Assuring Quality in Chinese IT Education

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Abstract: China is experiencing unprecedented economic growth within a context of globalisation and the emergence of a global knowledge economy. This growth is fuelled by developments in Information Technology (IT) and high quality IT services. Skilled industry-oriented IT graduates are needed who will be immediately productive in an internationally competitive environment. Any barriers to providing such graduates must be removed through national educational reforms, driven by research-based best practice, and informed by international experience. In response to the challenges faced by China in producing industry-oriented IT graduates the EMERSION project (Education to Meet the Requirements of the Software Industry and Beyond) was established in 2003, as a partnership project between the Dublin Institute of Technology, Harbin Institute of Technology, and the University of Wolverhampton, funded under the European Union ASIA-Link programme to develop, implement, and evaluate an industry-oriented IT education model and system in China. A key aspect of this model is its quality assurance system which is an integration of best practice from the quality assurance systems of the partner institutions. This paper describes the motivation for introducing a quality assurance system in education, describes EMERSION and the motivation for the EMERSION quality assurance model, and then describes the quality assurance model and its role in ensuring sustainability and evolution of the education model in the face of globalisation. The importance of the research described in this paper is that it provides an example of successful international co-operation between researchers, educators, and policy-makers, guided by research-based best practice, to achieve a common understanding of quality issues in industrially focused education. Government policy-makers, educators, and industrialists developing industry-oriented education models will gain insight into the issues faced when educating current and future generations of IT professionals to meet the challenges of a globalised knowledge economy.
Keywords: IT, education, industry, quality, model

1. Introduction

China, like most countries in the Asia-Pacific region, is experiencing unprecedented economic growth within a context of globalisation and the emergence of a global knowledge economy. This growth is fuelled by developments in Information Technology (IT) and high quality IT services. Skilled industry-oriented IT graduates are needed who will be immediately productive in an internationally competitive environment. Any barriers to providing such graduates must be removed through national educational reforms, driven by research-based best practice, and informed by international experience.

In 2001, China's Ministry of Education established thirty five national pilot software schools to address the ongoing shortage of well-trained software professionals. Harbin Institute of Technology (HIT) was selected to set up a pilot software school to produce well-trained industry-oriented IT graduates. The Dublin Institute of Technology (DIT) was

identified by the Chinese Ministry of Education for its industry-oriented education model and invited to collaborate with HIT in setting up the pilot software school (Xu 2003).

DIT's education model is recognised for its industry-oriented graduates who have made a major contribution to Ireland's economic success. Ireland has experienced a major economic transformation in the 1990s (Florida and Tingali 2004) to become an emerging knowledge economy, with one of the world's leading software industries (Gallen 2005). Irish educational institutions such as DIT have played a major part in this transformation.

The EMERSION project (*Education to Meet the Requirements of the Software Industry and Beyond*), extended the DIT-HIT collaboration in 2002. EMERSION is a partnership project between the School of Computing in DIT, HIT and the University of Wolverhampton (UoW) to develop, implement, and evaluate an industry-oriented IT education model and system in China (EMERSION 2002; EMERSION 2006a). EMERSION is funded under the European Union (EU) ASIA-Link programme (ASIA-Link 2006).

The EMERSION project completed its final phase in February 2006 producing an industry-oriented education model for software development which incorporates the industrial ethos and focus of DIT and UoW with the advanced excellence in research of HIT to support the IT sector in China (Lawless et al., 2004; Lawless et al., 2006).

A key aspect of this model is its quality assurance system which is an integration of best practice from the quality assurance systems of the partner institutions (DIT-HIT-UoW).

This paper considers issues in assuring quality in Chinese IT education through the lens of the EMERSION quality assurance model which underpins EMERSION's industry-oriented education model. The following Section describes the motivation for introducing a quality assurance system in education. Section 3 then describes the EMERSION project while Section 4 describes the motivation for the EMERSION quality assurance model. Section 5 presents the EMERSION quality assurance system and Section 6 describes the quality assurance systems role in ensuring sustainability and evolution of the education model. The final section presents a summary and conclusions.

