'Computing the Profession': Crossing the Chasm with a new Masters Degree in Information Technology

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Proceedings of the 15th Annual NACCQ, Hamilton New Zealand July, 2002 www.naccq.ac.nz

ABSTRACT

Successive ACM national and international curriculum efforts have addressed the evolving nature of the computer science curriculum. The academic discipline of computer science has been subjected to critical questioning in terms of the preparedness of graduates to meet the continuing demand for well educated and effective computing professionals. An increasing trend sees educators in cognate computing disciplines grouped in schools of Information Technology (IT). This paper reports on a new curriculum initiative to create a Masters degree in Information Technology aimed at supporting IT professionals in their personal and career growth. The paper will cover the rationale, mechanisms for stakeholder involvement, aims, structure and content of the programme, and strategies for delivery.

1. INTRODUCTION

In his call to move beyond earlier curriculum models such as the CS'91 model of "computing as a discipline" (Denning, 1989) to broader curricula that meet the needs of the IT profession, (Denning, 1999) Peter Denning has laid down a challenge. That being, "to resolve the severe mismatch between the demands of the market for IT professionals and the supply systems of education". A new Masters in Information Technology degree (M. Info Tech) developed at Auckland University of Technology (AUT) represents one response to this challenge, and a strategy to provide education for IT professionals in New Zealand at transitional stages in their careers.

2. THE CONCEPTUALISATION OF INFORMATION TECHNOLOGY

While a broader term than Computer Science, and one considered by a range of computing practitioners to describe their industry, Information Technology is an inherently murky term both in industry terms and in academic literature. Howe, er having a clear understanding of what knowledge and capabilities Information Technology encompasses has important implications for the design of programmes and curricula for IT professional education, as well as

having an impact on the types of skills that may be required by the educators.

Insights into the intellectual domain of the IT profession can be gained by considering what specialties could be considered to have a separate professional identity within the IT profession. Denning (Denning, 2001b) identifies over 40 such specialties, characterising them as "IT-specific" (such as computer science and software engineering), or "IT-intensive" (such as E-commerce and MIS) and occupations that are "IT-supportive" (such as network technician and DBA). A consequence of this wide diversity of specialties under the IT umbrella is that IT education needs to span the traditional boundaries of discipline areas such as computer science, information systems, management information systems, information science etc., to provide a common core of capabilities and knowledge.

This notion of the IT crossing traditional discipline boundaries is reinforced when the academic view of IT is considered. For example, from a review of the academic literature, Orlikowski (2001), suggests that there are four distinctly different conceptualisations of IT, each having different implications for how we view "IT artifacts":

- The tool view, where little conceptualisation of technology takes place and it is seen as a "black-box" tool that organisations can use to substitute for labour, increase productivity, enhance information processing or alter social relations. These perspectives typically represent business drivers of industrial research and development activities.
- The computational view which takes the perspective of "technology as algorithm" and emphasises the capabilities of the technology to process and model parts of the world by representing and processing information. This has long informed the computer science discipline.
- The proxy view, which emphasises the perspective of IT being represented by a set of measures. This includes metrics such as users' perceptions, the penetration or "diffusion rate" of an IT artifact within an organisation, or even dollars spent. This is typically the intellectual domain of the information systems discipline.
- The ensemble view includes the perspective of "technology as development project" – this model in combination with "technology as algorithm" could be said to underpin the software engineering discipline.

Another important aspect of IT professionals' knowledge domain with, implications for IT education, is the knowledge embodied in professional practices that have developed as a result of IT professionals engaging in the application of technology and participating in "communities of practice" (Wenger, 1998). For a professional IT degree, then, mechanisms need to exist whereby professional practice is embedded in the curricula and students are encouraged to have fuller participation in "communities of practice" by sharing "their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems" (Wenger, 2000).

3. SCHOOLS OF INFORMATION TECHNOLOGY

As a response to the overlaps and complementarities in such different perspectives on the computing disciplines, the Informatics discipline arose in Europe during the eighties. Denning now notes in the US the "growing movement in Universities to establish schools of Information Technology based upon a common interdisciplinary IT core and offering professional masters degrees" (Denning, 2001a).

Auckland University of Technology has long had a similar view with a unified group of computing specialists, comprising Computer Scientists, Information Scientists or Information Systems Academics, Information Technologists and Software Developers/Engineers. The group has recently been established within a new school of Information Technology.

Within this school there is a strong focus on professional education within the IT discipline, in which both conceptual and professional knowledge are valued. The school has a teaching community with a combined teaching and professional experience base of over 400 years in the discipline. It aims to educate its students through a solid theoretical grounding combined with the best of current and emerging IT practice, and create new knowledge mainly through research that is grounded in a context. For instance associated with the school is the AUT Technology Park in which innovative IT ideas are taken through the stages from concept through implementation to commercial realization in the form of a new IT related product or service.

