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Abstract

Career outcomes are one of the major influencing factors when applicants are selecting their course. While theoretically, linking curriculum design closely with career outcomes might be an ideal situation, in practice, ICT curricula are in a constant state of flux and it is unclear whether the specified career outcomes for a course were part of the curriculum (re-)design process. SFIA provides a common reference model to communicate the value and relevance of a course to potential applicants and employers. This paper reports on the application of the ACS process for designing an ICT curriculum that is directly informed by the career outcomes relevant to the local and national ICT industry and the necessary SFIA skill sets to attain those career outcomes. Using this approach we are able to illustrate to employers the capabilities of graduates and provide evidence to applicants that the course relates to the advertised career outcomes.

Keywords

ICT career outcomes, ICT skills, SFIA, ICT curriculum

INTRODUCTION

Graduate career prospects are one of the major factors influencing applicants when they select their course. Unfortunately, it is often unclear whether the career outcomes were part of the curriculum development process and there is little evidence that the advertised career outcomes are really attainable by graduates.

Information and Communication Technology (ICT) curricula are in a constant state of flux in response to emerging technology and continuous changes in resources such as staffing levels, student numbers, and juggling the different demands of local and international students and increased specialisation of programs. In attempts to respond to these changing constraints and ever-changing technology it is easy to lose sight of the advertised career outcomes as a focus in any curriculum redevelopment. A study undertaken by Gruba et al (2004) to investigate the drivers of curriculum change discovered that outspoken individuals, budgetary constraints, and student demand rather than academic merit and external curricula predominantly drive change. Henkel and Kogan (1999), suggest that an emphasis on such academic objectives tends not to end in a coherent curriculum but results in a large range of units. While an abundance of units might allow for an abundance of career outcomes, this makes it difficult for students to know exactly which units to take to achieve a desired career outcome. Once a course is completed, graduates find it difficult to identify career outcomes that relate to the skills they have developed (Alexander et al 2010, Nagarajan and Edwards 2008). Furthermore, it is difficult to determine solely on the basis of a graduate's course whether that course contains the relevant skills for a particular career. Calitz et al (2011) stated "universities must link and publish computing programs, linking each program with specific career tracks, indicating specific career specialisation and knowledge".

The Skills Framework for the Information Age (SFIA) is the world's most comprehensive definition of information technology skills and provides a standardised view of a wide range of professional skills needed by people working in information technology. SFIA (2013) provides a common reference model to communicate the value of a course to potential employers, so that they can understand the capability of graduates and understand the value of the course. Likewise it can be used to communicate to potential applicants the usefulness and relevance of the course and provide evidence that the course relates to the advertised career outcomes.

While there have been a few universities using SFIA in curricula (Bailey and Morrell 2011, Streater 2013), there is little literature focussing on how to link career outcomes and skill sets with the development of ICT curricula. This paper is a summary of a process, highlighting how the career outcomes relevant to the local and national ICT industry and how the necessary SFIA skill sets directly informed the development of an ICT curriculum.

Similar to other university ICT courses, attaining accreditation of our course was an essential criterion. The Australian Computer Society (ACS) is our accrediting body, so our development process was strongly guided by the seven-step process for curriculum design recommended by the Australian Computer Society (ACS 2011). Herbert, de Salas, et al (2013), reported on the methodology used to complete the first three steps — the identification of career outcomes, skill sets and the skill level of responsibility, including how feedback from each step was used to develop and refine the list of potential career outcomes and SFIA skills. This particular paper describes how career outcomes and SFIA skills were used as inputs for the subsequent course structure, and the evidence that can be produced to relate the capabilities of graduates to employers, and the evidence that can be provided to applicants that the course relates to the advertised career outcomes.

Our Context

The University of Tasmania (UTAS) is the only university within Tasmania. The School of Computing and Information Systems, as the only ICT School at UTAS, is responsible for developing work-ready graduates for a broad local ICT industry, and for providing research input and collaborations with industry and government. An external school review conducted in 2011 recommended the consolidation of the two existing undergraduate degrees (a Bachelor of Computing and a Bachelor of Information Systems) into a single Bachelor of ICT degree. Additionally, due to a shrinking staff profile coupled with pressure for increased research output there was a recommendation to reduce the number of undergraduate coursework unit offerings from 50 to just 30.

