

A Contribution to the Concept and Philosophy of Industry-Oriented Higher Education^{*}

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Abstract A turbulent re-engineering of higher education and higher education institutions is underway in many countries across the world to achieve a more direct and proactive engagement with society in general than ever before. This paper presents the authors' suggestions on the concepts and philosophy of quality-assured industry-oriented higher education based on the close cooperation between DIT and HIT, particularly on the recently completed EU Asa-Link EMERSON project in relation to software education, as a constructive contribution to the process of re-engineering higher education.

Key words industry-oriented education; higher education review; university re-engineering; DIT/HIT collaboration; EMERSON project; quality assurance

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1 Introduction

There is a deep-going review and re-engineering of higher education, its role and institutions underway throughout the world. Technological and societal changes have buffeted the universities and other higher education institutions and revealed shortcomings in their services to the communities and societies in which they exist and on which they depend for their continued viability. Together with national and international government agencies the institutions have been struggling to fully understand the forces of change and their implications and to forge a new role and identity as more appropriate formers of the intellectual leadership of this changing society^[1-3].

This struggle is far from being over.

New and some old and neglected models of higher education with potentially improved matching to the needs of society are being developed, re-developed and evaluated.

The Dublin Institute of Technology (DIT) and its predecessor colleges have an historical legacy of 120 years of higher education provision with an applied technological, vocational, professional and industry-oriented emphasis mainly for young people in Ireland but increasingly in other countries in Europe and beyond as well. This emphasis has prepared young people for technician and graduate employment in a wide range of scientific, engineering and business areas. DIT

served as midwife in Dublin and Ireland for the electricity, telecommunications, water and sewage transport, construction, chemical and pharmaceutical, hospital laboratory, retail and wholesale business and management and associated revolutions since 1887. It has done so through producing the skilled workforce that introduced and maintained these emerging technologies by offering relevant and up-to-date industry-oriented education, training and research programmes^[4].

DIT has strongly retained this industry-oriented approach to higher education in the current phase of industrial, social and economic development that has been fuelled principally by the information technology/communications revolution of the past thirty years^[5-6]. DIT is now seeking to meet the challenges posed by the emerging knowledge economy in Ireland. Not only must it continue to meet the immediate demands of its local community and economy, but it must also broaden its perspective to meet the needs of Ireland as a player in the broader EU and global community^[7]. This challenge is formidable and impacts on all aspects of higher education policy and delivery. It will require the higher education institutions to absorb all the lessons of earlier successes to guide the necessary re-engineering.

Some initial re-engineering steps at institution level and implementation level are already underway within DIT. In the area of IT education significant enhancements to the content, structure and delivery of the programmes offered have been made to meet the needs of

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the IT industry in Ireland⁸. The international collaboration it has established with China is a significant indicator of its wider perspective on the global community.

The Chinese government has been interested in the experience of DIT in education oriented to the IT industry since 2001 and facilitated the ongoing collaborative link between DIT and Harbin Institute of Technology (HIT). The highlight of this collaboration has been the recently completed 3-Year (2003 – 2006) EU Asia-Link Project termed the EMERSON Project. EMERSON was devised to investigate the adaptation of DIT's approach to IT industry-oriented education at home in Ireland to the conditions and situation in Harbin in China. It was one pilot experiment in the Chinese government's effort to reform its mainly theoretically based higher education system so as to better meet the rapidly evolving industrial, economic and social challenges in China⁹⁻¹¹.

Investigating and devising the best mechanisms to achieve high quality industry-oriented education has been the main focus of DIT throughout its existence, including this recent collaboration with China. The achievement of the EMERSON Project has been to successfully develop an industry-oriented education model for software education in China. This success was based on the experience of all the partners and their willingness to clearly identify the challenges and requirements in China, and then to develop and implement a model to meet these. This project has provided many striking lessons to those involved and these lessons can be of great value to the wider higher education community facing similar challenges. DIT's experience in the area of IT education provides a useful case study for higher education institutions facing the challenges of re-engineering, not only in IT education, but to a considerable extent in all academic areas.

