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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Australian Council of Deans of ICT

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Nature and Extent of Information and Communication Technology

For the ICT disciplines, the following statement has been adapted from The LTAS Project Engineering and ICT Academic Standards Statement December 2010, The Overview Report [ACM, AIS & IEEE-CS] 30 September 2005 (Joint Task Force for Computing Curricula, 2005) and consultation with ICT Deans 2015.

ICT (Information and Communications Technology) is the umbrella term for a variety of disciplines in which the application of digital technology, the practices and theory of digital processing, storage, retrieval, and communication of information, and the study of the design, construction and use of computer programmes and networks, are used to solve problems. In this way ICT enables society in a dynamic and organic way; the common element being the human interface. Aspects of ICT will be found across disciplines, providing services, creating and innovating, allowing mobility and pervasive computing as part of infrastructure.

From the specifics of manipulating information using available communication technologies to achieve business goals and objectives, of big data storage, analytics, data security, visualisation and performance intelligence, through social and entertainment media, to cloud computing, software engineering, mobile engineering, and hardware design, ICT as a discipline evolves rapidly, driven by technology and changing user demands and practice.

A student typically earns a bachelor's degree in one of the main computing disciplines (including but not limited to computer engineering, software engineering, computer science, information technology, information systems, and multimedia systems), often with a named specialisation, to prepare for entry into the ICT profession. An advantage of a career in ICT is the ability to shift focus and move into a different area of ICT. Undergraduate degrees reflect this by not always providing a specific focus, but rather a broad based approach to ICT in the early part of their degree and later being encouraged to specialise in one or more majors/sub majors.

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 recognised 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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Threshold Learning Outcomes for Information and Communication Technology

TLO Descriptions	On completion of a bachelor degree ICT graduates will have the knowledge and skills to:
1. 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*	1.1 Identify, interpret and analyse *stakeholder needs* 1.1.1 Ascertain client requirements 1.2 *Establish priorities* 1.2.1 Effectively plan and organise activities in a range of contexts. 1.2.2 Manage time and prioritise activities to achieve deadlines 1.3 Establish *goals, constraints and uncertainties* of the system (social, cultural, legislative, environmental, business etc.) 1.3.1 Determine stakeholder privacy and civil liberties 1.3.2 Determine environmental and sustainability issues 1.3.3 Ascertain implications for computer crime 1.3.4 Ascertain intellectual property and legal issues 1.3.5 Interpret how ICT is used and managed to gain benefits in organisational and societal contexts 1.4 Use *systems thinking* 1.4.1 Model an organisation as a complex system in a complex environment 1.4.2 Conduct comprehensive systems analyses 1.4.3 Implement the elements of the software development life cycle 1.5 Value *ethical implications* of professional practice 1.5.1 Apply basic ethics theories 1.5.2 Conform to professional integrity systems (including the ACS Code of Ethics, the ACS Code of Conduct, ethics committees and whistle blowing) 1.5.3 Acknowledge the role and limitations of professional integrity systems 1.5.4 Employ methods of ethical analysis 1.5.5 Establish ICT-specific ethical issues (professional, e.g. compromising quality and conflict of interest, and societal, e.g. phishing and privacy) 1.6 Acknowledge *history* and *status* of ICT discipline: 1.6.1 Acknowledge where and when the discipline began and how it has evolved 1.6.2 Respond ongoing issues in the discipline
2. Problem-solving and design Apply *problem solving,*	2.1 Apply *problem solving, design and decision-making methodologies to d*esign solutions for complex ICT problems

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*	2.2 Develop components, systems and/or processes to meet specified requirements 2.2.1 Analyse ICT use in a range of situations and contexts 2.2.2 Design ICT systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations 2.2.3 Write design specifications that satisfy formal requirements 2.2.4 Implement ICT systems, components and processes using appropriate languages and technologies 2.2.5 Conduct rigorous testing of ICT systems to ensure compliance with user requirements and relevant policies and standards 2.3 *Employ innovative approaches* to synthesise alternative solutions, concepts and procedures 2.3.1 Utilise data and information effectively to make informed recommendations and draw coherent conclusions 2.3.2 Apply discipline specific knowledge and tools to engage in higher-level specialised technical roles 2.3.3 Demonstrate ability for high level synthesis and evaluation of experiences 2.4 Demonstrate *information skills* and *research methods* 2.4.1 Identify, formulate, research literature and analyse complex ICT problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences 2.4.2 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
3. Abstraction and modelling Apply *abstraction, mathematics and discipline fundamentals* to analysis, design and operation, using appropriate *computer software,* laboratory *equipment* and other	3.1 Apply *abstraction, mathematics and discipline fundamentals* to analysis, design and operation 3.1.1 Demonstrate highly developed problem-solving skills 3.1.2 Apply modelling methods and processes to understand problems, handle abstraction and design solutions 3.1.3 Generate creative and innovative design solutions 3.2 Utilise appropriate *computer software,* laboratory