IDENTIFY POTENTIAL ICT ROLES FOR GRADUATES OF COURSE

There is a general consensus that ICT has an image problem at a time when the need for skilled ICT professionals has never been greater, and that there is a lack of awareness of the wide range of career possibilities in ICT (AWPA 2013). A career in ICT is perceived as male-dominated, repetitive, isolated, and focused on the technical rather than the professional (AWPA 2013). To counter this negative and inaccurate perception, and to promote the future growth of the industry, it is essential that the career outcomes for modern ICT curricula reflect the wide and ever-expanding reality of actual ICT careers now available (ACM 2013) and a curriculum is designed such that graduates can attain these careers (von Konsky 2008). The fast-changing nature of technology has implications for ICT careers, as existing career titles and their attendant skill sets are disrupted, transformed or replaced (AWPA 2013).

As our investigation, in 2012, indicated there appeared to be no nationally recognised standard set of career titles and definitions, our first essential step was to identify an externally validated objectively-developed set of ICT career definitions that covered a broad range of careers, rather than one subjectively developed by academics. Our list of career roles was sourced from the Queensland (QLD) ICT Public Sector Development Office (QLD Government 2013) which had developed an interactive ICT career streams diagram. This diagram identifies 55 key ICT careers. Given our constraint of only thirty units it was necessary to identify a subset of the 55 roles that would be career outcomes for our new curriculum. A broad range of career outcomes was required to create a non-specialised ICT curriculum that would meet the needs of local and national industry, have wide appeal, as well as give graduates a range of career options.

To identify a subset, consultation was sought from an academic working party and a range of ICT industry members. To ensure that the new curriculum was not overly influenced by an individual (Gruba et al 2004), a working party was formed consisting of eight academics, heavily interested in teaching and learning with a variety of different characteristics and backgrounds (Herbert, de Salas, et al 2013). Nagarajan and Edwards (2008) encouraged academics to collaborate with industry to incorporate crucial employability elements for graduates as a part of curricula design. We held five forums with local and national ICT industry and government and pre-tertiary educators: three forums near the start of the process to identify career outcomes and skills, and two forums near the end of the process to receive feedback on the proposed final course structure. Over thirty different industry representatives participated, with some overlap with the people that attended the early and late forums. Our attendees represented organisations with varying number of ICT employees from one to thousands. Nearly all had employed graduates into various positions throughout their career; most less than ten, some as high as fifty or more.

Eighteen representatives of the local and national ICT industry and government participated in an exercise to identify career outcomes. They identified 17 careers (out of the 55) for the new curriculum, shown in Table 1. Additionally, the industry members were asked if they had employed in the past or would employ in the future a graduate into the career. The total number of respondents (out of 18) is shown in Table 1. The academic working party identified 24 careers; 15 of which were also identified by industry. ICT Researcher, was not on the ICT careers stream diagram (QLD Government 2013); however, given that one of our constraints was an increase in research output it was added to the list.

In a post-exercise discussion the following relevant considerations to the curriculum design were raised:

- Employers commonly place graduates in a Help Desk Operator career initially to test competence, and if they show ability, they are quickly advanced to a Systems Administrator or Software Developer career.

Table 1: Career outcomes identified by academic and industry representatives

Industry and Academics		*Industry*	*Academics*
Software Designer (12)	Data Modeller (14)	Graphics Designer (9)	ICT Manager (8)
Software Developer (16)	Systems Analyst (12)	Business Analyst (11)	Security Architect (7)
Multimedia Designer (5)	Web Developer (12)		Testing Manager (7)
Multimedia Developer (7)	Security Specialist (10)		Network Manager (6)
Help Desk Operator (11)	Project Manager (10)		Solutions Architect (8)
Project Support Officer (10)	Network Analyst (7)		Games Developer (2)
Database Administrator (11)	Technical Architect (8)		Systems Administrator (10)
Business Process Modeller (11)			Technical Development Manager (7)
			Information Management Specialist (5)
			ICT Researcher