2 Industry-Oriented Education

The main outcome sought of industry-oriented higher education is the achievement of a smooth and efficient transition from recent graduate to productive employee, and ultimately to entrepreneur/employer. The idea is to eliminate the frequent need for extensive and expensive on-the-job training of the new graduate recruit to the workplace. Rather the new graduate recruit should become a productive member of staff very soon after joining the workforce. The later transition of the employee to entrepreneur, individually or with a team of colleagues, would also be considerably facilitated.

It is the authors' view that, for success, the processes of industry-oriented education must be char-

acterised by the development and implementation of an education quality assurance/enhancement system with suitable procedures and a strong industry involvement, and a number of key programme learning outcomes, including

- (1) acquisition of expertise, theoretical and practical, in the discipline to the standard normally required for the degree award
- (2) awareness/experience of working in the industry context and the full range of related boundary conditions
- (3) practical experience of multi-level team working
- (4) management competence in individual and collective projects
- (5) possession of discipline, integrity and good interpersonal communications skills
- (6) acceptable personal and social behaviour for working in the industry setting
- (7) commitment to professional and career development and life-long learning
- (8) possession of a personal portfolio indicating many of these attributes
- (9) awareness of the global context of the industry.

Such an approach would offer rewards to the new graduates, to the higher education institutions, to the industries they serve, as well as to general social cohesion in society. The young graduates would be sharply attuned to the professional industry environment. The institutions would be helped to provide more relevant programmes and research, and produce more employable industry-oriented graduates. The industries would then be in a good position to recruit better prepared and more productive employees as well as acquiring a wider intellectual hinterland and the potential for relevant and fruitful research and development outcomes. A more general outcome would be the potential for improved social advancement and social cohesion in society.

3 Salient Features of Industry and Higher Education Institutions today

All sectoral industries have many general and specific characteristics. In this discussion industry has the widest connotation and includes manufacturing and service industries, agriculture, art and culture, business, commerce, trade, transport, and also government, inter-governmental and international agencies.

Industry underpins society to a large extent through the provision of products and services to the

market as well as employment and income for citizens. Increasingly industry exploits constantly developing advanced technologies and automation. Most industries and their ramifications and operations span the globe and operate in many countries on a 24-hour basis and a global scale. The rapidly changing profiles of different industries have deep repercussions on people and their social orders and social cohesion. This dynamically changing industry and society requires a workforce with an intellectual formation and commitment to lifelong learning so as to enable the people involved to cope with and master the changing technological, functional and behavioural demands of this increasingly globalised world^[12].

Just as industry and the society it serves are in continuous development and rapid change, so also is higher education, with universities and similar institutions in all countries in a state of flux.

One element of the response of the higher education institutions to this state of flux has been, at the urging and insistence of their governments, to open their doors to wider participation, to more academically weak students, to more mature students, to students with disabilities and to students from other countries. This measure, or range of measures, has added to the state of flux, and indeed to a phase of rapid growth and expansion of the higher education institutions.

Another element of the response has been the development of quality assurance procedures to seek to guarantee to students, governments and society in general that the academic standards achieved and the skills and competences acquired by students and graduates in the new larger mass education institutions are comparable to or superior to those achieved in previous generations^[13]. Within the particular context of Irish higher education, it is notable that the development of effective quality assurance systems has been a significant aspect of recent reviews of higher education, now required under legislation^[12-15].

The higher education institutions have also begun to engage in frequent self study and strategic planning, seeking to extend and deepen their involvement in and active engagement with the widest range of elements and aspects of society. One fruitful model for this newer, wider engagement is the development and implementation of industry-oriented education programmes.