devices, ensuring *model applicability, accuracy and limitations.* ***ACS:*** *(PS) ICT Problem Solving as underpinning of other skill and knowledge areas*	*equipment* and other *devices* for abstraction and modelling processes 3.2.1 Apply knowledge and skills in novel ways 3.2.2 Use methods and tools for handling abstraction appropriate to the specific ICT discipline 3.2.3 Employ technical knowledge to underpin implementation, acquisition or management of IT 3.3 Test *model applicability, accuracy and limitations* 3.3.1 Demonstrate critical, creative and analytical thinking
4. 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*	4.1 *Communicate and coordinate* proficiently by listening, speaking, reading and writing English for professional practice 4.1.1 Conduct oral presentations 4.1.2 Create written presentations 4.1.3 Formulate reasoned arguments and clear explanations 4.1.4 Conduct technical report writing 4.1.5 Write user documentation 4.1.6 Develop and demonstrate effective interpersonal skills 4.1.7 Conduct communications with sensitivity to cross cultural issues and international perspectives 4.1.8 Demonstrate capacity for community engagement 4.2 Work as an *effective member* or *leader* of diverse teams *4.2.1* Engage in productive collaboration *4.2.2* Manage time and prioritise activities to achieve deadlines *4.2.3* Align activities within group dynamics *4.2.4* Apply contextually relevant leadership styles *4.2.5* Engage in planning for conflict resolution *4.2.6* Execute conflict resolution *4.2.7* Engage in activities for team development *4.2.8* Collaborate using groupware 4.3 Use basic tools and practices of formal *project management* *4.3.1* Demonstrate project management knowledge & skills including those relevant to systems analysis and the software development lifecycle *4.3.2* Apply frameworks for structuring the interactions of ICT technical personnel with business customers and users *4.3.3* Align activities with operational concerns of the organisation and could be referred to as 'operations architecture' or 'operations management' 4.4 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) 4.5 Conduct organisational analyses, business process analyses, operational culture analyses, organisational change management, business process change management 4.6 Analyse and design policy and systems that implement computer system security, physical security, operational security, procedural security, and communications security
5. Evaluation and Self-management Manage own time and processes effectively by *prioritising competing demands* to achieve *personal* and *team goals, with regular review* of personal *performance* as a primary means of *managing continuing professional development.*	5.1 Conduct operations in a professional manner *5.1.1* Demonstrate relevant expertise *5.1.2* Acquire appropriate certification *5.1.3* Demonstrate operational competence *5.1.4* Act with autonomy *5.1.5* Pursue goals of excellence *5.1.6* Accept and meet responsibility *5.1.7* Operate transparently and accountably *5.1.8* Demonstrate capacity to take initiative and embrace innovation in responding to change and leadership issues 5.2 Manage own time and processes effectively by *prioritising competing demands* to achieve *personal* and *team goals* *5.2.1* Demonstrate capacity for independent action *5.2.2* Demonstrate own operation with a high level of responsibility to team success *5.2.3* Set personal goals to align with team goals *5.2.4* Demonstrate ability to prioritise competing demands on time and resources 5.3 *Review* personal *performance* *5.3.1* Reflect on own professional practice *5.3.2* Set personal development goals 5.4 *Manage continuing professional development* *5.4.1* Enhance relevant technical and professional skills *5.4.2* Prepare for lifelong learning in pursuit of personal and professional development *5.4.3* Engage in independent and lifelong learning in the broadest context of technological change

Note: ACS shaded areas are included for cross reference only.

