (the UCLan CETL). He has been Project Director for over ten Employability and Enterprise projects worth in total more than £6 million over the past ten years.

Xiamen University of Technology (XMUT)

With roots extending back to 1981, XMUT lies at the heart of the Xiamen Special Economic Zone. XMUT now has two campuses, Siming and Jimei, a total enrolment of almost 17,000 students and is dedicated to meeting the social and economic needs of the region.

Since achieving University status in 2004, XMUT has developed a broad portfolio of courses and currently offers 40 separate, four-year bachelor programmes across 17 departments and colleges. The University's educational expertise is founded upon advanced and specialist engineering, aimed at meeting the needs of local businesses, and providing both professional training courses and preparing extremely competent graduates to meet increasingly complex demands. It prides itself on being a 'cradle for talents for local training' and works intensively in partnership with regional enterprises to fulfil business expectations, guided by senior professionals from within the work-based community. The core of XMUT's future vision is to develop highly-skilled, work-ready graduates, and already 90% of XMUT's students secure high level employment within months of leaving the university. Its courses incorporate strands of world-class employability embedded within and throughout the curriculum.

The city of Xiamen hosts the annual China International Fair for Investment and Trade which attracts enormous foreign capital to the area and helps to secure the region's position through fostering an entrepreneurial spirit. XMUT itself mirrors this ethos through initiatives such as the Innovation and Entrepreneurship Park, which cultivates the innovative abilities and professional competences of student entrepreneurs. Students can build upon their business knowledge, launch projects and incubate their business ventures in a creative and supportive environment. With proven expertise in the field, XMUT's long term goal is to achieve recognition as a world leader in entrepreneurship education. Such international acknowledgement would affirm the quality and value offered to students, helping to prepare a new generation of engineering graduates with the skills and competencies required in a global labour market. The senior management of XMUT fully supports this joint venture with UCLan and its goal of implementing a new shared vision for the future of engineering education.

The China Project Manager for this project is Fang Xiaodong, Director of XMUT's Innovation and Entrepreneurship Park. With an impressive private sector background and an MBA from Guangxi University, Fang Xiaodong is well-placed to head up XMUT's flagship department. He is currently the team leader of two innovation and entrepreneurship projects, as well as being an active team member of four university research projects and one high-profile external scientific research project. He is also an award-winning educator recognised at regional level for his achievements.

DEFINITION OF TERMS

Members of the project team have significant experience of exploring the differences between employability, enterprise and entrepreneurship with international partners. In China, this distinction is particularly important since the three terms are frequently translated into the Mandarin language by the same word. For clarity, the definition of some terms which are, confusingly, often used inconsistently and interchangeably has been agreed, as listed below [1]:

- **Employability**: "having a set of skills, knowledge, understanding and personal attributes that make a person more likely to choose and secure occupations in which they can be satisfied and successful" [2]. This would encompass generic employability skills such as imagination/creativity, adaptability/flexibility, willingness to learn, working in a team, ability to manage others, ability to work under pressure, good oral communication, communication in writing for varied purposes/audiences, numeracy, attention to detail, time management, assumption of responsibility including decision-making and planning, coordinating and organising ability [3]. For engineering graduates and employees in particular, 'employability' should also encompass the ability to use new technologies, and commercial awareness.

- **Enterprise**: this is a widely used term that can have a number of different meanings. The meanings can range from it being a term to describe a businesss, to being a specific set of skills knowledge and attributes needed to apply creative ideas and innovations to practical solutions whether graduates plan to work within an organisation or become self employed [1] and [4]. Rae [4] suggests that this set of enterprise skills includes: initiative, problem solving, identifying and working on opportunities, leadership, acting resourcefully, and responding to challenges.

- **Entrepreneurship**: "the desire, motivation and skills necessary to start and manage a successful business" [1].

Although other definitions and usage of these terms may exist, this project will aim to clarify matters by maintaining the above definitions.

BACKGROUND AND MOTIVATION FOR COLLABORATIVE PROJECT

Market forces within the global economy are increasing the pace of change in contemporary higher education. Competition within and between countries has placed heightened value on intellectual capital and knowledge management. Economists have suggested that future economic competitive advantage will stem less from natural resources and cheap labour and increasingly from technological innovations and the strategic use of knowledge.

Higher education needs to respond to the forces for change within the global economy. Large employers stress the difficulties they face in recruiting sufficient graduates with the employability 'soft skills' they need [5, 6]. Design and innovation are seen to be increasingly important for wealth creation in the 21st century. As predicted, we are seeing evidence that future competitive advantage will stem increasingly from technological innovations and the strategic use of knowledge [7] and [8].