2. The motivation for introducing a Quality Assurance System in Education.

In the last ten to fifteen years the emergence of a global knowledge economy has had a profound effect on national economies worldwide. Knowledge has become a factor of production and is becoming increasingly commodified as a strategic element of economic growth (World Bank 2002). Education is now perceived by governments as a strategic constituent of a nation's ability to compete in international markets. High quality educational provision is of strategic importance to national economic success in the face of globalisation. In recent years provision of effective quality assurance systems has figured prominently in government initiated policy reviews of higher education provision (OECD 2004; EUA 2006).

2.1 Regional motivation

Strategic initiatives such as the Lisbon strategy in the EU aim to open up education and training globally and allow higher education institutions to compete internationally in a globalised education market. The EU aims by 2010 to be "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable growth with more and better jobs and greater social cohesion" (Education and Training 2006, para. 1). European Governments intend the EU to be "the world leader in terms of the quality of its education

and training systems" (Education and Training 2006, para. 2). Such strategic initiatives are a motivating force for quality in education which requires an institution's quality assurance system to be a key tool in enhancing its education and training provision.

Europe is currently laying the basis for a European Higher Education Area by 2010, through the Bologna process. One of Bologna's main objectives is to "promote European co-operation in quality assurance" (Bologna 2005a, Overview section, para. 1). The Bologna process motivates developments in quality assurance in each EU state. The Irish Higher Education Quality Network for example was established in 2003. This network consists of the main higher education organisations in Ireland which play a role in quality assurance in Irish higher education. The network is originating a "common national position on key quality assurance issues" (Bologna 2005b, Quality assurance section, para. 1), to influence debate at EU level. Processes such as Bologna which drive progress in quality assurance development, act as powerful motivators for ensuring that effective quality assurance systems are in place in educational institutions

Governments in the Asia-Pacific Region acknowledge the positive effect a high-quality tertiary education system will have on their national economies, consequently, more government finances are being invested in higher education (Stella 2005a). Governments in the region seek assurance that public monies are being spent wisely in enhancing national higher education capacity. This motivates governments in the region to instigate higher education reforms where quality assurance mechanisms play a key role (Stella 2005a).

Quality assurance agencies in the Asia-Pacific region are working together in a number of regional networks such as The Asia-Pacific Quality Network (Stella 2005a) to address educational quality assurance needs in the region.

The EU and Asia's motivation for introducing an effective quality assurance system to underpin industry-oriented education is essentially the same; a desire to produce graduates who can contribute effectively to the knowledge economy and enhance regional ability to compete in a global environment. It is clear that both in the EU and Asia-Pacific regions there is motivation for reform and enhancement of educational quality assurance systems at regional level.

2.2 National Motivation
Due to the phenomenal growth of the Chinese software industry (Xu 2003) many more software professionals are required. China recognizes the need to modernise its software engineering education programmes to ensure that they become more industry-oriented. As a consequence HIT has set up a National Pilot Software School with an associated industry-oriented education model for software engineering. China has strategically searched internationally for successful examples of industry-oriented software engineering education models. Graduates of programmes based on such industry-oriented models must be resilient and adaptable to changes in a global economic environment. This is an important quality issue and motivates introduction of appropriate quality assurance mechanisms to ensure that industry-oriented models are sustainable and responsive to change at national level.

2.3 Institutional Motivation
Quality Assurance of an educational institution is a process whereby the institution guarantees to itself and its stakeholders that its teaching, learning, research and supporting services consistently reach a standard of excellence (Duff et al., 2000).

A primary motivation for introducing a quality assurance system in education is to satisfy the collective demands of the main stakeholders in the education process (students, academics, academic management, industry and government) for assurance as to the effectiveness of an institution's educational programmes (Carroll et al., 2006).

Educational institutions must guarantee the quality of their educational provision by putting in place quality assurance systems to provide monitoring and feedback (Duff at al., 2000) together with the capability for corrective action when stakeholder needs are not met. Educational programmes must be constantly evaluated and revised to meet the needs of the stakeholders in the education process.

Students as stakeholders in the educational process seek a quality education that will prepare them for the workplace. They need to know that a programme is of high quality so as to make an informed choice of programme. Once embarked on an educational programme they require feedback on the educational process to inform them of its operation and they require input into quality assurance mechanisms to correct any perceived deficiencies. They must be able to influence programme operation so that any deficiencies can be corrected.