Threshold Learning Outcomes Expanded

Discipline Specific Expansion of TLOs

Change in technology leads to new professional ICT roles which in turn require new skills and knowledge for graduates. These requirements also branch into specific disciplines with their own unique TLO requirements. Through consultation with the Australian Council of Deans ICT L&T Forum, ALTA 2015 workshop participants and other ICT academics and professionals, this paper has identified the following disciplines for further expansion of the Threshold Learning Outcomes common to all ICT graduates. This paper aims to categorise and represent the requirement of all the ICT disciplines.

Not all TLOs require discipline expansion. In a large part, the essential knowledge and skills required of graduates for *needs, context and systems* is common across all ICT bachelor degrees, as are *coordination and communication,* and *evaluation and self management,* however *problem solving and design*, and *abstraction and modelling* have some very specific learning outcomes which graduates must satisfy for registration and further study in their respective areas.

The Threshold Learning Outcome working party identified many sub-disciplines that are associated with one or more of the discipline areas. These sub-disciplines were identified as areas of study, not disciplines in themselves, and therefore encompassed in the expanded outcomes at the threshold level.

The expanded TLOs following have been taken from the IS2010 Information Systems, BSC Concepts, and BInf Tech Program Design 0.6, and used as a guide to expanded discipline options.

Information Technology

2.5

2.5.1 Improve organisational processes:

i. exploit business opportunities created by technology innovations
ii. identify and address information requirements
iii. apply current practices in agile systems analysis
iv. design and manage enterprise architecture
v. align IT with business strategy
vi. apply creative, critical and analytical thinking to problem solve complex organisation issues, specifically problem definition, setting goals and objectives, developing potential solutions and testing the viability of solutions
vii. evaluate how organisations can benefit from technology capabilities, converting opportunities created by information technology innovations into sustainable organisational value through systematic processes
viii. liaise and communicate effectively with business clients
ix. analyse and document organisational information requirements at various levels
x. identify and demonstrate organisational forms including an awareness of the impact of new technology on organisations
xi. communicate and report on organisational forms and the role of technology in the enhancement of production and service functions
xii. analyse and design in partnership with the enterprise how to deliver high-quality IT services while adopting a business and customer oriented approach to the delivery of services and cost optimisation
xiii. analyse, design, measure and implement capabilities for aligning IT processes with organisational strategy including specifying an accountability and authority framework for important IT decisions
xiv. report, manage, and control organisational risks that are associated with the use of IT-based solutions, including ensuring that data and IT infrastructure resources are protected from a variety of security threats
xv. evaluate, interpret findings, and communicate trends about mobile technologies and the strategic uses of information technology to achieve a goal of mobilising and networking an organisation's workforce
xvi. propose innovative technical solutions to real-world problems, make informed decisions regarding new and emerging technologies, envisage creative and innovative ways to leverage that technology within business contexts, and demonstrate how technology can deliver value and benefits for all stakeholders

Information Systems

2.6

2.6.1 Developing organisational capability:

i. analyse information needs of an individual, organisational unit, or an organisation in order to determine how information technology-based solutions can best be designed to support these information needs
ii. identify threats and provide high-level solutions for protecting the organisation
iii. manage and control for a variety of organisational risks that are associated with the use of IT-based solutions
iv. identify and design opportunities for IT-enabled organisational improvement
i. align IT strategy and organisational strategy
ii. improve organisational processes with information technology solutions
iii. report on and design the role of information systems in managing organisational risks and establishing controls
iv. identify and exploit opportunities created by emerging technology innovations
v. document information requirements
vi. improving various stakeholders' experience in interacting with the organisation; human-computer interaction

2.6.2 Analyse trade-offs:

i. identify and design high-level solution and sourcing options
ii. analyse and document the feasibility of various options
iii. compare solution options using multiple decision criteria
iv. perform capital budgeting for IT-intensive projects
v. create financial justifications for choosing between alternatives
vi. evaluate cultural differences for options that cross geographical boundaries

2.6.3 Management of people and organisations:

i. design enterprise architectures
ii. identify, evaluate, and procure detailed solution and sourcing options
iii. configure and integrate organisational solutions using packaged solutions
iv. design and implement solutions that provide a high-quality user experience
v. design secure systems and data infrastructures
vi. design and implement applications, application architectures and integrated systems
vii. manage and optimise organisational data and information
viii. design data and information models
ix. manage information systems development/procurement resources
x. manage information systems projects

2.6.4 Managing ongoing information technology operations:

i. manage the use of enterprise technology resources
ii. manage application performance and scalability
iii. maintain existing information systems

iv. manage relationships with technology service providers
v. secure data and systems infrastructure
vi. plan for business continuance