China is pursuing the goal set by Hu Jintao in 2006 to become an 'innovation-oriented country by 2020'. Also in 2006, Tony Blair declared that 'there is a greater economic premium on innovation than there ever has been'. Individuals who could be employable in a global context need to acquire the tools to generate innovative ideas, solve complex problems, adapt quickly to change and be conversant with new technology. Engineers need "the confidence and ability to challenge industry practice, work in international teams, and turn innovative ideas into practical solutions" [9]. They require inventive problem-solving, entrepreneurship, and highly developed skills in human relations as well as high-order technical abilities in order to find innovative, long-term solutions to complex global problems. The globalisation of the labour market will lead to more uniformity in systems of education, training and qualifications. In turn, agreed educational frameworks, clear indicators of quality, and provision relevant to global economic forces need to be developed.

For these reasons, our project team comprising Engineering and Enterprise educators from XMUT and UCLan is keen to cooperate in developing new approaches to cultivating the creative talents and entrepreneurial spirit of our Engineering students. We recognise that we have much to learn from each other, and we know the importance of having a shared understanding of terminology, as defined above.

MODELS OF EMPLOYABILITY

Both of the institutions involved in this project display high levels of success in graduate employability and have placed the further development of employability and entrepreneurship at the centre of their strategic development plans, leading each institution to develop its own model of employability.

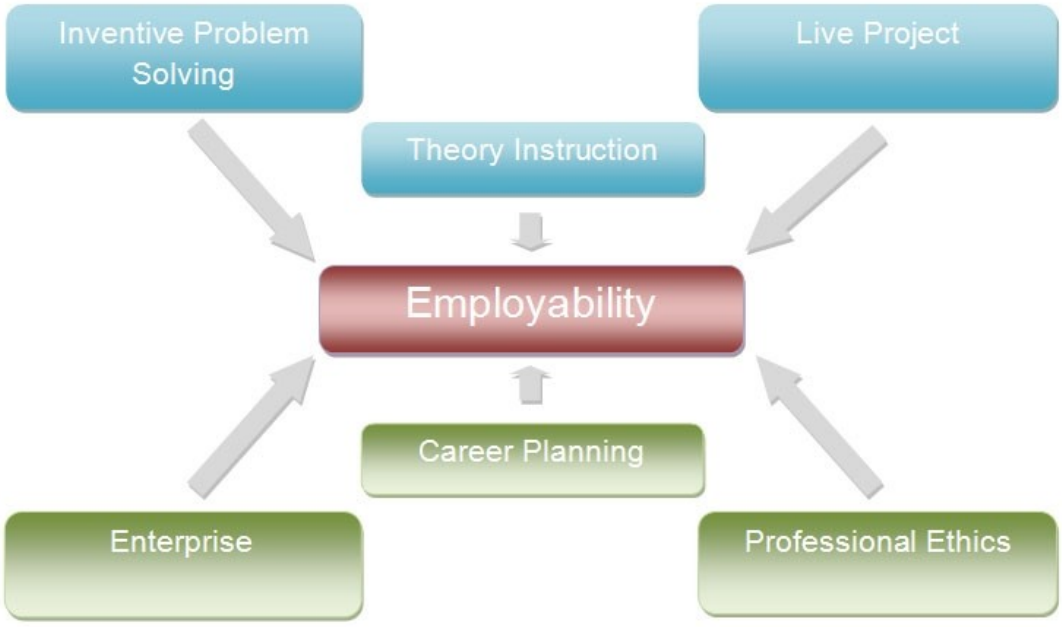

Figure 1 Employability model developed by Xiamen University of Technology (XMUT)

XMUT have developed a robust educational framework for the delivery of the various educational, business-focussed and innovation-led components which contribute towards the development of enterprising graduates. A key element of this framework is the inclusion of Inventive Problem Solving which underpins much of the project-based learning. XMUT has invested heavily in the establishment of an Innovation and Entrepreneurship Park for

undergraduates, which cultivates student entrepreneurs and allows them to acquire business knowledge, develop projects and launch ventures in an innovative and supportive environment under the model shown in Figure 1.

UCLan has merged all its Employability & Enterprise support into a new unit called 'Futures' which addresses work-related learning, employability, enterprise and careers advice alongside entrepreneurship and start up support. We encourage students to develop their understanding of Business Enterprise and Entrepreneurship in order to enhance their future career options. The UCLan 'CareerEDGE' model (see Figure 2) shows the relationships between the various components of Employability and Enterprise. This provides a clear framework for exploration and discussion of the variables and their interrelationships in seminars with colleagues, facilitating exploration of the key concepts.

Figure 2 'CareerEDGE' employability model developed by University of Central Lancashire (UCLan) [1]

A significant component of the CareerEDGE model is Emotional Intelligence, and its importance in graduate success is becoming more widely recognised. Emotional intelligence is rapidly becoming a quality that employers are insisting graduate recruits demonstrate, as they recognise that EI underpins much of social interaction. The ability to deal with the emotional side of working life, in addition to rational decision-making and problem solving skills, is becoming essential in the modern global workplace. Similarly, graduate entrepreneurs need well developed social skills to enable them to operate successfully in highly competitive markets [10-12].

