Information and Communication Technology

Academic Standards Statement

"We've arranged a civilization in which most crucial elements profoundly depend on science and technology."

Carl Sagan

Members of

Australian Council of Deans ICT Learning and Teaching Academy (ALTA)

Consultation Draft

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Nature and Extent of Information and Communication Technology

For the ICT disciplines, the following statement has been adapted from The Overview Report [ACM, AIS & IEEE-CS] 30 September 2005 (Joint Task Force for Computing Curricula, 2005).

> In a general way, we can define ICT (Information and Communications Technology) to mean any goal-oriented activity requiring, benefiting from, or creating computers and/or telecommunications. Thus, ICT includes designing and building hardware and software systems, stand-alone and networked, for a wide range of purposes; processing, structuring, and managing various kinds of information; doing scientific studies using computers; making computer systems behave intelligently; creating and using communications and entertainment media; finding and gathering information relevant to any particular purpose, and so on. The list is virtually endless, and the possibilities are vast. ICT also has other meanings that are more specific, based on the context in which the term is used. For example, an information systems specialist will view computing somewhat differently from a software engineer.
>
> A student typically earns a bachelor's degree in one of the main computing disciplines (arguably computer engineering, telecommunications and network engineering, software engineering, computer science, information technology, information systems), often with a named specialisation, to prepare for entry into the ICT profession. Because ICT provides such a wide range of choices, it is impossible for anyone to become proficient at all of them. Hence, an individual who wishes to become an ICT professional requires some focus for his or her professional life. The different kinds of undergraduate degree programs in computing provide different foci and perspectives on the ICT discipline of computing.

Is this statement still complete and relevant? Insert your comments here:

Context for this work

The Tertiary Education Quality and Standards Agency (TEQSA) are responsible for regulation and quality assurance of tertiary education. A key part of defining assessable standards has been to define the generic learning outcomes statements for each degree level through the work of the Australian Qualifications Framework (AQF). Many disciplines and their professional associations have generated statements of assessable academic standards that define the minimum knowledge and skills (competencies) that a graduate of an accredited degree program will possess.

In 2010 the Australian Learning and Teaching Council published the Engineering and ICT Learning and Teaching Standards Statement. This work, led by Professor Ian Cameron and (then) Associate Professor Roger Hadgraft, sought to define the Threshold Learning Outcomes for graduates of Australian Engineering and ICT degree programs. Based on extensive consultation five major domains of capability were determined that were applicable to graduates from both discipline areas. Threshold Learning Outcomes (TLOs) were described in terms of: Needs, context and systems; Problem solving and design; Abstraction and modelling; Coordination and communication; and, Self-management.

In the Learning and Teaching Academic Standards (LTAS) statement Engineering Australia's Stage 1 competencies provide a detailed listing of the areas of knowledge and skill that a graduate engineer will be able to demonstrate at the completion of the program of study. Similarly, the LTAS for

Science and its sub-disciplines also have detailed descriptions. Such a detailed account of threshold graduate knowledge and skills enables effective program design including assessment design that captures learning outcomes examples aimed at assuring program quality and professional accreditation. The LTAS statement for ICT has very high level descriptions which in conjunction with relevant professional documentation from ACS and SFIA might be used to provide more detail.

The Australian Computer Society has compiled the ICT Core Body of Knowledge (CBoK) (adapted from: Gregor, von Konsky, Hart & Wilson, 2008) that represents the knowledge that is fundamental to all ICT programs of study and is shared by all ICT professionals. It is a minimal core expressing the essential areas of knowledge that are likely to be relatively stable over time. With a wide range of potential professional ICT careers it is not intended to represent a complete specification of knowledge needed by an ICT professional.

The core is divided into six sub-components being: ICT Problem Solving (PS); Professional Knowledge (PK); Technology Building (TB); Technology Resources (TR); Services Management (SM); and, Outcomes Management (OM). From sub-components statements relevant skills can be inferred but are not defined. To assist in skills definition the ACS maps the ICT core knowledge components to skills defined in version five of the Skills Framework for the Information Age (SFIA). There are many SFIA skills that are not mapped to CBoK as, at the appropriate level, they represent what business might expect of a graduate in the workplace. These skills, however may be taught, practiced, or assessed in particular ICT programs.

At the ACDICT L&T Forum in 2014 it was determined that the particular Threshold Learning Outcomes for the Information and Communication Technology discipline could be further refined to provide clear academic standards for knowledge, skills, and application of knowledge and skills. The rationale is to aid ICT program design and accreditation processes to assure program quality across the Higher Education sector.