2.6.5 Improving organisational processes:

i. identify the fundamental concepts related to organisational processes
ii. indentify general principles of process analysis in order to apply them to specific situations
iii. analyse existing processes based on interviewing, observation, documentation analysis, and other similar methods
iv. use the very large amounts of data collected by modern organisations can be used to review, redesign, and improve processes
v. identify and capture the essential findings from the large amount of data produced by the analysis process
vi. negotiate solutions that satisfy the political requirements for new processes
vii. customise processes to address cultural and ethnic needs
viii. identify technology capabilities, converting opportunities created by information technology innovations into sustainable organisational value through systematic processes
ix. identify operationally, financially, and technically feasible solution alternatives and the mechanisms through which an organisation can acquire these technology resources
x. model the reuse and building on of existing components (such as modules, reusable objects, databases, information architectures, etc.)
xi. utilise the globalisation of the IS/IT supply chain

Multimedia

Source document required for expansion.

Computer Science

3.4

3.4.1 Computing Architectures:

i. identify the evolution of computing, data representations, processors, machine code, IO systems and memory organisation
ii. apply the concepts and theories of combinatorial and sequential logic to create basic arithmetic, logical and control functions
iii. apply the principles of information theory and error detection in relation to data storage issues
iv. apply instruction sets and assembly language to create small code segments

3.4.2 Program Languages:

i. create programs that apply object oriented and functional programming constructs
ii. demonstrate an understanding of polymorphism, encapsulation, inheritance, and other advanced programming constructs to solve specific problems using industry relevant languages
iii. create software applications for mobile and web platforms

3.4.3 Computing algorithms:

i. create efficient and effective algorithms to solve computing problems
ii. manipulate different algorithmic strategies for problem solving
iii. apply and analyse the behaviour and space-time complexity of a range of sorting, searching, binary tree, graph and parsing algorithms
iv. build database systems and data models
v. evaluate and apply different numerical algorithms for solving scientific computing problems
vi. evaluate and create different algorithms for solving visualisation problems

3.4.4 Operating systems:

i. identify different kinds of operating systems and VMs, their objectives, components, functions, features, and capabilities
ii. exploit the principles of file systems, IO devices, multitasking, multithreading, interprocess communication and synchronisation primitives to create system level software
iii. evaluate the effectiveness of alternate concurrency, synchronisation and interprocess communication techniques to solve specific programming problems

3.4.5 Distributed computing:

i. utilise computer networks, protocols, the operation of the internet and a range of distributed (network) applications
ii. apply concepts of distributed programming to create distributed applications

3.4.6 Discrete structures:

i. map sets, relations and functions
ii. apply basic logic, counting and discrete probability theory to problems
iii. evaluate proofs

3.4.7 Intelligent systems:

i. evaluate and apply machine learning techniques, search strategies and knowledge representation techniques
ii. apply theories relating to reasoning, reasoning under uncertainty and natural language processing
iii. apply principles relating to robotics and intelligent agents
iv. apply principles of machine perception to solve non-textual pattern recognition problems

3.4.8 Data Science

i. apply database storage techniques, DBMS, indexing, query languages and transaction processing relational databases and information management and data mining

Software Engineering

3.5

3.5.1 Software Design

i. create requirement specifications by applying appropriate strategies to identify and analyse criteria appropriate to specific problems, and plan strategies for their solution
ii. create and apply effective test plans by analysing requirements, designs and software implementation and to quantitatively assess software quality
iii. apply project management skills to the software development processes
iv. assess and manage any risks that may be involved in software development projects, or the operation of computing software and equipment within a given context
v. apply knowledge and understanding of essential facts, concepts, principles, and theories relating to computer science and software applications to create system models and high level designs of computer based systems and software and document accordingly
vi. apply knowledge and understanding of software architectures, design paradigms and computer science to solve problems through creating detailed designs and to document these accordingly
vii. apply knowledge and understanding of the principles and theories relating to HCI and design patterns to create and evaluate effective human computer interfaces

3.5.2 Computer Programming

i. apply knowledge and understanding of C programming language and its entire feature set to create robust and non-trivial computer programs that solve specific problems on a variety of platforms

Computer Engineering

Source document required for expansion.