4 Quality Assurance in Industry-Oriented Education

Ensuring an ethos of quality enhancement is fundamental to industry-oriented education and must be

the aim of all stakeholders involved. This ethos must pervade all aspects of the educational programme and so it is necessary that all stakeholders, academic and administrative staff of the higher education institution and industry staff, take responsibility for the quality of their individual components by also for the integration of these components. Teamwork is a basic requirement. The quality assurance system of procedures and structures is a framework to facilitate this teamwork amongst the stakeholders^[13].

4.1 Quality Assurance in Taught Programmes

The quality assurance procedures first come into play at the stage of proposing a new programme and constructing the case for the programme by a development team. This case needs to be based on industry and society developments and needs and on the availability of requisite resources. Authoritative input from industry and other professional and government agencies is essential in establishing a firm foundation for the programme. The case must itemize and give evidence for the industry needs, the feasibility of the programme objectives, the learning outcomes and how these match the industry and society needs, the industry support for the programme and the resources both human and physical required to offer the programme.

After the proposed programme has been given outline approval by the higher education institution the development team has to develop and document the complete curriculum for the programme. The programme document must provide the aims and learning outcomes for each stage and each module, the detailed syllabus of each module including teaching, learning and assessment strategies, the arrangements for industry input and guidelines for specific aspects of the programme (e.g. student handbook for each stage, industrial placement, final year and other projects, etc.). Assistance, advice and involvement by industry representatives in the process of drafting this document is essential.

The programme must next be validated by an independent panel of experts, with members from both academia and industry. This validation panel visits the institution, meets the programme team and considers the proposal in detail. When the proposal is adjudged satisfactory, possibly after the inclusion of recommendations by the panel, the panel recommends that the programme be approved to be offered to students and that successful students on the programme be eligible for the degree or other award of the higher education institution.

The programme committee, with academic and industry members, manages the overall delivery of the

programme as specified in the programme document. Assessments of the students provide vital corrective feedback within the quality assurance system and are administered as specified in the programme document under the regulations of the institution. External examiners are an essential element of external peer review in relation to assessments and both an academic and an industrial external examiner should be appointed to emphasize and ensure the industry orientation of the programme and its learning outcomes.

The assessment board, a formal meeting of all internal and external examiners involved, determines each student's results for the overall assessment process for a given stage of the programme, guided by the general institution assessment regulations, any specific regulations specified in the programme document and the principles of natural justice and equity.

The programme should be evaluated annually. The programme committee reviews the implementation of the programme, including student, staff and industry feedback as well as the assessment results and the report of each external examiner on the assessment process and their observations on the programme in general. The key outcome of this review is an annual report containing an evaluation of the current implementation of the programme, a summary of the assessment results with comments and suggestions by the external examiners and industry collaborators, the key feedback observations of students, staff and industry representatives involved, and an action plan for improvements in the implementation of the programme.

The overall programme is also evaluated periodically, usually once every two to five years. This should involve a root-and-branch self-study and evaluation of the programme and its implementation, taking into account its success in fulfilling the requirements of the relevant industry (industrial placements, learning outcomes, numbers of graduates), the changes underway in the industry, the student feedback received, the feedback from industry on students in placement and graduates employed, the outcomes of the lecturer evaluation processes in the programme, and comparison with similar programmes in other institutions at home and abroad. It would also involve a review of the industry it serves and other relevant local and national developments by the programme committee. A reviewed programme document is prepared and submitted to an independent review panel and examined in a similar manner to the initial validation, for continuing approval as a degree or other award programme.

4.2 Quality Assurance in Research Programmes

Industry-oriented postgraduate research pro-

grammes must be subjected to a broadly similar framework of quality assurance procedures, with industry involvement at all key points. In this case the stages at which industry collaboration and peer review are vital for corrective feedback and other quality assurance activities include

- (1) elaboration of an appropriate research plan
- (2) agreement on any requisite terms of confidentiality and on intellectual property rights
- (3) the formation and continuing development of the supervision team of staff from the higher education institution and the industrial companies involved
- (4) provision of access to equipment and work stations
- (5) the annual report and evaluation of the progress of the research
- (6) evaluation of the thesis preparatory to submission
- (7) assessment of the thesis and the viva voce by external academic and industry examiners
- (8) feedback from the student on the research experience
- (9) feedback for industry on the student in placement and of the graduate employed
- (10) the production of papers on the work for publication
- (11) the further exploitation of the outcomes of the research

