Defining the ICT Profession: A Partnership of Stakeholders

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Abstract

This position paper describes the stakeholders involved in defining the Information Communications Technology (ICT) profession and initiatives for raising the stature of the profession internationally. A number of recommendations are made. These include using the Skills Framework for the Information Age when writing ICT position descriptions for job postings, and for defining the skills attained by graduates of ICT degree programs. Academic institutions and employers in industry should encourage staff to join professional societies and promote their professional development, giving hiring preference to society members who have been certified professionally. It is also recommended that ICT degree programs focus on employability skills. These should include knowledge and skills from compatible disciplines, such as business, to enhance employability and professionalism for a new generation of ICT professionals in the 21st Century.

Keywords: Professional, Professional Development, Professional Standards, Accreditation, Education

1 Professionalism

It is generally accepted that a professional is one who (Rochester, J, 2001):

- has significant knowledge and skill in a particular domain or discipline;
- is accepted by the community, either through certification, licensing, or general recognition as one who is qualified to practise in that discipline;
- operates with authority and responsibility;
- adheres to a strict code of ethics; and
- is of service to the community.

Clearly, the community views medical doctors and lawyers as professionals.

Do they view Information Communications Technology (ICT) professionals in the same way?

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This position paper describes international initiatives for defining an ICT profession, provides an overview of the stakeholders involved, and puts forward an agenda in which professional societies, academia, and industry work together to define and evolve the profession.

2 International Initiatives

The International Federation of Information Processing (IFIP) (IFIP, 2008a) is an apolitical organization that represents ICT societies internationally. Its recently inaugurated International Professional Practice Partnership (IP3) (IFIP, 2008b) aims to accredit the professional programs of member societies, such that the professional stature of their members are recognised globally.

IP3 has adopted the Skills Framework for the Information Age (SFIA) (SFIA Foundation 2005) as a framework against which the programs from member societies will be judged.

SFIA defines a collection of ICT skills, broadly sorted into a number of categories and sub-categories. The level of autonomy and responsibility at which each skill is practised is defined on a 7 level scale, as shown in Table 1. At level 1, an ICT practitioner works under close supervision. At level 7, a professional sets strategy, and mobilises and influences others.

Table 1: SFIA Levels of Autonomy and Responsibility (SFIA Foundation, 2005)

Level	Autonomy and Responsibility Description
1	Follow
2	Assist
3	Apply
4	Enable
5	Ensure, Advise
6	Instantiate, influence
7	Set strategy, inspire, mobilise

Table 2: Indicative criteria for professional pathways (ACS 2008; Gregor, 2008)

Grade	SFIA Level	Criteria
Specialist	SFIA Level 7: set strategy, inspire, mobilise SFIA Level 6: instantiate, influence	Not yet defined, but likely to include CPEP program, 30 hours of professional development annually, plus a specialist ICT qualification at the postgraduate level.
Certified Computing Professional (MACS CCP)	SFIA Level 5: ensure, advise	Be eligible for MACS PCP status plus other requirements related to indemnity coverage.
Practising Computing Professional (MACS PCP)	SFIA Level 5: ensure, advise	Requirements for MACS plus 30 hours of professional development annually, and CPEP program for those joining ACS after 1 June 2006.
Professional (MACS)	SFIA Level 5: ensure, advise	Completion of accredited ICT degree, plus 4 years work experience in the ICT industry.
Provisional Member	SFIA Level 4: enable	Completion of an accredited ICT degree or demonstrated equivalence.
Associate Professional	SFIA Level 3: Apply	Completion of an accredited ICT diploma plus 2 years work experience in the ICT industry.

3 Professional Societies as Stakeholders

Professional Societies are key stakeholders in defining a profession. They often have an impact on entry to the profession and on the education and professional development of their members.

The Australian Computer Society (ACS) is the principal society for ICT professionals in Australia. It offers multiple professional membership pathways, is responsible for the accreditation of Australian ICT degree programs, and is currently working to revise the Core Body of Knowledge (CBOK) shared by its membership.

3.1 Professional Pathways

ACS membership grades and levels are based on an individual's experience, background, and contribution to the ICT profession (ACS, 2008a). Some of these levels and their indicative criteria are shown in Table 2.

Professional membership typically requires completion of an accredited ICT degree, plus four years of experience working in the ICT industry.

Members may also qualify as a Practising Computer Professional (MACS PCP). In addition to the requirements for Professional Membership, this requires 30 hours of professional development annually, and the completion of the Computer Professional Education Program (CPEP).