- The decreasing number of applicants for (and graduates from) ICT courses concerned industry. ICT courses continue to rank poorly on the list of preferred courses for applicants for university places. In 2013, the broad field of IT ranked second-lowest of highest preference applications out of 10 fields of education (DIISRTE 2013). Even though very few industry members identified the Game Developer career, they recognised that this career was a strong draw card for applicants and they welcomed the potential increase in graduate numbers it provides. Discussion also took place on the quality of the international graduates and in particular how to improve their communication skills and hence make them more employable in the local industry, as demand for graduates is currently exceeding supply.
- Similar to Pilgrim (2012), industry members believed it was essential that students were exposed to concepts in business analysis and modelling, business process management, and project and change management. Though, they noted that a graduate could not enter into a Project Manager or Business Analyst career without demonstrating a detailed understanding of ICT and how ICT operates within the business.
- The issue of an increased use of off shoring was identified as a possible impact on graduate software developer positions; this was mirrored in a report by NIEIR (2012). Software developer careers related to application development for mobile devices were identified as becoming increasingly mainstream.
- The industry members were in favour of an "all-rounder" rather than aiming for a specific career outcome. Similar to the national findings (AWPA 2013), Tasmanian employers want graduates to have a broad range of skills, with enough technical ICT content, so they have the ability to understand the needs of clients. Those who are too specialised are unlikely to be chosen over a graduate with a broad range of ICT skills.
- The interviewees were insistent that the University produce professionals with the ability to communicate. Interviewees identified that there was no longer room in the industry for graduates who could not relate well to business and clients. Similar claims that Australian ICT graduates are not work ready were cited in AWPA (2013). Pilgrim (2012) noted widespread views of "common deficiencies in the workplace readiness of new graduates particularly regarding the development of essential generic skills such as interpersonal and professional communications, business awareness and problem-solving abilities".
- Industry also recommended that they participate more in the teaching program to bring in real world examples and industry perspectives to the content. Koppi et al (2010), reported that in responses to a recent survey, students requested "greater industry involvement in learning and teaching, up-to-date practical and relevant industry-based technologies and practices, real-life examples, and business knowledge to industry".

IDENTIFY THE SKILLS IN A GIVEN ICT CAREER ROLE

Having identified 27 potential careers to use as a guide for the new curriculum development, the next step was to determine the combinations of skills required for the attainment of these career outcomes by graduates. SFIA (2013) provides a standardised view of a wide range of ICT professional skills. Specifically, it lists 96 professional ICT skills organised into six categories, with each skill being mapped across seven levels of responsibility. In our process we relied on the SFIA skill set to ensure that our curriculum contained the relevant skills that will be expected of graduates when they seek employment, and to ensure that our course appeals to those who wish to be qualified for that type of employment.

The online version of the ICT career streams diagram (QLD Government 2013) is interactive and selecting a role will take the user to further information that clearly defines the career and identifies the SFIA skill set required to perform the career (SFIA 2013). Using each potential career 38 SFIA skills were identified, with 12 skills in the Strategy and Architecture category while only one skill in the Procurement and Management Support category and none from the Client Interface category. When reviewing all the SFIA skills that were not included as a result of the career outcomes identified, we discovered two that we would include: HFIN (Human factors integration) and UNAN (User experience analysis). Both these skills relate to the recommendation in the ACM IT curriculum (ACM 2013) that user-centeredness become a pervasive theme.

Table 2: Identified SFIA skills based on careers chosen and level of responsibility