The UCLan model suggests that some aspects of Employability and Enterprise can be addressed through 'bolt-on' modules in areas such as team working, communication skills and emotional intelligence. However, many of the more sophisticated aspects of employability (self-esteem, self-efficacy) need to be incorporated and embedded into the core fabric of the courses. Not surprisingly therefore, some aspects of Employability are embedded into the curriculum and delivered by professional engineers. However, career development learning is currently only available through bolt-on elective modules delivered by specialists. Similarly, while some basic aspects of enterprise (e.g. business awareness) are embedded, students currently have to opt for specialist modules or join extra-curricular programmes if they wish to pursue entrepreneurship learning.

PROJECT PROGRESS

This Project formally started in January 2010. Various aspects of the work have been identified and developed, and the main areas of progress and proposed further work are summarised below:

- **Pre-bid visit of UCLan staff to Xiamen**: an initial visit of three UCLan staff to XMUT allowed the UK and China Project Leaders and members of the proposed team to meet to discuss possible areas of collaboration, leading to inception and development of the bid.

- **Visit of UCLan staff to Xiamen**: five members of the UCLan side of the Project team (three based in Employability and Enterprise, and two based in Engineering) visited XMUT in January 2010. This visit was aimed at disseminating information on current practice between members of each institution, as well as discussing potential ways forward and areas of common ground and good practice.

- **Action Plan for various phases of the Project**: items identified include development of an Audit Tool and potential areas of joint teaching, for example a shared project-based undergraduate module (Year 2) involving applications of electronic systems.

- **Employability Audit Tool**: an Audit Tool has been developed to assess the effectiveness of the engineering curriculum content in terms of employability aspects. Application of this tool for UCLan courses is ongoing, and future work will include assessment of these results, development of the courses to address areas identified as lacking, and application of the tool for XMUT courses.

- **Further aspects of proposed work** include further visits of staff between the institutions, development of joint course material for areas of common interest (initially this is likely to involve a module which is shared or part-shared between the two institutions), and dissemination of the Project's developments and findings.

CONCLUDING REMARKS

A collaborative project between a UK partner (UCLan) and a China partner (XMUT), aimed at developing a joint framework to facilitate embedding employability and enterprise in the engineering curriculum, has been described in this paper. Various aspects of the work are ongoing and will be published in further publications as well as formal reports for the Project. It is envisaged that the work will lead to developments in the undergraduate curricula for both institutions, initially for courses in the area of electronic engineering, and subsequenty in other areas of engineering. This work has potential benefits for students and graduates of both institutions, in terms of both enhanced employability and enterprise provision, and international collaborations between student groups of both institutions.

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REFERENCES

[1] Sewell, Peter and Dacre Pool, Lorraine, "Moving from conceptual ambiguity to operational clarity: employability, enterprise and entrepreneurship in higher education", *Education + Training*, Vol. 22, No, 10, 2010, pp.89-94.

[2] Dacre Pool, Lorraine and Sewell, Peter, "The key to employability: developing a practical model of graduate employability", *Education + Training*, Vol. 49, No, 4, 2007, pp.277-289.

[3] Pedagogy for Employability Group, *Pedagogy for Employability*, The Higher Education Academy, York, 2006, pp.4.

[4] Rae, D., "Connecting enterprise and graduate employability. Challenges to the higher education culture and curriculum?", *Education + Training*, Vol. 49, Nos. 8/9, 2007, pp.605-619.

[5] CBI and Universities UK, *Future Fit: Preparing graduates for the world of work*, 2009, http://highereducation.cbi.org.uk/reports/00167/, last accessed 16 June 2010.

[6] CIHE, NCGE and NESTA, *Developing Entrepreneurial Graduates: Putting entrepreneurship at the centre of higher education*, 2008, http://www.ncge.com/publication/developing_entrepreneurial_graduates.1.pdf, last accessed 16 June 2010.

[7] Porter, M. E., *The Competitive Advantage of Nations*, MacMillan Press Ltd., Basingstoke, 1990.

[8] Yin, C.C., Kwok, H.N. and Mok, M.M.C., "Economic considerations in education policy making: a simplified framework", *International Journal of Educational Management*, Vol. 16, No. 1, 2002, pp. 18-39.

[9] Royal Academy of Engineering, "Engineers for Enterprise" project, http://www.raeng.org.uk/education/ee21c/default.htm, last accessed 16 June 2010.

[10] Lopes, P.N., Bracket, M.A., Nezlek, J.B., Schutz, A., Sellen, I. and Salovey, P., "Emotional intelligence and social interaction", *Personality and Social Psychology Bulletin*, Vol. 30, 2004, pp 1018 - 1034.

[11] Cote, S. and Miners, C.T.H., "Emotional intelligence, cognitive intelligence and job performance", *Administrative Science Quarterly*, Vol. 51, 2006, pp 1 - 28.

[12] Daus, C.S. and Ashkanasy, N.M., "The case for the ability-based model of emotional intelligence in organizational behaviour", *Journal of Organizational Behavior*, Vol. 26, 2005, pp 453 - 466.