CPEP is an on-line postgraduate educational program offered by the Society (ACS, 2008b). It is anticipated that the CPEP program will be accredited under the IFIP IP3 initiative. The program is designed to enhance the business and professional skills of ICT professionals. The completion of three core subjects is required. These currently include:

- Business, Legal, and Ethical Issues;
- New Technology Alignment; and
- Business Strategy and IT.

CPEP students also complete one elective subject. Choices currently include:

- Adaptive Business Intelligence;
- Project Management; and
- IT Services Management.

Additionally, Table 2 shows the intended level of autonomy and responsibility required for each membership level. For example, Specialists generally operate with higher levels of autonomy and responsibility than other professionals, setting strategies and inspiring, mobilising, and influencing other. However, the criteria for this membership level has yet to be determined.

3.2 ACS Core Body of Knowledge (CBOK)

A working party has been established to revise the ACS Core Body of Knowledge (CBOK). This has been expanded to include a framework for defining the skills and knowledge required by ICT professionals in given career roles, and by graduates of accredited ICT programs.

A working white paper detailing the working party proposal has been distributed for discussion. Feedback is currently being gathered, with completion of the process planned for late 2008 (ACS Professional Standards Board, 2008).

The working party proposal is partially illustrated in Figure 1.

A goal of the working party has been to focus the framework on the skills and competencies required by specific ICT career roles. SFIA has been identified as a good vehicle for doing this (ACS Professional Standards Board, 2008; von Konsky *et al.* 2008a). The underlying Core Knowledge Concepts, Role Specific Knowledge, Core Professional Knowledge, and complementary non-ICT domain knowledge that supports the application of these skills are also considered in the framework.

At its heart, the proposal identifies 8 Core Knowledge Concepts that form a required foundation for all ICT professionals. These have been distilled from the overlap in international curriculum as defined for various ICT disciplines including Information Systems, Computer Science, Software Engineering, and Information Technology.

Based on this analysis, the Core Knowledge Concepts shared by all ICT disciplines are (Gregor, 2008):

- IT infrastructure and platforms;
- data and information management;
- networking;
- programming fundamentals;
- human-computer interaction;
- system building and acquisition;
- IT project management; and
- methods and tools for problem solving, abstraction, design, and implementation.

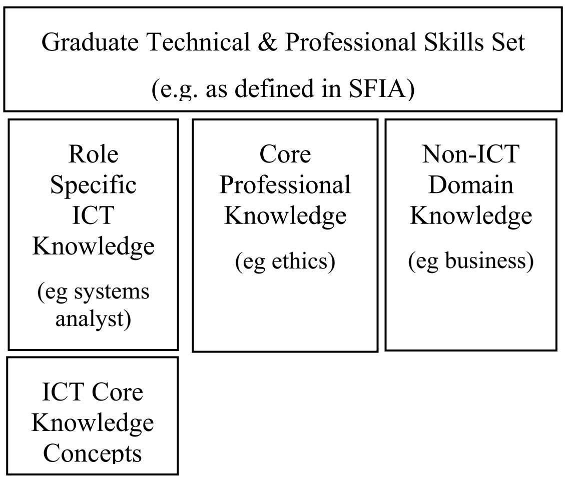

Figure 1: Building blocks showing skills and knowledge areas achieved by graduates of accredited ICT programs (Gregor, 2008).

Core Knowledge Concepts should be complemented with technical knowledge appropriate for an intended ICT career role. Where applicable, this should be identified by a discipline specific body of knowledge. For example, in describing roles that might be undertaken by a software engineer, the Software Engineering Body of Knowledge (SWEBOK 2004) would be used. In those cases where such a body of knowledge does not exist, it is necessary to define the technical knowledge required for the specific role. In both cases, it should be possible to demonstrate appropriate breadth and depth.

International curriculum definitions were also considered in identifying the overlap in essential professional knowledge, sometimes called “soft skills”. This includes knowledge that supports professional skills related to community, group, and individual responsibilities.

Community Level Knowledge includes (Gregor, 2008):

- professional practice;
- historical and social contexts;
- risks and liabilities;
- intellectual property;
- standards; and
- organisational issues.

Group Level Knowledge incudes knowledge supporting teamwork concepts and interpersonal communication skills (Gregor, 2008).

Individual Level Knowledge includes knowledge supporting creativity, problem solving, planning and scheduling, and life-long learning skills (Gregor, 2008).

Additional non-ICT domain knowledge that complements the intended career roles should also be identified on a case-by-base basis. For example, this might include business knowledge or knowledge of science and the environment.