Academic stakeholders seek to provide a high quality educational experience. Internal academics are concerned with the effectiveness of programme delivery and its outcomes. External academics are concerned with ensuring that programme provision is comparable internationally.

Management stakeholders are responsible for providing a high quality educational environment through managing both the physical and human resources of the institution.

Industrial stakeholders as major consumers of educational output seek assurance as to the quality of educational provision in terms of relevance and currency of educational programmes

Government as a key stakeholder in the educational process seeks assurances of value for money and prudent financial control.

Quality assurance therefore, is a key tool in the education process (Duff et al., 2000) which motivates the introduction of a quality assurance system to ensure the quality of an institution's education provision. A comprehensive quality assurance system should underpin the main activities of an institution's education model to ensure sustainability of the education model in the face of a globalised education environment.

3. The EMERSION Project

The EMERSION Project (**E**ducation to **ME**et the **R**equirements of the **S**oftware **I**ndustry and Bey**ON**d – Establishing, Implementing and Evaluating an Industry-Oriented Education Model in China) was initiated in 2003 to establish, implement and evaluate an industry-oriented education model to support sustainable industry-oriented education in China particularly in the IT sector (EMERSION 2002).

The project benefits staff, and students (both at undergraduate and postgraduate level) in the partner institutions (DIT-HIT-UoW). All partners benefit by evolving their education models, increasing research co-operation, and commencing new research initiatives.

A Steering Committee comprising senior personnel from each of the partners monitors and controls the overall project. A Project Team in each partner institution, led by a local Project Manager, reports to the steering committee via a local Project Board. The Project Team is responsible for specific project activities carried out via local Implementation Teams. Implementation Teams were set up in each partner institution for the following project areas; Curriculum Development, Quality Assurance, Work Placement, and Research. Each Implementation Team had a local leader reporting to the local Project Manager.

The EMERSION quality assurance system development process was facilitated through on-line collaboration between the implementation teams, face-to-face meetings, workshops and training events at the partner institutions in China, Ireland and the UK.

EMERSION was an extension of an existing collaboration between DIT and HIT. HIT's National Pilot Software School introduced an industry-focused quality assurance system in 2002 which referenced DIT experience of quality assurance in software engineering education (Xu 2003; Liu et al., 2006). The initial implementation of the EMERSION quality assurance model was based on this framework.

The EMERSION project has developed an industry-oriented education model for software development which incorporates the industrial ethos and focus of DIT and UoW with the advanced excellence in research of HIT (Lawless et al., 2004; Lawless et al., 2006).

An industry-oriented curriculum, and supporting, teaching, learning, and assessment strategy has been developed as part of this model together with a quality assurance system to assure the quality of the model's implementation and evolution. The EMERSION industry-oriented model supports a four-year programme whereby novices progress to graduate as industry-oriented practitioners (Lawless et al., 2006) who will be adaptive to changing technical and organisational environments in the Chinese software industry in the face of globalisation.

4. The motivation for the EMERSION Quality Assurance Model

The development of a quality assurance system to monitor and maintain quality in the EMERSION industry-oriented software education model was one of the primary objectives of the EMERSION project (EMERSION 2002).

The initial implementation of the EMERSION quality assurance model was based on an industry-focused quality assurance system introduced by HIT's National Pilot Software School in 2002 which referenced DIT experience of quality assurance in software engineering education (Xu 2003). Based on this framework the quality assurance implementation team's aim was to integrate quality assurance best practice from the partner institutions (HIT-DIT-UoW) in order to create a quality assurance system that supported the EMERSION education model's industrial focus and that also recognised the Chinese education system and culture within the educational context of HIT (Xu 2003).

In the first phase of the EMERSION project, the partner institutions DIT, UoW and HIT surveyed their academic staff, and the IT industry in their own countries to develop a set of requirements to guide the development of the EMERSION education model and its associated quality assurance system (Lawless et al., 2004).

The quality assurance implementation team worked to create and implement a quality assurance system to support a sustainable and resilient industrially-oriented education model with the capacity to evolve in the face of globalisation.