Category	Code	Skill	Lvl	Career Outcomes
Strategy and Architecture	IRMG	Information management	5	Information Management Specialist
	SCTY	Information security	5	Database Administrator, Security Specialist
	INAN	Information analysis	5	Systems Administrator
	ICPM	Information content publishing	4	Web Developer, Graphics Designer
	CNSL	Consultancy	5	Software Designer, Systems Analyst, Web Developer, Multimedia Designer or Developer, Business Process Modeller, Information Management Specialist, Security Architect, Solutions Architect, ICT Manager, Technical Architect, Project Manager, Network Analyst, ICT Researcher, Technical Development Manager (level 6)
	TECH	Technical specialism	5	Game Developer, Software Designer, Software Developer, Web Developer, Solutions Architect, Technical Architect, ICT Researcher
	BPRE	Business process improvement	5	Business Process Modeller, Business Analyst
	BURM	Business risk management	5	Project Manager
	ARCH	Solution architecture	5	Solutions Architect
	EMRG	Emerging technology monitoring	5	Multimedia Designer or Developer, Security Architect, Technical Development Manager, Solutions Architect, Technical Architect, Network Analyst, ICT Researcher
	SPIM	Software development process improvement	5	Game Developer, Software Developer
	METL	Methods & tools	4	Project Support Officer, Testing Manager, Business Analyst
	RSCH	Research	4	ICT Researcher
Business Change	PRMG	Project management	5	Technical Development Manager, Project Manager
	BUAN	Business analysis	4	Business Process Modeller, Business Analyst
	CIPM	Change implementation planning and management	5	Project Manager
	PROF	Project office	4	Project Support Officer (level 3)
	BENM	Benefits management	5	Project Manager, Business Analyst
	RLMT	Stakeholder relationship management	5	Business Analyst, Project Manager
Solution Development and Implementation	DLMG	Systems development management	5	Technical Development Manager (level 6)
	DTAN	Data analysis	5	Data Modeller (level 3), Business Analyst
	DESN	Systems design	5	Systems Analyst
	NTDS	Network design	5	Network Manager
	DBDS	Database/repository design	5	Database Administrator
	PROG	Programming/software development	4	Game Developer, Software Designer, Software Developer, Systems Analyst
	INCA	Information content authoring	5	Multimedia Designer, Graphics Designer, Multimedia Developer
	TEST	Testing	4	Game Developer, Software Developer, Web Developer, Graphics Designer, Multimedia Designer, Multimedia Developer, Testing Manager
	UNAN	User experience analysis	4	Pervasive Theme
	HFIN	Human factors integration	4	Pervasive Theme
Service Management	ITMG	IT management	5	Network Manager, ICT Manager (level 6)
	FMIT	Financial management of IT	4	Project Support Officer
	CHMG	Change management	4	Systems Administrator, Network Analyst, Network Manager
	SYSP	System software	4	Data Modeller
	SCAD	Security administration	5	Systems Administrator, Security Specialist, Security Architect, Database Administrator
	ITOP	IT operations	4	Network Analyst, Help Desk Operator (level 2)
	DBAD	Database administration	5	Database Administrator
	PBMG	Problem management	5	Systems Administrator

IDENTIFY THE LEVEL OF AUTONOMY AND RESPONSIBILITY DEVELOPED

All the identified skills were reviewed against the responsibility level required in each to determine the extent to which the skill could be developed in the curriculum. The online version of the ICT career streams diagram (QLD Government 2013) also identifies the competency level (referred to as "level of responsibility" in SFIA) for each skill (SFIA 2013). An analysis of our selected career outcomes resulted in needing to develop the skills across five (out of seven) levels. Guided by the ACS recommendation that undergraduate degrees should produce graduates with skills around SFIA level 4 of responsibility (ACS 2011), there were some careers that were selected that had skill levels that were too low or too high for an undergraduate degree:

- The Help Desk Operator role requires SLMO (Service Level Management), and USUP (Service Desk and Incident Management) at responsibility level 2. Help Desk Operator was eventually considered a side-effect career outcome of the degree, and was not seen as a role worthy as a career outcome for a university degree as many students take on these roles before graduation. These skills were not required for any other career and so were removed from the list.
- Technical Development Manager required CNSL and DLMG at level 6, and ICT Manager required ITMG (IT Management) at level 6. Level 5 is the highest that can be achieved within an undergraduate degree. ICT Manager also required SURE (Supplier Relationship Management) at level 6 – our only skill from the Procurement and Management Support category. This skill was not required for any other career and removed from the list.

Table 2 lists the remaining 37 skills (thirteen to level 4, twenty-four to level 5) that will be developed within the curriculum and also includes information about which skill is required for each career.

Using combined insight developed from the previous three stages an informed decision was made about the final set of career outcomes that would guide the curriculum course structure. Given that graduates will find that not all potential careers identified are immediately attainable, we developed categories to distinguish the differences in the attainability of these career outcomes:

- Graduate Roles—all skills would be fully developed and the role is suitable for graduates (though they may need six months of experience to reach the specific competency level);
- Career Roles—all theoretical skills are included and the role is suitable for graduates who have acquired a years experience and shown a detailed understanding of ICT and how ICT works within the business;
- Non-goal roles—all the skills would be developed however the delivery of the unit content and discussion would not be focused towards these particular roles; and
- Partially Qualified Roles—some key skills may be absent or not at the required level in the degree.