Explanatory Notes on Threshold Learning Outcomes for ICT

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

Application for OLT Seed Grant 2015

Title: **Developing and Validating a New Academic Standards Statement for the ICT Discipline**

A. Project rationale and need for the project

The ICT discipline area is a collection of disparate sub-disciplines (such as: Information Technology; Computer Science, Information Systems, Multimedia, Software Engineering, etc.) each with substantially different graduate learning outcomes. A previous attempt at defining academic standards and threshold learning outcomes for Engineering and ICT in the LTAS project (ALTC, 2010) succeeded in producing quite detailed learning outcome statements for the Engineering discipline, which have been continuously refined, but quite generalized statements and descriptors for the ICT discipline.

Lack of clear academic standards statements creates challenges for designing ICT program learning outcomes and assessment strategies that can validate program quality and be benchmarked with other institutions nationally or internationally. Without standards that define the threshold learning outcomes of graduates from Australian universities the marketplace has limited means to determine their knowledge and skills fit with organizational needs.

All STEM disciplines other than ICT have usable academic standards statements. Engineering Australia developed a clear set of graduate competency statements that detail graduate learning outcomes required for their professional affiliation. The Science discipline, through the Australian Council of Deans Science (ACDS), set out academic standards and threshold learning outcomes statements (ALTC, 2011). These have subsequently been elaborated upon to provide particular detail for each of the Natural Sciences, Physics, Chemistry (RACI) and Mathematics.

Current ICT program design and evaluation is undertaken against the Australian Computer Society (ACS) Professional Book of Knowledge. This document defines knowledge areas but not the learning outcomes and standards. Its focus is mainly on a core body of knowledge relating to Information Technology and Computer Science and does not detail any other sub-disciplines especially relating to ICT in organizations and multimedia. It refers instead to the Skills for the Information Age framework (SFIAv5) which relates skill sets that professionals (and graduates) might exhibit in the workplace. Other source documents refer to curriculum design for institutions and not learning outcomes for graduates.

The purpose of this seed project is to produce and validate a national Academic Standards statement for the ICT discipline area and each of its sub-disciplines with threshold learning outcomes applicable to any ICT Higher Education provider at AQF level 7. In the cases of the Information Systems and Multimedia sub-disciplines it can provide the bases for accrediting frameworks and professional memberships.

Future directions: It would be possible to expand upon the project outcomes in the future to include Threshold Learning Outcomes for AQF level 9. It would also be possible in the future to design a range of assessment types with exemplars that demonstrate the desired learning outcomes. Peer review of assessment and benchmarking can also be extended to international partners to create global networks and reference points.

B. Project outputs (or deliverables)

1. Establishment of a national working party for the development and review of ICT academic standards. Through the Australian Council of Deans ICT Learning and Teaching Academy

(ALTA) preparatory identification of ***a list of collaborators*** for benchmarking has been initiated.

2. Validated *academic standards statement* for ICT. The ***document*** will be modelled on the academic standards documents that currently exist in the other STEM discipline areas.
3. Establishment of an ICT Peer Review of Assessment Network (PRAN). Building upon the work of Dr Sara Booth and the OLT supported Peer Review of Assessment Network framework, with members and associates of ALTA, a national review ***network for external peer review of assessment items and regimes*** will be initiated and operating parameters set and tested.

4. ***Documented process*** for using the ICT academic standards statement to benchmark WIL and capstone units in ICT degrees across institutions.

5. ***Guidelines for application of academic standards*** statement to the design of ICT programs and unit assessments

6. ***Validation statement*** for academic standards statement and review processes by national professional accrediting body (ACS).

7. OLT ***Final project report***

C. Project impact

1. *What indicators exist that there is a climate of readiness for change in relation to your intended project?*

There is a combination of factors indicating a positive climate of readiness for change in relation to this project. First, the development of academic standards is a priority area for the OLT. Section 5.5 of the Higher Education Standards Framework requires standards for achievement of students within a discipline and for benchmarking courses/programs against similar accredited courses of study. Similarly, assessing equivalence of qualifications and learning outcomes is an OLT priority area. Without an academic standards statement for the ICT discipline this is difficult to achieve. For TEQSA auditing purposes, national academic standards make the achievement and validation requirements clear and transparent. The Australian Council of Deans ICT has initiated a focus on creating and academic standards statement for the ICT disciplines and has appointed the Chief Investigator to lead the initiative.