It was also recognized that the ICT profession is one that is changing rapidly with the increasing integration of new technologies into various aspects of life. Change in technology leads to new professional ICT roles which in turn require new skills and knowledge for graduates. In this context a contemporary definition of the Threshold Learning Outcomes for today's graduates drives this document creation.

Threshold Learning Outcome Working Party membership

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Insert your names here:

Threshold Learning Outcomes for Information and Communication Technology

- Question: Are Information Systems, Multimedia, Computer Science, and other related skills and knowledge areas appropriately represented and categorized?
- Are TLO descriptions (left column in table) still adequate and appropriate today?
- Question: Is level 3 (Application) of Blooms the appropriate level to source verb statements for all ICT skill descriptors?
- Question: Is SFIA level 4 the appropriate minimum level of skills for ICT graduates?
- How do SPEC specialized skills get incorporated into this document effectively?
    - Provide details of ACS PBoK (TR) and (TB) knowledge and skills in expanded form (missing from TLOs)

TLO Descriptions	**On completion of a bachelor degree ICT graduates with have the knowledge and skills to:**
Needs, context and systems Identify, interpret and analyse *stakeholder needs, establish priorities* and the *goals, constraints and uncertainties* of the system (social, cultural, legislative, environmental, business etc.), using *systems thinking,* while recognising *ethical implications* of professional practice. ***ACS:*** *(PK) Ethics* *(PK) Professionalism* *(PK) Societal / Legal / Privacy* *(PK) History and status of discipline* *(SM) Service management* *(SM) Security management*	1. Identify, interpret and analyse *stakeholder needs* a. Determine client requirements 2. *Establish priorities* a. Effectively plan and organise activities in a range of contexts. b. Manage time and prioritise activities to achieve deadlines 3. Establish *goals, constraints and uncertainties* of the system (social, cultural, legislative, environmental, business etc.) a. Determine stakeholder privacy and civil liberties b. Determine environmental and sustainability issues c. Determine implications for computer crime d. Determine intellectual property and legal issues e. Interpret how ICT is used and managed to gain benefits in organisational and societal contexts 4. Use *systems thinking* a. Model an organization as a complex system in a complex environment b. Conduct comprehensive systems analyses c. Implement the elements of the software development life cycle 5. Value *ethical implications* of professional practice. a. Apply basic ethics theories b. Conform to professional integrity systems (including the ACS Code of Ethics, the ACS Code of Conduct, ethics committees and whistle blowing) c. Acknowledge the role and limitations of professional integrity systems d. Employ methods of ethical analysis e. Establish ICT-specific ethical issues (professional, e.g. compromising quality and conflict of interest, and societal, e.g. phishing and privacy) 6. Acknowledge *history* and *status* of ICT discipline: a. Acknowledge where and when the discipline began and how it has evolved b. Respond ongoing issues in the discipline

Problem-solving and design Apply *problem solving, design and decision-making methodologies* to develop components, systems and/or processes to meet specified requirements, including *innovative approaches* to synthesise alternative solutions, concepts and procedures, while demonstrating *information skills* and *research methods.* ***ACS:*** *(TR) Hardware and software fundamentals* *(TR) Data and information management* *(TR) Networking* *(TB) Programming* *(TB) Human-computer interaction* *(TB) Systems development* *(TB) Systems acquisition* *(PS) ICT Problem solving*	1. Apply *problem solving, design and decision-making methodologies to d*esign solutions for complex ICT problems 2. Develop components, systems and/or processes to meet specified requirements a. Analyse ICT use in a range of situations and contexts b. Design ICT systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations c. Write design specifications that satisfy formal requirements d. Implement ICT systems, components and processes using appropriate languages and technologies e. Conduct rigorous testing of ICT systems to ensure compliance with user requirements and relevant policies and standards 3. *Employ innovative approaches* to synthesise alternative solutions, concepts and procedures a. Utilize data and information effectively to make informed recommendations and draw coherent conclusions b. Apply discipline specific knowledge and tools to engage in higher-level specialised technical roles. c. Demonstrate ability for high level synthesis and evaluation of experiences 4. Demonstrate *information skills* and *research methods* a. Identify, formulate, research literature and analyse complex ICT problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. b. Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
Abstraction and modelling Apply *abstraction, mathematics and discipline fundamentals* to analysis, design and operation, using appropriate *computer software,* laboratory *equipment* and other *devices,* ensuring *model applicability, accuracy and limitations.* ***ACS:*** *(PS) ICT Problem Solving*	1. Apply *abstraction, mathematics and discipline fundamentals* to analysis, design and operation a. Demonstrate highly developed problem-solving skills b. Apply modelling methods and processes to understand problems, handle abstraction and design solutions c. Creativity and innovation that is required of computing professionals 2. Utilize appropriate *computer software,* laboratory *equipment* and other *devices* for abstraction and modelling processes a. Apply knowledge and skills in novel ways b. Use methods and tools for handling abstraction appropriate to the specific ICT discipline c. Employ technical knowledge to underpin implementation, acquisition or management of IT