Table 3 illustrates our refined and categorised set of career outcomes. In total we have identified 30 career outcomes for our curriculum. The categorisation resulted in the identification of 18 graduate roles that would be immediately attainable by our graduates and would thus be our primary focus in developing the ICT curriculum. In addition, we also identified 6 career roles, 3 non-goal roles, and 3 partially qualified roles.

Table 3: Final categorised career outcomes

Graduate Roles		
Business Process Modeller	Systems Analyst	Graphics Designer
Data Modeller	Network Analyst	Multimedia Developer
Database Administrator	Security Specialist	Multimedia Designer
Systems Administrator	Software Designer	Games Developer
Information Management Specialist	Software Developer	Web Developer
Project Support Officer	Testing Manager	ICT Researcher
Career Roles (After 1 Years Experience)		
Project Manager	Solutions Architect	Network Manager
Business Analyst	Technical Architect	Security Architect
Non-goal Roles		
Benefits Analyst	Animator	ICT Change Manager
Partially Qualified Roles	**Missing Skill**	
Help Desk Operator	USUP, SLMO Level 2	
Technical Development Manager	DLMG, CNSL Level 6	
ICT Manager	ITMG, SURE Level 6	

INFLUENCE OF CAREER OUTCOMES AND SFIA ON CURRICULUM AND COURSE STRUCTURE

Having identified a set of attainable career outcomes and the necessary skill sets to achieve those careers, the next step was to develop a curriculum and course structure that would ensure our graduates would have the relevant skills when they seek employment. By focusing on a set of career goals, we were able to design a curriculum that develops the identified skill sets within a reduced number of units.

As attaining ACS accreditation was a constraint of our new curriculum it was a given that we would include the core ACS curriculum (ACS 2011). This core is based on the Association for Computing Machinery (ACM 2013) curricula recommendations. The ACM along with leading professional and scientific computing communities, have created and continued to update curricula recommendations to the changing landscape of computing technology. The ACM (2013) provides curricula recommendations in five sub-disciplines: Computer Science, Computer Engineering, Information Systems, Information Technology, and Software Engineering. The ACS (2011) core curriculum is based on the overlap of these five curricula.

We determined to use the ACM IT curriculum (ACM 2013) as the basis for our curriculum but to include some aspects from the ACM IS and ACM CS curricula. Henkel and Kogan (1999) suggest**,** when emphasis is placed on employment objectives the resulting curricula are more directed and coherent. We used the SFIA descriptions of each identified SFIA skill to identify the units (subjects) from the ACM curricula specifications that would be required in the new course. Each unit that was included in the final course provided knowledge towards the development of a set of SFIA skills, an extract is shown in Table 4; the full table with all units can be found at CIS (2013) including information on hierarchy and pre-requisite structure of units. For example KIT202 Secure Web Programming works towards the partial development of nine SFIA skills; 22 hours of related material is included in the core of the ACM IT curriculum. Another example is KIT205 Data Structures and Algorithms works towards the partial development of three SFIA skills; 28 hours of related material is included in the core of ACM CS curriculum. The final example is KIT204 ICT Solutions Analysis for Business that works towards the partial development of sixteen SFIA skills; extensive material for this unit was extracted from the ACM IS curriculum.

Table 4: Extract of a table linking our units with the SFIA skills that will be developed within the unit

Unit Code	*Unit Title*	*SFIA code*
KIT101	Programming Fundamentals	METL, PROG, TECH
KIT102	Data Organisation and Visualisation	METL, PROG, DTAN, HFIN, UNAN, ICPM, SCAD, SCTY, INAN, TECH, DBDS, DBAD, IRMG, INCA
KIT103	Computational Science	METL, PROG, TECH, RSCH
KIT104	ICT Architecture and Operating Systems	METL, PROG, ITOP, TECH, SYSP, SCAD, SCTY, PBMG
KIT105	ICT Professional Practices	METL, BUAN, HFIN, UNAN, SCTY, CNSL, RLMT, ARCH
KIT106	ICT Impact and Emerging Technology	RSCH, HFIN, UNAN, EMRG, ARCH
KIT201	Data Networks and Security	METL, ITOP, SCAD, SCTY, TECH, PBMG, NTDS
KIT202	Secure Web Programming	METL, DTAN, PROG, HFIN, ICPM, SCAD, SCTY, TECH, INCA
KIT204	ICT Solutions Analysis for Business	METL, BUAN, DTAN, PROF, UNAN, INAN, PRMG, CNSL, DESN, PBMG, BPRE, RLMT, BENM, IRMG, ARCH, DLMG
KIT205	Data Structures and Algorithms	METL, PROG, TECH
KIT305	Mobile Application Development	METL, PROG, ICPM, HFIN, UNAN, TECH, RSCH, EMRG, INCA
KIT306	Data Analytics	METL, DTAN, RSCH, SCAD, INAN, TECH, DBDS, IRMG, INCA