The Master of Information Technology (M.InfoTech.) programme being reported here is the new professional practice master's degree being offered by the school from 2002. The philosophy of the M.InfoTech. aligns with that of the school, in seeking to educate IT professionals, who are both well grounded in the computing discipline and multifaceted, adaptable individuals.

4. RATIONALE FOR THE DEGREE

Noting the breadth and complexity of the intellectual domain of the information technology profession and the mismatch with traditional discipline-based education, it was recognised that the experience and values embodied in the newly formed school of IT at AUT offered an opportunity to meet the local need for a professional masters degree.

To provide a strong focus for the development of the programme, a clear understanding of the needs of the local environment was sought. This involved a process of consultation with stakeholder groups, including current students, former students, IT employers, faculty within the school, a number of current practitioners, the University's Computing Advisory Committee (an external body comprising several senior IT professionals), and prospective student groups. This consultative process was a hallmark throughout the development of the programme and has involved not just testing and clarifying assumptions regarding the need for the programme, but also the level of demand, the likely student body, the required focus of the programme and the delivery mode.

Four groups of practicing IT professionals with complementary sets of needs were identified from this process:

- Those information technology professionals wishing to update and extend their technical knowledge and capabilities. Much has been written about the half-life of knowledge in rapidly expanding disciplines or about the constant changes in the contexts in which such disciplines are practised. The half-life of knowledge, particularly technical knowledge, in computing-related fields is frequently quoted as being less than five years. In either case the consequence is that practitioners find the technical material they learned in their undergraduate programs becomes dated and needs regular refreshing.
- IT professional wish to increase their skills in management of information technology. In the IT profession practitioners have the opportunity to move quite quickly from technically focused careers into managing technical areas of the enterprise. This brings the need to acquire a wholly different and supplementary set of IT-specific managerial capabilities and skills.

It is expected that these two groups will constitute the majority of students in the programme, however, there are two other important groups of practitioners who would benefit from such a Masters programme:

- IT professionals wish to develop their knowledge and capabilities in research and practice of information technology (many of these would be expected to go onto a research degree such as the PhD), and
- IT professionals who seek a postgraduate qualification as part of a strategy to change their careers or to gain a New Zealand based qualification in information technology.

Substantial flexibility has been designed into the programme to allow these latter groups to participate.

To meet these needs with a suitable programme, a review was undertaken of programmes with similar objectives, both within the computing field and in disciplines with similar characteristics, with the intention of identifying good or best practice. This was complemented by the on-going stakeholder consultation previously mentioned.

The school does have a Master of Business Programme with an IT major, but this assumes a business background and adopts a business and managerial approach to the IT discipline. The M.InfoTech. degree by contrast is designed to complement this programme with a more technically focused degree that would suit practicing IT professionals or students with a stronger technical background. The M.InfoTech. also enables the school to provide a full range of education for IT professionals, from undergraduate degree to the Doctoral programme.

The M.InfoTech. extends opportunities for IT professionals, who see the need to lift their careers to a new level. Generic titles for graduates from this degree could include "IT Manager or Chief Information Officer" for those with more of a managerial emphasis,

or “Software Architect or Chief Technology Officer” for those with a more technical career orientation.”

4.1 STAKEHOLDER FOCUS GROUPS

The use of focus groups has been a key strategy to inform the development team of stakeholders’ views, throughout the development of the programme. A brief selection of feedback from one group is given below.

In one of the focus groups a group of senior IT employers were asked about the key issues facing them, and their implications. Specific questions asked were:

- What are the 3 most important issues facing IT employers today?
- What are the implications of these 3 issues for IT employers?

The responses were then analysed by a process of open coding (Sarkar, 2001), and grouped into clusters representing loose themes. A summary of the responses is shown in figures 1 and 2.

Beneath these themes were more specific issues, for instance employers’ difficulty in finding challenging projects to motivate and retain their high performing staff, increasing employee expectations of employer investment in training, possibly as an element of shared benefit for employees with an eye to a personal skills portfolio as part of a portable career. A very strong theme of volatility and continual change in skill requirements, combined with the need for commercial awareness came through in this session. This reinforced the general approach we had adopted with the design of the M. Info Tech. curriculum, which incorporated both the technical and the professional dimensions, which we had surmised would be vital to IT professionals wishing to lift their careers to the next level.

5. THE AIMS OF THE DEGREE

In addition to the mastery of a body of conceptual knowledge, the masters programme aims to develop graduates who are critically reflective researchers and professionals and can contribute to the ‘communities of practice’ Wenger refers to 1998. Graduates will be expected to demonstrate:

- Advanced knowledge and capabilities in a specialist field of information technology and the ability to apply them creatively and rigorously to new situations and problems.
- The ability to carry out research in information technology and to integrate research findings with practice.
- Rigour in analysis, synthesis and problem-solving
- The ability to critically evaluate the literature in their specialist field, and to rigorously analyse and argue a position.