The EMERSION quality assurance model's requirements are grouped into ten main specification categories; University Support Structure; Individual and Collective Responsibility; Inclusiveness; Focus on Continuous Improvement; International Benchmarking and Transparency; Quality Assurance Documentation; Regulatory Framework; Program Validation/Evaluation/Monitoring/Review System; Feedback; and Staff Training and Development. The components of these ten categories are summarised in Table 1 below.

Specification	Component
University Support Structure	• Management; • Resources; • Student Recruitment.
Individual and Collective Responsibility	• Lecturer's individual responsibility for quality of module(s); • Integration of module within overall programme; • Collective responsibility through teamwork to ensure the overall quality of the programme.
Inclusiveness	• Lecturers; • Students; • Management; • Teamwork; • Industry.

Focus on Continuous Improvement	• Periodic review of model by national and international experts
	  - Student Experience;
	  - Effectiveness of Quality Assurance System;
	  - Effectiveness of Curriculum;
	  - Industrial relevance.
	• Monitoring of performance
	  - Feedback from peer groups and stakeholders
	• Measures to improve performance
	  - Quality Action Plan

International Benchmarking and Transparency	• International external examiners both from industry and academia; • Freely communicated quality assurance procedures; • Publication of peer group, periodic reviews of the programme.
Quality Assurance Documentation	• Course; • Student; • Team; • Work Placement.
Regulatory Framework	• Course Committee and Team; • Student Handbook; • Regulations; • Competition for and approval of Subject/Component Delivery by an Individual Teaching Staff Member or a Teaching Team; • Monitoring and Evaluation of Subject/Component Delivery; • Examination Board; • Peer Review; - External Examiner (academic);

	- External Examiner (industry).
Program Validation/ Evaluation/ Monitoring/ Review System	• New Programme Proposal; Curriculum Development; Programme Approval; • Annual Programme Evaluation; • Annual Monitoring Report; • Two-yearly Programme Evaluation and Review.
Feedback	• Student; • Staff; • Management; • Industry.

Staff Training and Development	• Learning and Teaching;
	 • Technology;
	 • Industry Involvement;
	 • Ethos and Philosophy;
	    - staff attitudes and organization culture;
	 • Quality Assurance;
	    - procedural, skills based and pedagogic quality assurance issues.

Table 1 *: EMERSION Quality Assurance System Requirement Specifications*

The specifications outlined in Table 1 underpin the EMERSION quality assurance model described in the next section.

5. The EMERSION Quality Assurance System

The aim of the quality assurance system which underpins the EMERSION education model is to provide a procedural framework that ensures the quality of the educational process and allows for the continuous improvement of all aspects of the educational experience for all stakeholders involved in the programme (Lawless et al., 2004).

The quality assurance system plays a key role in ensuring the education model's sustainability in the face of globalisation. The EMERSION model's software engineering education programme produces graduates who are adaptive to changing technical and organizational environments (Lawless et al., 2006).

To ensure that the education model continues to produce such graduates it is the role of the quality assurance system to signal where the educational model may be failing. Through monitoring and corrective action, the quality assurance system will ensure that graduates educated according to the industry-oriented model will still be adaptive into the future with sustainable key software skills and competencies for both the Chinese and international software industries.

Specific academic quality assurance procedures are initiated at three stages in the life cycle of a programme based on the EMERSION model (EMERSION 2006b). First, during the preliminary design stage of a new programme, quality assurance procedures are employed based on peer review (both external and internal) which subject the program proposal, design, and development plan to a rigorous validation process. Then, within the annual operating cycle of a programme, quality assurance procedures for programme enhancement are applied. These include examinations and assessments monitored by external examiners (both industrial and academic), and an annual monitoring report and quality rating of the programme which uses various performance indicators together with feedback from staff and students. Finally, every two years an in-depth internal critical self-study of the programme

and how it operates is carried out. A review of the programme then follows which subjects the programme to rigorous external and internal peer assessment. If all is in order the programme is revalidated for a further two years.

The following sections briefly describe the EMERSION quality assurance system developed by the EMERSION quality assurance implementation team. The material presented highlights some of the notable features of the EMERSION Quality assurance system. These features are described in detail in the EMERSION quality assurance handbook (EMERSION 2006b).which forms part of the research output of the EMERSION project.