An extract of the reverse table, that illustrates for each SFIA skill which units those skills are developed within, is shown in Table 5, the full table with all 37 skills can be found at CIS (2013). This table demonstrates that to fully develop a skill a number of units over the full three levels of the course are required, creating a hierarchy. This also illustrates that within our course we have integrated the skills development across a number of units and that we are not merely developing a skill in an isolated unit. Industry indicated that for graduates to be useful, they need to understand how all the ICT content links together as this sort of understanding helps with analysis and understanding the needs of clients. To achieve this content linkage, the development of each skill is spread across a number of units relating the skill to a wide-range of ICT topic areas at all levels of the course.

Our course includes elective units, which either expand on the material in a knowledge area covered in the core (compulsory) units, or introduce new knowledge areas to the curriculum. The elective units are essential building blocks for some career outcomes. Having developed the material for both Tables 4 and 5, we were able to develop Table 6, which is similar to the one in the ACM IS curriculum (ACM 2013), indicating the core and elective units that should be taken by a student for a particular career outcome, the complete table for all identified career outcomes can be found at CIS (2013).

Table 5: Extract of a table linking a SFIA code with the units that provide material to develop the skill

SFIA Code	Unit Codes
BUAN	KIT105, KIT203, KIT204, KIT301, KIT303
DTAN	KIT102, KIT202, KIT203, KIT204, KIT206, KIT301, KIT306
PROG	KIT101, KIT102, KIT103, KIT104, KIT107, KIT108, KIT109, KIT202, KIT205, KIT206, KIT207, KIT208, KIT212, KIT301, KIT302, KIT305, KIT307, KIT308, KIT309
ITOP	KIT104, KIT201, KIT304
HFIN	KIT102, KIT105, KIT106, KIT109, KIT202, KIT206, KIT207, KIT208, KIT301, KIT302, KIT305, KIT311
UNAN	KIT102, KIT105, KIT106, KIT109, KIT203, KIT204, KIT206, KIT207, KIT301, KIT302, KIT303, KIT305, KIT311
TEST	KIT203, KIT206, KIT302, KIT303
SCAD	KIT102, KIT104, KIT201, KIT202, KIT304
SCTY	KIT102, KIT104, KIT105, KIT201, KIT202, KIT304
INAN	KIT102, KIT204, KIT108, KIT303, KIT304, KIT306
PRMG	KIT203, KIT204, KIT206, KIT301, KIT302, KIT303
CNSL	KIT105, KIT203, KIT204, KIT206, KIT301, KIT302, KIT303
EMRG	KIT106, KIT108, KIT109, KIT208, KIT304, KIT305, KIT306, KIT308, KIT309, KIT311
PBMG	KIT104, KIT201, KIT203, KIT204, KIT206, KIT301, KIT302, KIT303, KIT304, KIT311
IRMG	KIT102, KIT203, KIT204, KIT301, KIT302, KIT303, KIT304, KIT306
ARCH	KIT105, KIT106, KIT203, KIT204, KIT206, KIT301, KIT302, KIT303
NTDS	KIT201, KIT304

The following is an outline of the key components of the course structure that were influenced by the career outcomes and skill set information:

- The Bachelor of Information and Communication Technology is a three-year (24 unit) degree. Students complete two majors (8 units each) and a minor (4 units) with the inclusion of at least four units that are electives from any discipline. The structure ensures that all students have the technical, non-technical, and generic professional skills needed, while still affording enough choice to further their individual interests.
- All students complete an "ICT Professional" major. This is a reversed major allowing breadth of professional skills such as teamwork, communication and interpersonal skills, ethics, entrepreneurship, and mathematics within the four introductory level units and it culminates in a capstone project at the advanced level to ensure these professional skills are reinforced throughout the course. In response to the demands for business acumen in our graduates all students will be required to complete units in entrepreneurship, project management, requirements analysis, and business modelling as part of this major.
- Students will choose their second major, "Software Development", or "Games and Creative Technology", based on desired career outcomes. Within these majors there is one compulsory programming unit at each level, with a core mobile application development unit at the advanced level. This structure allows students the flexibility to change major easily should their interests change. The remaining units in the majors vary between majors to give the students specific skills for their chosen career paths.
- There are two pervasive topics embedded throughout the curriculum: security and information assurance, and HCI and user-centeredness. As was noted in the ACM IT (ACM 2013) curriculum, these topics did not seem to belong in a single specific unit. As shown in Table 6, for the skills HFIN (Human Factors Integration), UNAN (User experience analysis), SCAD (Security Administration), and SCTY (Security Information) the development is spread across a number of units relating the skill to a wide-range of ICT application areas at all levels of the course.
- An intermediate level elective industry placement unit is available for students to gain genuine work experience in addition to the core capstone project experience they receive at the advanced level. Pilgrim (2012) noted the importance of introducing work-integrated-learning early in the curriculum, rather than just the capstone units at the end of a course. There is an intention to embed talks by industry speakers throughout all units to relate the content to what the students will later experience in employment.
- Though we have significantly reduced the number of coursework units, there are three additional elective non-coursework ICT R&D project units at all levels of the course. Each year there will also be three additional advanced elective elite units that relate to research focuses in the School delivered by research-intensive staff or research-industry employees. All these units will have pre-requisites that restrict enrolment to the top students; small classes and special experiences for these elite students will hopefully inspire in them a desire to stay to complete higher degrees and pursue a career in research in the field of ICT.
- Many international students are given advanced standing on the basis of prior learning in their own country. This results in them entering at the intermediate level at UTAS and by-passing units that have provided incidental induction to UTAS and which have developed communication and teamwork skills. As a result many are technically competent but are not best able to compete for employment on graduation. A bridging unit will redress this and ensure all graduates have well-developed communication and teamwork skills.

Table 6: Indicates which units to take that develop the skills for a particular career outcome

		Business Process Modeller	System Analyst	Software Developer	Web Developer	Games Developer	Multimedia Designer	Database Administrator	Systems Administrator	Project Manager	Business Analyst	Network Manager	Solutions Architect	Security Specialist	ICT Researcher
Core units in ICT Professional major															
KIT101	Programming Fundamentals		≡	■	■	■	≡						≡		▒
KIT103	Computational Science		≡	▒	≡	■							≡		■
KIT105	ICT Professional Practices	■	≡	≡	≡	≡	≡	≡	≡	■	■		■	■	≡
KIT106	ICT Impact and Emerging Technology						≡						▒		■
KIT203	ICT Project Management and Modelling	■	■	■	■	■	■	■	■	■	■		■		≡
KIT204	ICT Solutions Analysis for Business	■	■	≡	≡	≡	≡		■	■	■		■		≡
KIT301	ICT Project A	■	■	■	■	■	■	■		■	■	≡	■		▒
KIT302	ICT Project B	■	■	■	■	■	■			■		≡	■		▒
Core units in Information Technology minor															
KIT102	Data Organisation and Visualisation		≡	■	■	■		■	■		▒		▒	■	■
KIT104	ICT Architecture and Operating Systems		≡	≡	≡	≡		■	■			▒	▒	■	
KIT201	Data Networks and Security							■	■			■	≡	■	≡
KIT202	Secure Web Programming		≡	■	■	▒		■	■		≡		≡	■	≡
Core units in Software Development major and Games and Creative Technology major															
KIT107	Programming		≡	■	■	■							■		■
KIT205	Data Structures & Algorithms		≡	■	■	■							■		▒
KIT305	Mobile Application Development		≡	■	■	■	▒								
Remaining core units in Software Development major															
KIT108	Artificial Intelligence			≡	▒	■									■
KIT206	Software Design and Development	▒	■	■	■	■	■	■		■	▒		■		≡
KIT303	ICT System Acquisition and Integration	■	■	≡	≡	≡	≡		■	■	■	≡	■		≡
KIT304	Server Administration and Security Assurance			≡	▒	≡		■	■			■	≡	■	
Remaining core units in Games and Creative Technology major															
KIT109	Games Fundamentals			≡	≡	■									
KIT207	Games Design and Production			▒	≡	■									
KIT307	Computer Graphics & Animation: Principles & Prog			▒	≡	■									≡
Remaining coursework elective units															
KIT208	Virtual and Mixed Reality Technology			≡	≡	■	■								≡
KIT212	Games Physics			≡		■									≡
KIT306	Data Analytics			≡	■	≡	≡	■	■		▒				■
KIT308	Multicore Architecture and Programming			≡		■									≡
KIT309	3D Games Programming			≡		■									≡
KIT311	Social & Cultural Issues in Digital Media Technology			≡	▒	■	■								≡