2. *In brief and indicatively, what impacts (changes and benefits) do you expect your project to bring about?*

This section is related to the areas of impact identified in the IMPEL framework. Due to the nature of the project and its particular application to programs some of the organization level and opportunistic impacts are either unlikely or difficult to gauge at this stage.

Changes for project team members will include a deeper understanding of the nature and detail of academic standards and threshold learning outcomes for the ICT discipline areas. Through academic standards development and deployment the project team will provide academic engagement and leadership at local and national levels. The individuals involved will have their names associated with a national standards document and related documentation for dissemination as outlined in the deliverables statement above. For a senior academic leadership and evidence of participation on a national project represents significant service to the profession and the organization. It is expected that the project report and the standards document will be cited in scholarly works internationally.

Changes for students as a consequence of the development of academic standards by the project team, and through adopting institutions, relates to assurance of quality of learning through application of standards and benchmarking to program and assessment design. This will have impact upon student employability and recognition of transferability of learning outcomes in a national and international marketplace.

Adoption of academic standards and benchmarking of learning outcomes will initially be trialled at the institutions of the project team and validated processes disseminated through existing networks such as ALTA, an ICT Peer Review of Assessment Network (ICT_PRAN) and OLT reporting. It is expected that impacts will be systemic in terms of course/program design and ongoing validation processes for all participating organizations and ultimately all providers of AQF level 7 ICT degrees. This equates to impacts particularly at levels 1, 2, 4, 5, 6 and 7 on the IMPEL framework.

An immediate impact will be to apply for OLT funding to assist with leading the embedding of academic standards and peer review of assessment at a broad range of institutions.

3. *What are your strategies for engaging with stakeholders throughout the project?*

Project team: It is anticipated that participants and stakeholders will be engaged at monthly project meetings to discuss strategies and actions, report outcomes and milestones against the project plan. The meetings will be conducted using a mixture of face to face and electronic media as agreed by stakeholders and as appropriate to needs. Communications of project developments, documents, ideas and actions will be executed via email and networked directories. Face to face meetings will be organized to implement working parties relating to evaluating program documentation against developed standards and trials of peer review of assessment.

External stakeholders: Initially, external stakeholders will be self-nominating members of ALTA who have agreed to review the draft standards and documents produced. Initial communications between the project team and institution-based working parties will be electronic until face-to-face meetings are required. Such meetings will be conducted for trial evaluation of the benchmarking process and to sight evidence of assessment quality and appropriateness.

4. *How will you enable transfer that is ensuring that your project remains impactful after the funding period?*

At a minimum, it is proposed that the ICT Academic Standards and Threshold Learning Outcomes statement, the project reports, guidelines and related documents will be published electronically via the OLT website, the ACDICT and ALTA websites, and project partner university websites. If appropriate, social networking will be implemented as well as a mobile application for the use of organizations engaged in peer review and standards implementation. Impact will be ongoing through the regular actions of program reviews, peer reviews of assessment and other activities that will accredit and benchmark against the standards at provider institutions. As part of the project, a regular review of the standards statement that involves the ACDICT and professional accrediting body(ies) will be proposed.

5. *What barriers may exist to achieving change in your project?*

Currently there is a high level of support for this project at the national level so barriers will most likely occur at the institutional and individual levels.

Institutional barriers may occur if academic standards are too divergent from the particular organization's program learning outcomes. There will be organisations that do not enjoy an open benchmarking culture that may resist change. By creating a broad set of threshold learning outcomes with broad approval, and by including as many organizations' representatives as possible in their design and validation these aspects can be minimised. Similarly, by making sure that there are very strong value statements for organisations to engage, that activities are aligned to national

and professional priorities, strong local leadership, and open assistance to engage then change can be enabled.
Individual barriers may occur through disagreements over aspect of the standards or the processes designed for their use, levels of inclusion of individuals, distances, time differences, communication effectiveness, and individuals' workloads. By collaboratively negotiating barriers and including as many stakeholders' views as possible, as early as possible, it is anticipated that general agreement can be reached. By ensuring that such engagements are personalised and generative of enthusiasm Project progression barriers may be encountered with respect to timely dissemination of materials; timely completion of websites; timely access to personnel; and similar factors. By employing effective project design and management skills these can be minimised.