Collectively, all of these knowledge areas and concepts should support the skills and competencies required for the intended ICT career roles, utilising a common framework that is applicable across ICT disciplines.

4 Academia as a Stakeholder

Academic institutions are stakeholders that play a key role in defining a profession. These institutions serve the community and shape public perceptions of a profession through:

- the provision of educational programs that prepare students for a chosen profession; and
- through applied research and consultancies undertaken by academics in collaboration with professionals from allied industries.
- Declining ICT student numbers in the face of the current skills shortage suggests that the ICT profession has an image problem. In particular, universities have largely failed to attract adequate numbers of qualified students to ICT

degree programs and subsequent professional practice.

Anecdotal evidence suggests that this may be due to commonly shared Generation Y misconceptions that:

- employment prospects are limited and less lucrative than other career alternatives; and
- ICT provides tools for communication and entertainment, just as the telephone or television did for their parents, but now common-place technology may not provide the basis for a rewarding or socially relevant career.

This suggests that a new generation of ICT courses should focus academic programs on:

- the skills and competencies that lead to full employment as ICT professionals, rather than on defining course structures based on a list of traditional technical topics;
- the significant and on-going societal and community impact of the ICT profession; and
- content flexibility, recognising that the employability of ICT professionals is enhanced if they possess skills and knowledge from compatible areas like business or science.

Challenges include:

- identifying, articulating, and developing ICT employability skills;
- developing course structures that cross traditional faculty boundaries where appropriate; and
- developing programs that are sustainable, pedagogically sound, and of high quality.

Universities in Australia and elsewhere are beginning to respond to many of these challenges, and to develop course structures that meet the educational needs of a new generation of students (Curriculum 2010, 2008; University of Melbourne; 2008a).

4.1 Professional Skills

In addition to developing technical skills, professional skills should be emphasised throughout the degree program as appropriate.

While it is commonplace to include a dedicated unit on ethics, it is also valuable for students to examine ethics in the context of other subjects throughout their program of study.

For example, when teaching Software Quality Management, it is possible to discuss ethics in the context of a software engineer's ethical responsibility to produce quality products by adhering to well established processes and methodologies (von Konsky *et al.*, 2007). Students can examine relevant questions, such as "*will following a Code of Ethics lead to outcomes that are likely to produce quality software?*" Moreover, teaching ethics in the context of a single unit on ethics may be insufficient, as it

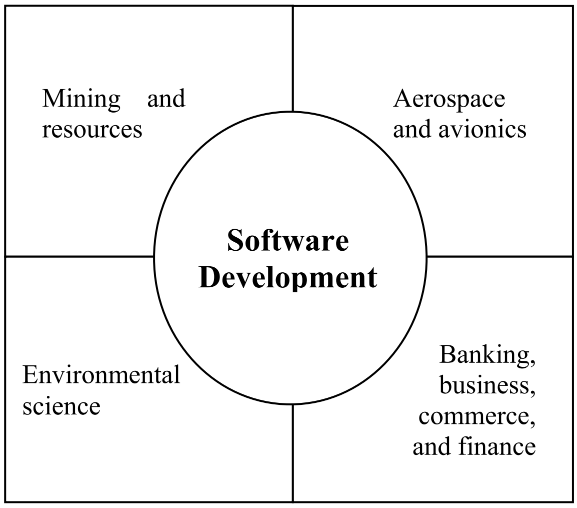

Figure 2: Software Development Professionals and related disciplines

can give the impression that this is an add-on subject of limited use to real professionals.

Work Integrated Learning (WIL) and team-based capstone projects are also a valuable means of preparing students for the workplace and professional practice. This is particularly true if learning experiences and assessment tasks engage student teams in authentic real-world project management activities. In such activities, students utilise teamwork, leadership, and other professional skills, in addition to developing and assessing technical outcomes (von Konsky *et al.*, 2008b).

4.2 Flexibility

Software development projects in industry are usually undertaken to solve a problem in another domain, such as those depicted in Figure 2. Flexible course structures can make it possible for students to take additional subjects of strategic significance, enhancing their employability in a given region. In Western Australia, it is reasonable for students to develop skills and knowledge that will enable them to write software for use in the state's booming mining and resources industry. In Melbourne, it might make sense for students to develop skills and knowledge that better equip them to write software for the banking industry. In Brisbane, given the presence of large avionics and aerospace companies, the employment prospects of software developers might be enhanced if they have specialist skills and knowledge that serve that domain. Generally, companies that develop software are run as a business to make money. Consequently, knowledge of commerce, finance, and accounting are always relevant regardless of where the professional lives or works.