5.1 The Organisational Structure of the Quality Assurance System

The organisational structure that supports the EMERSION educational quality assurance system is shown in Figure 1. The operation of each committee and team is described in EMERSION quality assurance handbook (EMERSION 2006b).
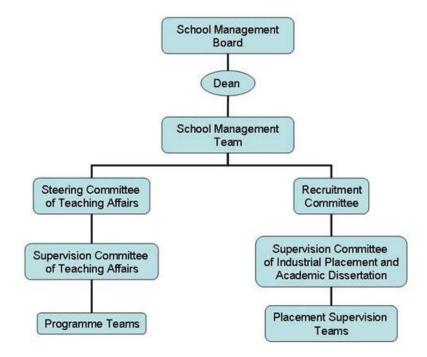

Figure 1: *Organisational Structure for EMERSION Education Model*

The Dean of the School is at the core of the EMERSION quality assurance system. The system's policy and implementation backbone is formed from several committees and teams with a series of supervision systems and operational flows connecting the system's components.

5.2 Overview of the Quality Assurance Process

The quality assurance processes associated with a programme are shown in Figure 2.
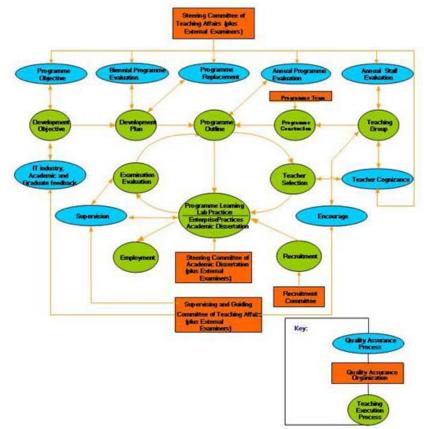
Figure 2: *Overview of EMERSION Quality Assurance Process (Liu et al., 2006)*

Each educational and operational process (denoted with circles in the Figure 2) has a corresponding quality assurance process (denoted with ellipses). Each process is implemented and monitored by its corresponding organisational committee or team. The bi-directional arrows between the educational processes and quality assurance processes denote interaction and corrective feedback; each process enhancing the other.

5.3 Stakeholders in the Quality Assurance Process

Each stakeholder in the industry-oriented software engineering programme (student, lecturer, guest lecturer, external examiners, industry partners and management) plays a role in the quality assurance process. A Quality Awareness Programme outlines the responsibilities of each stakeholder in the quality assurance process and the mechanisms by which the quality assurance process operates within the validation, operation and review cycle of the industry-oriented programme. The Quality Awareness Programme ensures that the roles and responsibilities of the stakeholders are clearly defined.

Students, for example, as the major beneficiaries of the programme must be aware of their responsibilities and role in the quality assurance process. Each year students will receive a quality assurance document detailing their quality assurance responsibilities and the programme's quality assurance mechanisms. Similarly the other stakeholders are provided with relevant quality assurance documents specific to their roles.

5.4 Data Collection Mechanisms

Data collection is fundamental to the operation and maintenance of the EMERSION quality assurance system. Data are required for the quality assurance system's monitoring,

evaluation and review functions to enable a high-level review of the industry-oriented programme to take place and ensure that academic standards are maintained.

Each stakeholder in the industry-oriented software engineering programme will view quality assurance from a different perspective. Since each stakeholder's conception of quality may be different (Cheng and Tam 1997) a different set of quality indicators may be important to each stakeholder. The resulting view of quality is a combination of a range of expectations of many stakeholders (Stella 2005b). By employing a broad range of quality indicators in the industry-oriented quality assurance model, an attempt is made satisfy the expectations of as many stakeholders as possible.

Key quality indicator data is mainly collected via reports and questionnaires which are detailed in the EMERSION Quality Assurance Handbook (EMERSION 2006b) and include student intake numbers; examination results; work placement indicators; graduate employment; and progression to post-graduate study.

The Annual Monitoring Report is the master data collection mechanism used in the EMERSION quality assurance model which draws together the outputs of other data collection methods.

5.5 Review Mechanisms

The quality indicator data, commentary, feedback, and views of the Programme Team are reviewed and analysed each year, and included in the Programme's Annual Monitoring Report. A Quality Action Plan detailing the improvements to be carried in the following year is also included. The Annual Monitoring Report is referred for review to the Supervision Committee for Teaching Affairs.