as underpinning of other skill and knowledge areas	3. Test *model applicability, accuracy and limitations.* a. Demonstrate critical, creative and analytical thinking
Coordination and Communication *Communicate and coordinate* proficiently by listening, speaking, reading and writing English for professional practice, working as an *effective member* or *leader* of diverse teams, using basic tools and practices of formal *project management.* ***ACS:*** *(PK) Interpersonal communication* *(PK) Teamwork concepts and issues* *(SM) Service management* *(SM) Security management* *(OM) IT Governance* *(OM) IT Project management* *(OM) Change management* *(OM) Security policy*	1. *Communicate and coordinate* proficiently by listening, speaking, reading and writing English for professional practice, a. Conduct oral presentations b. Create written presentations, c. Formulate reasoned arguments and clear explanations d. Conduct technical report writing e. Write user documentation f. Develop and demonstrate effective interpersonal skills g. Conduct communications with sensitivity to cross-cultural issues and international perspectives h. Demonstrate capacity for community engagement 2. Work as an *effective member* or *leader* of diverse teams, a. Engage in productive collaboration b. Manage time and prioritise activities to achieve deadlines c. Align activities within group dynamics d. Apply contextually relevant leadership styles e. Engage in planning for conflict resolution f. Execute conflict resolution g. Engage in activities for team development h. Collaborate using groupware 3. Use basic tools and practices of formal *project management.* a. Demonstrate project management knowledge & skills including those relevant to systems analysis and the software development lifecycle b. Apply frameworks for structuring the interactions of ICT technical personnel with business customers and users c. Align activities with operational concerns of the organisation and could be referred to as 'operations architecture' or 'operations management' 4. Execute Information Systems analysis and design incorporating fundamental governance principles, ICT specific governance issues, & ICT management (e.g. structures to encourage moral behaviour within organisations and corporations, and moral behaviour by organisations and corporations) 5. Conduct organizational analyses, business process analyses, operational culture analyses, organisational change management, business process change management 6. Analyse and design policy and systems that implement computer system security, physical security, operational security, procedural security, and communications security
Self-management Manage own time and processes effectively by *prioritising competing demands* to achieve *personal* and *team goals,*	1. Conduct operations in a professional manner a. Demonstrate relevant expertise b. Acquire appropriate certification c. Demonstrate operational competence d. Act with autonomy

with regular review of personal *performance* as a primary means of *managing continuing professional development.*	e. Pursue goals of excellence f. Accept and meet responsibility g. Operate transparently and accountably h. Demonstrate capacity to take initiative and embrace innovation in responding to change and leadership issues 2. Manage own time and processes effectively by *prioritising competing demands* to achieve *personal* and *team goals* a. Demonstrate capacity for independent action b. Demonstrate own operation with a high level of responsibility to team success c. Set personal goals to align with team goals d. Demonstrate ability to prioritise competing demands on time and resources 3. *Review* personal *performance* a. Reflect on own professional practice b. Set personal development goals 4. *Manage continuing professional development* a. Enhance relevant technical and professional skills b. Prepare for lifelong learning in pursuit of personal and professional development c. Engage in independent and lifelong learning in the broadest context of technological change

Note: TLOs should be expressed in terms of verb statements that are assessable or demonstrable. Avoid terms like: “understands”, “is aware of”, “appreciates”, “recognizes” and “addresses” as they do not accurately define particular levels of knowledge or skill that represent graduate outcomes or that are directly assessable. Consider using Bloom’s Taxonomy of Learning Outcomes as a source of more appropriate verbs and verb statements.

Threshold Learning Outcome XX.X (Expanded)

ALTA 2015 participants to contribute

Threshold Learning Outcome YY.Y (Expanded)

ALTA 2015 participants to contribute

Explanatory Notes on Threshold Learning Outcomes for ICT

To be completed after participant information has been analysed and integrated into Academic Standards statement