Moreover, courses that are too rigidly defined make it difficult for educational institutions to respond quickly to changes in market demand that are driven by economic swings impacting industries and employment prospects in a given region.

As depicted in Figure 3, a flexible undergraduate course might consist of a block of subjects that introduce students to professional studies, foundation topics, and an

ICT major. Another block of subjects could consist of subjects in the ICT major, which might be in computer science, information technology, or information systems. A third block of subjects would introduce a second major, or electives and options, or several minor courses of study.

Pathways containing various majors that are compatible with further ICT specialisation in a postgraduate program could also be specified.

Such a structure would be consistent in philosophy with that of the Bologna Accord, which provides for a common higher education framework for the European Union. In this framework, three-year generalist undergraduate degrees can be complemented with two-year postgraduate professional qualifications. Examples have traditionally included medicine, law, and engineering.

The University of Melbourne is the first university in Australia to implement the Bologna Accord. In their "new generation" Bachelor of Science (University of Melbourne 2008a), students undertaking the Computer Science Major complete nine subjects leading to the major (University of Melbourne 2008a). Additionally, students would take nine science subjects that complement the major, and six additional breadth subjects. In the sample course plan on the University's web page, computer science majors take subjects in earth sciences, atmosphere and ocean sciences, economics of the environment, and climate change.

Anecdotal evidence suggests that some students choose careers and university degree programs if they perceive that it will lead to a career with societal relevance and impact. In a world where climate change is a major social issue affecting the entire planet, combining environmental science subjects with a Computer Science Major may help some students to consider a career as an ICT professional. This may be particularly attractive to those with the intention of applying technology towards the solution of this important global problem. Perhaps some future professional who undertook the Computer Science Major at the University of Melbourne will utilise advanced ICT skills to successfully simulate viable solutions to the problem of global warming.

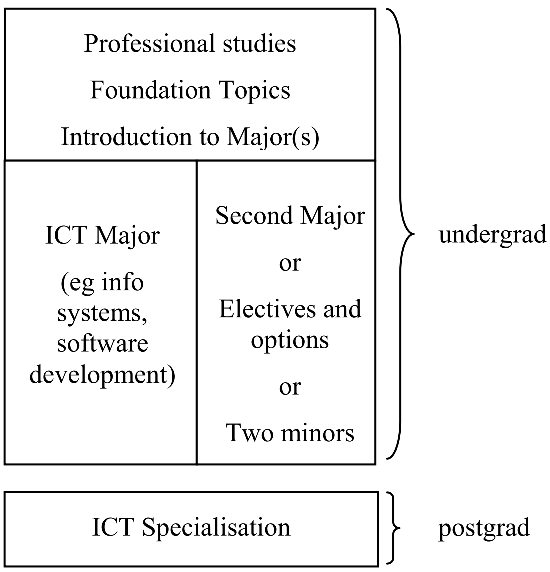

Figure 3: Flexible course structures

5 Industry Stakeholders

The ICT industry is another stakeholder that plays a significant role in defining the ICT profession.

In particular, the ICT industry:

- employs ICT professionals and supports their professional development;
- commercialises applied research originating in universities; and
- designs, implements, and supports the ICT products and services used by allied industries and the wider community.

Public perceptions of the ICT profession are influenced by a number of factors, including:

- the quality of software products purchased or downloaded;
- the ease and speed at which technical problems can be rectified; and
- the introduction of Web 2.0, contributing to a perception of broad public ICT expertise as non-professionals author and access distributed data and media using tools like Wikepedia, Facebook, Myspace, and Google Earth.

This last example highlights another important point. The general public possesses ICT knowledge and skills, which influences their perceptions of the profession. Some working in the ICT industry can be characterised as paraprofessionals, others as professionals, depending on the extent of their knowledge and the level of autonomy and responsibility undertaken.

Similarly:

- parents bandage the skinned knees of their children;
- nurses look after the sick in hospital; and
- doctors diagnose and recommend treatment for patients.

The extent of medical knowledge and skill and the level of autonomy and responsibility with which they practise medicine differentiate these individuals. Society is generally able to differentiate these levels on the basis of a long held understanding of the differences between them.

As a relatively new profession, this common understating is not necessarily held for those working in the ICT industry. What is needed is a framework that helps the public to understand the skills and the level at which they are practised to differentiate between professionals, paraprofessionals, and non-professionals.