5.6 Examinations, Examiners, and Examination Board

Examination and assessment provides essential feedback which inform the education quality assurance processes of the industry-oriented model

Internal and external examiners are appointed to each programme and are responsible for the implementation of the examination process. Internal examiners are full-time or part-time academic staff members of the institution. One industrial and one academic examiner are appointed for each programme.

The Examination Board provides an opportunity for both internal and external peer review of the examination processes. The Examination Board determines the result and level of performance recorded for each candidate, prior to progression to the next semester or year, or to the final award for the programme.

External examiners provide objective peer judgment on the examination and assessment standards achieved by the students on the programme. This enables benchmarking of the results against national and international academic and industrial standards.

The quality assurance procedures for examinations, examiners, and exam boards are detailed in full in the EMERSION Quality Assurance Handbook (EMERSION 2006b).

5.7 Program Validation, Evaluation, Monitoring, and Review

Quality assurance procedures are applied at three stages during the program life cycle.

1. *Preliminary Design Stage*

The new program proposal, design, and development plan are subjected to a rigorous validation process based on peer review. Program demand; feasibility; entry requirements; learning outcomes; industry requirements; resource implications; are all subjected to review.

2. *Annual Monitoring and Evaluation*

The operational program is subjected to quality enhancement procedures including external moderation of examinations and assessments by industrial and academic external examiners. An annual monitoring report and quality rating is prepared using various performance indicators, along with feedback from staff and students. A quality action plan is prepared arising from consideration of the annual report, which provides a blueprint for corrective action.

3. *Critical Self-Study and Review*

The programme is subjected to an internal critical self-study of its operation every two years. The program is then reviewed through rigorous external and internal peer assessment. If the program is judged to be healthy the programme is revalidated for a further two years.

The complete quality assurance procedures for Program Validation, Evaluation, Monitoring, and Review of the industrial model are detailed in full in the EMERSION Quality Assurance Handbook (EMERSION 2006b).

5.8 The Test Lecture

The recruitment process for new academic staff includes two rounds of interviews and a test lecture. The test lecture is a key component in the EMERSION quality assurance system and is an important vehicle for evaluating a candidate's subject knowledge and communication ability.

After the second interview the candidate must prepare and give a test lecture. The candidate presents a fifteen minute topic introduction followed by a thirty minute lecture on a predetermined topic. If the lecturer is unsuccessful a second test lecture is organised within two weeks. A lecturer can only give lectures after a successful test lecture.

5.9 Monitoring the Teaching Process

The teaching processes in the industry oriented-model are monitored via regular attendance by members of the supervision committee at lectures and practicals. If serious problems arise, delivery of a subject may be suspended until the problems have been rectified. The evaluation of the teaching process should be constructive with timely feedback to the lecturer in question.

Student feedback is solicited via survey questionnaires at various times throughout the academic year. The results are used to enhance programme quality and improve course delivery.

Staff performance evaluation is carried out for each lecturer each year in two stages; lecturer self-assessment each semester; and annual lecturer performance evaluation. Lecturer evaluation is based on their performance evaluation, and data and information collected from the different feedback sources.

Training and development is an essential component of the quality assurance process. Staff training and development must be provided for all aspects of the quality process associated with the industry-oriented model. Staff attitudes and organisational commitment, quality assurance procedures, as well as procedural, skills-based and pedagogic issues are considered.

5. 10 Quality Assurance System Review

A review of the EMERSION Model's quality assurance takes place every three to four years based on stakeholder feedback and experience operating the industry-oriented programme. An international review panel evaluates the quality assurance system and produces an objective report which highlights the strengths and weaknesses of the educational quality assurance system and includes specific recommendations for improvement.

The review panel comprises senior lecturers of the academic institution, senior personnel in the software industry, senior lecturers from other software schools in China, and international experts with experience in educational quality assurance system evaluation.

The evaluation team reviews the organisational structure of the quality assurance system and its operating processes.

The review should include a review of the quality assurance documentation; review of the quality assurance information dissemination mechanisms; dialogue with members of the programme team regarding the perceived operation of the quality assurance system; and evaluation of the school's educational quality assurance infrastructure.

The review panel produces an objective report indicating the strengths and weaknesses of the industry-oriented model's quality assurance system, with specific recommendations for improvement.