5 Mechanisms of Implementation of Industry-Oriented Education

The main services provided by higher education institutions are higher education and training in relevant skills and competencies, principally but not exclusively to primary degree level or standard. Shorter education and training programmes as well as more advanced postgraduate degree level programmes are also important natural parts of their armoury of services. Postgraduate research programmes leading to higher degrees are vital to the knowledge generation as well as the knowledge/skill teaching functions of these institutions. Commercial research, development and consultancy services to industry, government and society are also provided to some extent by higher education institutions, generally as income-generating enterprises.

In each of these service areas, the depth and intensity of the industry orientation must be consciously developed and optimised.

The interactions between the higher education institutions and industrial companies can be manifold and may include

(1) interactive collaboration in research consultancy and other projects

(2) seamless direct relationships through industry representation in teaching and research programme planning and implementation student and staff placement in companies industry staff placement in the institutions research/development cooperation etc

(3) indirect relationships through government and other think tanks national and other strategic planning processes professional accreditation and standards bodies etc

(4) involvement of authoritative representatives of industrial companies at all stages (planning validation implementation assessment review and change of taught and research programmes overall institutional reviews and strategic planning in the quality assurance procedures of the higher education institutions as outlined above)

Another significant area for such constructive quality assured interaction with industry is the recruitment induction training and continuing development of the relevant staff of the higher education institution and particularly the process of forming and developing the team to deliver each programme Recruitment of teaching staff for the programme with senior experience in relevant industries can be very advantageous Building and maintaining the cohesion general agreement on the industry-oriented approach and constructive participation of all elements of the programme team are vital for success

These interactions need to be carefully managed collectively agreed and fully documented In particular the associated documentation should unambiguously reflect the interactive nature of the relationship between the higher education institution and industry that underpins the industry-oriented education model

The ultimate employment of the graduates and their employers' evaluation of their work performance should provide a definitive indicator of the success of the industry-oriented education model and indeed indications on ways to enhance the model

6 Discussion and Summary

The collective agreement on the industry orientation and on the quality assurance framework by the staff members of the higher education institution and of the companies participating is key to the success and continuing enhancement of industry-oriented education This requires strong commitment and leadership by the presidents and deans of the institutions and the directors of the companies as well as time and dedication

on the part of staff

Every effort must be made to maintain constructive friendly flexible helpful and non-exploitative dialogue and goodwill between the relevant staff of the institution and the industrial companies involved Issues of confidentiality intellectual property and academic freedom must be agreed at an early stage in their interactions Dialogue between institution and industry should be supported by an appropriate partnership agreement whose terms of reference are such that neither side dictates the direction but listens to advice and acts by mutual agreement wherever possible 16 Ultimately however the responsibility for academic standards must rest with the higher education institution concerned as there may be sound pedagogical reasons why certain courses of action may not be appropriate within the academic context

A reengineering and reorientation of higher education and its institutions is underway across the world It is widely agreed that the institutions need to forge a more direct and hands-on engagement with society in general than existed before They must help to develop better understanding of practical issues in society and communicate these effectively to society They must indicate timely solutions to issues of industrial development and competitiveness in the global economy and other pressing geopolitical social and cultural issues

The industry-oriented approach outlined in this paper while still a work in progress has been shown to be extremely fruitful and applicable as much in China as in Ireland by the robust collaboration between DIT and HIT in relation to industry-oriented software education It offers significant potential for enhancing the engagement between higher education institutions and industry and society in general It offers considerable social rewards It can make a significant contribution to the fundamental reengineering processes within the higher education institutions and significant assistance in managing the dislocating processes of technological change within society

With further elaboration and adaptation industry-oriented education can become a valid global approach to reengineering higher education for this era of the globalised economy

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