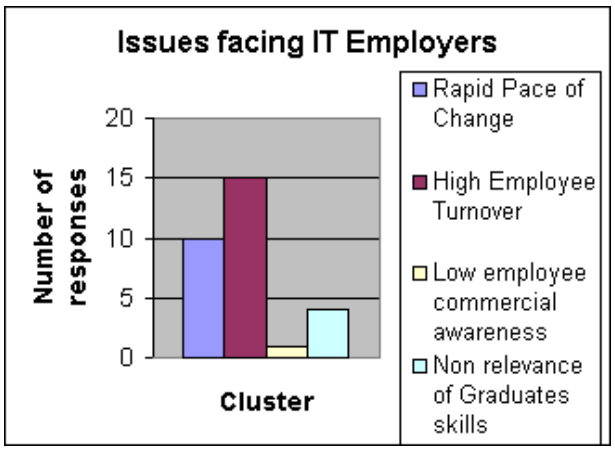

Figure 1. Issues facing IT Employers

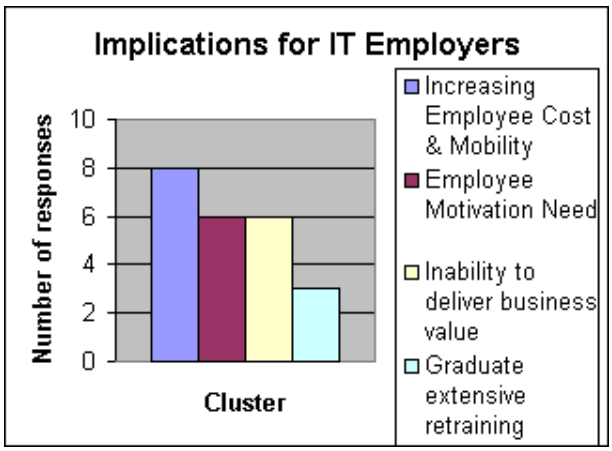

Figure 2. Implications of these Issues for IT Employers

- Independence in learning and an understanding of the need to continue learning as a professional through research and scholarship.
- Excellent oral and written communication skills
- The ability to work effectively as a member of a team.
- The ability to work well with people from other cultures and backgrounds and to be sensitive to different approaches and beliefs.

The emphasis in teaching in the programme therefore is not on the mere transfer and acquisition of content, but on a mode of learning in which students are engaged and active, and in which the learning experience is one of personal transformation.

As a further indication of our expectations of students an excerpt from our M.InfoTech. graduate profile is given below:

"It is expected that an AUT M.InfoTech. graduate will be able to operate at a senior organisational level as a technical leader or manager, with the capability, credibility and judgement to manage significant software development projects and teams of IT professionals engaged in information technology analysis, design, construction, implementation, technical support and service delivery roles. Augmenting their advanced technical prowess, creativity, analytical and conceptual abilities, M.InfoTech. graduates would be expected to develop strong interpersonal and communication skills. They would be expected to provide inspired leadership, coupled with an assertive and principled approach to quality in their practice as an IT professional." (AUT, 2002)

6. STRUCTURE AND CONTENT OF THE DEGREE

In developing the overall structure of the degree programme, experiences from other Universities, insights from ACM graduate curricula in information systems (Gorgone, 1999), curriculum efforts in computer science (Cross, 2001), in software engineering (Bourque, 1998), insights from practice in the management of software development and research projects and teams, and perspectives on the potential student body, the graduate profiles and needs of the New Zealand IT industry, have all contributed to the programme structure and content.

The degree, in common with all New Zealand University Masters Degree programmes involves two years of full time study, but we envisage the majority of the student body being part time students already in employment.

The degree begins with two core subjects representing a full time semester of study:

- Contemporary Issues in Information and Communications Technology (ICT)
- Research Methods.

These have the purpose of grounding students in a common base of knowledge to inform their further study.

The Contemporary Issues subject is in many ways the cornerstone of the programme. It is designed to cover (in some depth, as it would be easy to lapse into a broad superficial treatment) selected key issues in contemporary information technology. These topics are linked thematically and currently include themes such as:

- Convergence (topics such as mInternet, mCommerce, voice XML, interactive TV)
- Business Intelligence (topics such as CRM, intelligent agents, data mining)
- Software Practice (topics such as software forensics, web analytics, extreme programming, biometrics).

The emphasis is on understanding the significance of these emerging technologies from a technological perspective, the potential commercial impact and the possible influence on IT policy and/or management. It is planned that the topics covered will be regularly reviewed for relevance.