The terms of reference of the report will be agreed with the Dean of School in conjunction with the Steering Committee of Teaching Affairs and the appropriate institute quality assurance function.

The report's contents involve at least an evaluation of the current quality assurance system with respect to international best practice; an audit of the main quality assurance documents and reports; an audit of the main data collection instruments; a review of the effectiveness and relevance of the semester and annual monitoring performance indicators; and recommendations for modifications and improvements to enable corrective action to be taken.

The report is submitted to the Dean of School, the School Management Board, and the Steering Committee of Teaching Affairs for appropriate action.

6. The Quality Assurance model's role in ensuring sustainability and evolution of the Industry-Oriented Educational Model

Developments in IT and high quality IT services have provided the fundamental infrastructure for the speedy globalisation of economic activity (Sheehan 1999).

Educational models to produce highly skilled IT graduates must be responsive to changes in the global economic environment, consequently mechanisms must be provided to scan the economic horizon and inform the inputs, processes, and outputs of the educational model.

The EMERSION quality assurance system performs such a horizon scanning function for its educational model. Its monitoring and feedback mechanisms respond to shifting IT industry demands, and changes in international best practice via feedback from external examiners and input from industrial partners. Feedback from annual and bi-annual peer reviews initiated via the quality assurance system also aid the scanning process.

The EMERSION model's quality assurance system is crucial to the sustainability of the EMERSION industry-oriented model as outlined above. It enables the EMERSION educational model to evolve in the face of globalisation and support sustainable industry-oriented IT education in China.

7. Summary and Conclusions

The key to sustainability and evolution of any endeavour is the ability to measure the quality of its constituent activities. The quality assurance model described in this paper provides a framework for assuring the quality of the industry-oriented software engineering education model. Quality processes, quality content, and quality delivery are essential if the EMERSION industry-oriented educational model is to remain sustainable and evolve in the emerging global knowledge economy.

A number of interesting insights are evident from the research described in this paper.

1. *The extension of the quality assurance systems to cover part-time and guest lecturers.*
Part-time and guest lecturers provide industrially-relevant material to the programme. Their performance is monitored and evaluated as part of the EMERSION quality assurance process. Mechanisms are in place to ensure part-time and guest lecturers are aware of their quality assurance responsibilities to the industry-oriented program.

2. *Educating industry via the part-time and guest lecturer quality assurance process.*
The benefit of part-time and guest lecturer quality assurance procedures is that by taking an active part in the quality assurance process and being subject to quality assurance evaluation, part-time and guest lecturers gain a deeper insight into the factors that are important to the educational institution for delivery of timely industry-oriented education.

3. *Staff personal development.*
The EMERSION quality assurance model incorporates the concepts of the test lecture and annual monitoring of staff teaching activity. This is useful as it encourages staff to think and reflect on their teaching and encourage the notion of the reflective practitioner (Schon 1984) in industry-oriented education.

4. *Internalising quality assurance into teaching practice.*
Quality assurance should be an integral part of teaching rather than a separate exercise. This perspective counters the tendency to view teaching and quality assurance as two separate and distinct processes. Good lecturers should always have quality to the fore in their academic activities.

5. *Team-based approach to teaching.*

   Coherence in program delivery is an important quality assurance issue. Team-based program delivery encourages coherence as it allows staff the take a program-wide view of teaching activity ensuring awareness of the relationship between their own individual modules and the other modules on the programme.

   The EMERSION quality assurance model includes mechanisms which will allow the industry-oriented education model to be implemented and evolved in a manner that ensures it meets the needs of China's software industry, both now and in the future.

   The research described in this paper provides an example of successful international co-operation between researchers, educators, and policy-makers, guided by research-based best practice, to achieve a common understanding of quality issues in industrially focused education. Highly valuable research relationships have been formed between the academic staff in the partner institutions which will outlive the EMERSION project life-cycle. Mutual benefits have accrued for all the EMERSION partners. The transfer of industry-oriented experience to China has been complimentary to EU partner exposure to the innovative research practices of HIT.

   The research provides government policy-makers, educators, and industrialists developing industry-oriented education models with insight into the issues faced when educating current and future generations of IT professionals to meet the challenges of a globalised knowledge economy.

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