SFIA 3.0 Skill Set		
Skill	**Id**	**Level**
Application support	ASUP	5
Business risk management	BURM	5
Configuration management	CFMG	3
Change management	CHMG	5
Database design	DBDS	3
Systems design	DESN	3
Systems development management	DLMG	5
Data analysis	DTAN	3
Systems ergonomics	HCEV	3
Systems installation/decommissioning	HSIN	5
Methods and tools	METL	5
Problem management	PBMG	5
Professional development	PDSV	5
Porting/software integration	PORT	4
Project management	PRMG	5
Project office	PROF	4
Programming/software development	PROG	4
Stakeholder relationship management	RLMT	5
Safety engineering	SFEN	3
Systems integration	SINT	5
Systems testing	TEST	4
Non-functional needs analysis	UNAN	5
Usability evaluation	USEV	4
Service desk and incident management	USUP	5

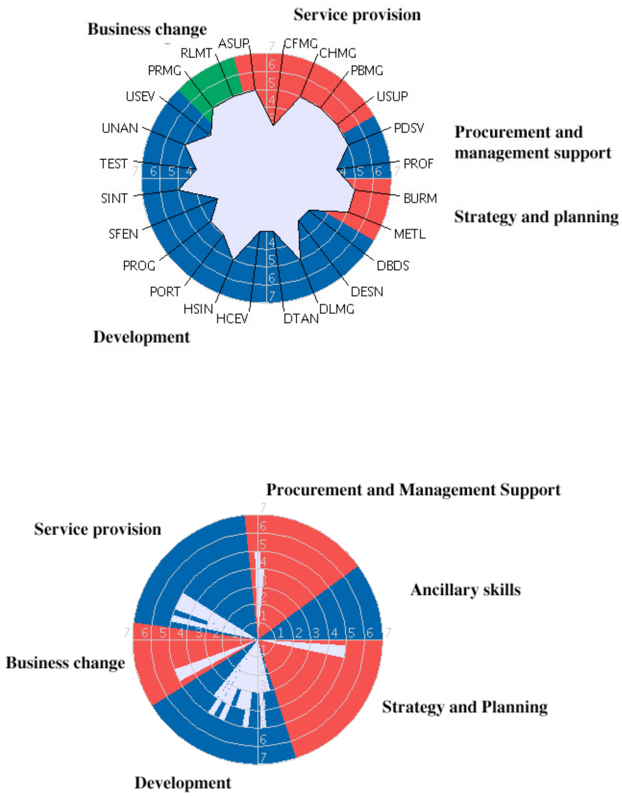

Figure 4: Skill set for a Software Manager job position description (von Konsky et al., 2008a).

SFIA 3.0 Skill Set		
Skill	**Id**	**Level**
Management and operations	COPS	2
Database administration	DBAD	2
Database design	DBDS	2
Content creation	DOCM	2
Systems installation/decommissioning	HSIN	2
Programming/software development	PROG	3
Systems integration	SINT	2
Sales support	SSUP	1
Systems testing	TEST	2
Usability evaluation	USEV	2
Service desk and incident management	USUP	1
Web site specialism	WBSP	2

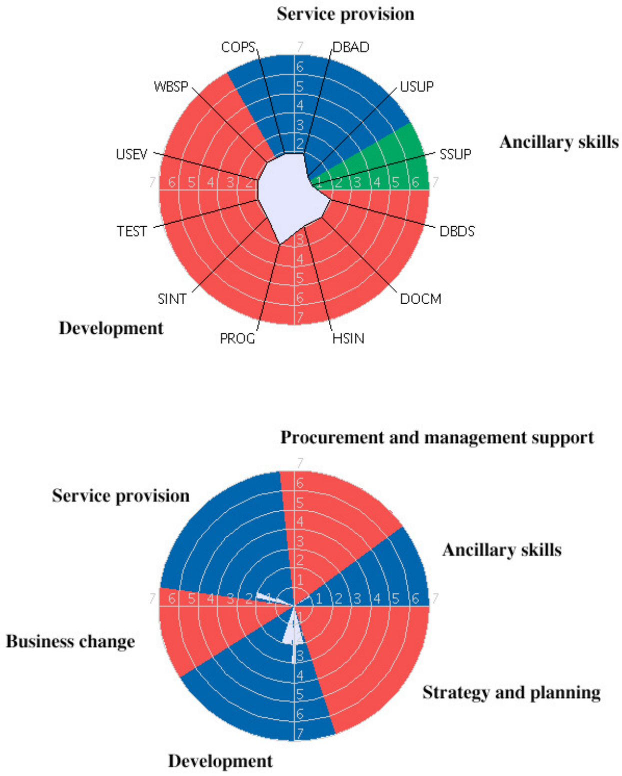

Figure 5: Skill set for Graduate Software Engineering position description (von Konsky et al., 2008a).