Practitioners and industry experts play an important role in the design of the content and delivery of sessions in this paper. The level of industry partner contribution varies widely and includes learning support activities such as preparation of student material, design of selected topics, delivery of lectures and demonstrations, contribution to online discussions and seminars, quality review of students' work, and contribution to course quality reviews.

The subject thus has the role of introducing students to the combined technical and professional

emphasis of the programme, while giving students some insight into possible directions their subsequent studies might take.

The other core paper, Research Methods, has three main aims:

- To provide students with the skills and tools to be able to undertake independent research projects under supervision
- To enable students to be able to conduct and report research in an academic or professional context
- To develop students' abilities to critically evaluate research literature.

There is an emphasis on making links between academic research and professional practice, each informing the other. The need for relevant context for developing research skills and capabilities has been recognized and data sets, case studies and other learning materials are drawn from IT related examples. Industry practitioners, both those engaged in delivering research services to the IT industry, as well as IT professionals involved in research and development, also make an important contribution to this paper.

After the two core papers the degree fans out, with modules from two complimentary tracks, one to develop technical capabilities in the computing discipline and the other to develop leadership capabilities in the profession. Four of these modules would represent a full semester of study. In the design of the curriculum it was decided to ground the computing discipline modules within a context domain, rather than select a particular technology for study. Thus for instance under the "ubiquitous computing" topic the scope for coverage remains broad, and able to adapt as particular technology options evolve. The modules for each track are given below:

Computing & IT Discipline Track

- Collaborative Computing
- Integrating Information Technologies
- Middleware
- Net-centric Computing
- Ubiquitous Computing
- Usage Centred Design

IT Professional Track

- ICT Issues in the Small to Medium Enterprise sector
- Information Technology Strategy and Policy
- Integrating Information Technology and the Enterprise
- Service Relationship Management
- Strategic Information Technology Contract Management

Either track

- Special Topic

Because of the positioning of the degree, most students entering the programme have significant experience as an IT professional. This is certainly true of the first cohort of students where all but one have worked as IT professionals. Formal recognition for this prior learning can be obtained through a cooperative education module, which would enable a student to gain credit for up to one semester of study.

The degree is rounded off by completion of either a dissertation (three quarters of a semester course of study) or a thesis (a full year course of study).

This structure means that all students would complete some technical and some professional papers, they might gain credit for academic reflection upon professional experience, and they would complete a piece of academic research of a moderate to substantial size. There are also options for gaining a postgraduate certificate or diploma after six months or a year of study respectively.

7. DELIVERY STRATEGIES FOR THE DEGREE

In a course of this nature credibility is important. While academics can bring important perspectives in defining and exploring the theoretical bases of the subject matter and in methodologies, it must be balanced by the realities of professional practice. As something of a hybrid degree, with the requirement to jointly address the technical and professional elements for a discerning and skeptical body of practising IT professionals, it was anticipated that credible delivery of the programme is likely to prove a challenging task.

We have adopted a model of partnership - partnership both in terms of development of the curriculum and teaching material and in the delivery. That partnership is between the faculty of the School and senior industry practitioners. Faculty lead the development and delivery teams, and there is extensive use of cross-disciplinary teaching teams sharing expertise, curriculum design, research and curriculum management skills. Experienced practitioners with specialist knowledge and skills, and senior industry professionals appointed as adjunct fellows bring to the courses the credibility that only a twenty year collection of practitioner war stories can bring.

A further challenge with such a target student body is delivering the programme in such a way that it will accommodate the requirements of a demanding professional life. The flexible delivery mode used involves a combination of 2 hour class sessions every second week, complemented with a six hour intensive block each third Saturday of the semester. This delivery is augmented by support through an electronic learning environment. (Petrova, 2001 and Salmon, 2000). This includes provision for submission of work, working in virtual communities to conduct online reviews and group critiques of assignments or readings, communicating with peers and lecturers to support the work of project groups, and download/upload of electronic resources, to supplement face-to-face sessions, or obviate the need to visit the campus to pick up materials.

8. CONCLUSION

It is the educators' challenge to imaginatively and critically interpret the "chasm that separates computing, the discipline, from IT the profession" (Denning, 2001a) and design effective educational programmes that provide the interdisciplinary base that underpins IT professional practice and will lead to better informed action and leadership. The Master of Information Technology offered at AUT has been developed with this specific aim of meeting the need of IT professionals to be life-long learners in this rapidly changing profession. Development of the programme by a team of industry partners and staff with extensive professional and academic experience has ensured that the planned learning and research students experience are grounded in both embodied professional knowledge and conceptual IT knowledge. It is our hope that this will result in graduates who are "theoretically informed pragmatists" with the ability to bridge the "chasm".

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