Key

■	Essential unit for this career	▒	Recommended unit for this career	≡	Contains relevant material for this career

Table 6 also shows the complete set of coursework units. We achieved our goal of reducing the number of coursework units to fewer than 30. We have identified the equivalent of 28 coursework units (15 core units, and 13 coursework electives) to cover the core ACS content (ACS 2011) and the skills to the required level. A few units are offered on a two-yearly rotation basis (KIT212, KIT308, KIT309) and two units are being co-delivered with the School of Maths and Physics (KIT103, KIT212). With such a reduced set of units, every one of the units must maximize its contribution by working towards providing graduates with the essential technical and non-technical ICT skills and professional skills to enhance the Tasmanian ICT industry and/or by attracting students into an ICT research career to increase the research output of the School.

The information contained in Tables 4, 5, and 6 will be useful to demonstrate to students the value of a unit towards their future development. This information will be made available within the core unit KIT105 Professional Practices so all students will gain an understanding of how the curriculum content relates to each career outcome and also how skill development towards a career is integrated across a number of units. This will also demonstrate to students the broad range of careers that are available to them if they complete this ICT degree. As this unit is scheduled for their first semester it will also be timely help for students to identify the relevant major and electives units for their chosen careers. The information contained in Tables 4, 5, and 6 will also be useful for employers when reviewing a candidate for a role to identify if they have the necessary skill set. Graduates will be able to identify their SFIA (2013) skill set on their curriculum vitae.

CONCLUSION AND FUTURE DIRECTIONS

Curriculum design is a complex process that must be informed by stakeholders and developed from multiple perspectives. In creating a new ICT curriculum we determined a need to identify those careers that would be attainable by our graduates to guide our curriculum design process. While career outcomes seemed a logical place to commence curriculum design, there were few reports available on using this approach. This paper reports on how the career outcomes, relevant to the local and national ICT industry, and the necessary SFIA skills directly informed the development of, in the words of an external academic review panel consisting of three leading national ICT academics (CIS 2013), a "very coherent, strong, contemporary" ICT curriculum.

Career outcomes and skill sets were identified by a balanced view of academic insight and employer needs, both being further supported by externally validated and industry-standard definitions. Decisions about what to include in the curriculum were guided by these career outcomes and skill sets avoiding the problems of outspoken individuals having undue influence on the curriculum. In focusing on a set of career goals, we were able to design a curriculum, that is aligned with ACM (2013) international curricula and the ACS (2011) core curriculum, that develops the skill set identified within a reduced number of units, allowing time for staff to do research, and still offer a broad range of career outcomes to meet student and industry demand.

Applicants can be assured that the advertised career outcomes are really attainable, and that the curriculum was developed with these career outcomes in mind. Furthermore, employers of our graduates can have confidence that our course contains the relevant skills that will be expected of graduates when they seek employment and by using SFIA (2013), the world's most comprehensive definition of information technology skills, we are able to communicate the value of the course to potential employers, so that they can understand the capability of graduates and understand the value of the qualification.

In 2014 the new curriculum will be implemented and it is proposed to undertake a longitudinal study that investigates the careers aspirations of our commencing students against the actual career outcomes of our graduates. We will also commence work on step seven of the ACS process (ACS 2011), and collect artefacts to demonstrate that our graduates have developed the required skills and capability for the ICT industry.

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