SFIA provides such a framework. It can be used to differentiate between ICT professionals and paraprofessionals, and those at different stages of their career and professional development. This is done on the basis of well-defined skills and levels of autonomy and responsibility.

Position descriptions expressed using SFIA for a Software Manager are shown in Figure 4, and for a more junior Graduate Software Engineering in Figure 5. These SFIA-based position descriptions were generated by an organization that develops software-based systems for defence, security, and civil markets. (von Konsky *et al*., 2008a). The goal was to evaluate the suitability of SFIA for this purpose.

The top spider diagram in each figure shows the level of autonomy and responsibility for each skill in the set. The lower diagram in each figure shows the same information, expressed as a percentage of the skills in each SFIA category.

The closer each polygon is to the outer ring, the higher the level of autonomy and responsibility. It can be seen from the figures that the manager has a higher level of autonomy and responsibility, and that the principal duties of the graduate are in the area of software development.

6 Stakeholder Partnership

Effectively, it is the responsibility of all stakeholders to define the ICT profession and ensure that professionals demonstrate:

- a high level of knowledge and skill in ICT, maintained through life long learning;
- ethical practice;
- value for money when offering products or services; and
- service to the community.

Moreover, as a shared definition of the ICT profession evolves in practice, all stakeholders must work together to communicate this common view to the general public.

How can this be achieved?

First and foremost, a common nomenclature for defining the skills required by different ICT career roles should be established. This includes skills for employability developed by student ICT professionals during their university studies, ICT graduates, and more senior ICT manager and specialists. SIFA provides a vehicle for doing this. Indeed, the IFIP International Professional Practice Task Force has set SFIA level 5 as the level at which an IT professional is expected to operate. Professional Societies like the ACS have suggested that SFIA can be used to define skills for specific career roles in its Core Body of Knowledge project (ACS Professional Standards Board, 2008). Although its use is not widespread, the ICT Industry has begun to investigate the use of SFIA in defining position descriptions (von Konsky et al., 2008a). What remains is for academic institutions to adopt SFIA to define the skills attained by students in a given degree program, and that prepare them for employability in the ICT industry.

If academic institutions and industry use the same nomenclature for defining skills, it will make it easier for the general public to appreciate the extent to which jobs are available in the ICT industry when they compare job positions in the weekend newspaper to course descriptions in university promotional literature.

Other means to improve stakeholder cooperation and evolve the profession include the following recommendations:

- Academics, students, and ICT professionals at all stages of their career development should be encouraged to take out professional society membership to facilitate their on-going professional development. In some cases, professional societies like the ACS give discounts to organizations that pay the annual dues of their staff. To a great extent, this can be justified as a means to ensure that ICT professionals remain current in their discipline.
- Industry should give hiring preference to job applicants with professional society membership, particularly those who maintain a status that requires on-going professional development, such as those holding the equivalent of the Practising Computing Professional (MACS PCP) or Certified Computing Professional (MACS CCP) designation from the ACS. On-going professional development and a commitment to a professional society Code of Ethics is a means of reducing organisational risk.
- Academics should work with industry and the community to identify academic research projects, student projects, and Work Integrated Learning experiences with societal relevance and impact. Examples of ICT projects with societal and community impact should be highlighted throughout ICT degree programs as appropriate. Many good examples of such projects exist.
- ICT academics should be encouraged to engage with industry through study leave, consultancy, and other means. While industry experience is expected of undergraduate students through Work Integrated Learning and industry-based projects, many academics have little or no recent industry experience. Industry exposure keeps academics informed on recent developments in their field, keeps their skills current, and informs their teaching in the classroom.
- There should be active involvement of industry representatives in academic programs through the use of guest and sessional lectures, and through industry leadership on course advisory boards. This input should be used to identify knowledge and skills that will foster the employability of graduates, including knowledge

and skills from complementary domains outside of the ICT discipline.

7 Conclusions

Stakeholders in the ICT profession have a responsibility to work together to define and monitor our profession, encourage professional development, and ensure ethical behaviour.

A commitment to professional practice by professional societies, academia, and industry are now well positioned to define our profession, and prepare a new generation of ICT professionals for the benefit of society and the communities we serve.

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