6. How will you keep track of the project's impact? What analytics may be useful?
The project's impact will be tracked through a range of quantitative and qualitative means. In the quantitative arena impact can be gauged through:

- number of institutions implementing academic standards in their programs
- number of schools or programs seeking, acquiring or reviewing their "academic accreditation"
- number of institutions involved in peer review of assessment and benchmarking
- register of institutions engaged in standards implementation and benchmarking
- number of requests of team members to facilitate benchmarking or assessment design and evaluation
- number of downloads of project report, links to project website, views of website
- number of downloads of mobile application (if appropriate)
- number of positive responses through social media (if appropriate)
- number of citations in scholarly literature of the project report, academic standards and related documents

Qualitative statements will be collected from team members and organizational representatives implementing standards, benchmarking and peer reviews of assessment. Project websites, related instruments and apps will be enabled to provide comments and feedback. In important impact measure will be the level of integration into professional bodies' accreditations, memberships, and certification schemes.

7. How will you maintain relevant project materials for others to access after the project is completed?
It is envisioned that we will engage with relevant national bodies including, Australian Council of Deans ICT (ACDICT), ACDICT Learning and Teaching Academy (ALTA), Australian Computer Society (ACS), and partner universities to maintain websites linking to a central repository of project materials. To ensure an ongoing quality statement and user needs the feedback that is received on documents and processes will be presented for review by the ALTA to determine updates and interventions.

D. Project approach

Initial engagement with the academic standards development process has been through the Australian Council of Deans of ICT Learning and Teaching Academy (ALTA). At a national workshop presented to ALTA forum in May 2015 the CI engaged the participation of 19 academics and academic managers from diverse organizations as potential project team members and reviewers of draft standards as they are developed. This level of collaboration at an early stage is significant and bodes well for developing further engagement and project success.
The proposed approach for the project will undertake the ***steps*** below as follows:

PROJECT PLAN	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
1. Form a working group through ACDICT and create contacts for collaboration on developing and reviewing a draft academic standards statement for ICT												
2. Engage a research assistant to assist with document production and development												
3. ***Project output #1*** *– National working party* National working party for the development and review of ICT academic standards.												
4. Review relevant extant documents including academic standards and threshold learning outcomes statements from ICT and other discipline areas to develop a draft working document												
5. Refine the draft standards through working group reviews												
6. ***Book test site visits*** for trial applications of the academic standards and applying peer review of assessment												
7. Develop a ***human research ethics application*** to enable the collection of case data relating to evolving the academic standards, peer review processes, and related documents at partner institutions and with professional bodies												
8. V***alidate the draft document with ACDICT*** to identify and minimise professional risk												
9. ***Validate the academic standards statement*** with the professional accrediting bodies (ACS & EA) and relevant academic and industry associations (ACPHIS, AIMIA, ACM, AIIA) – case study												
10. ***Project output #2*** *– ICT Academic Standards document* Validated *academic standards statement* for ICT, modelled on existing STEM discipline academic standards documents												
11. Initiate a national ICT Peer Review of Assessment Network												
12. ***Project output #3*** *– Network for external peer review of assessment items and regimes (PRAN)*. Building upon the work of Dr Sara Booth and the OLT supported Peer Review of Assessment Network framework												
13. Design documentation (processes & instruments) for undertaking case studies into peer review of assessment												

(Refer to RACI process and tools)												
14. **Execute** trips to partner institutions, validate the academic standards statement, processes and instruments, through peer review of assessment of WIL and capstone units between 3 partner organizations (case studies) • Visit site A (with representative from GU and site B) to 'test' academic standards and evaluation process (collect case data) • Visit site B (with representative from GU and site A) to 'test' academic standards and evaluation process (collect case data) • Visit GU site (representative from site A and site B) to 'test' academic standards and evaluation process (collect case data)												
*15. **Project output #4** – Documented process and instruments for using ICT Academic Standards to benchmark program learning outcomes*												
16. ***Design*** a mobile application or other mobile tool (if appropriate) to expedite program evaluations and peer reviews of assessment												
17. **Compile** guidelines for application of academic standards to the design of ICT programs and unit assessments												
18. **Create** a list of exemplar assessment item types and achievement that would demonstrate threshold standards												
*19. **Project output #5** – Guidelines document for application of academic standards to program and assessment design*												
20. Submit documentation to ICT and Engineering professional accrediting bodies for validation of academic standards, guidelines and review processes												
*21. **Project output #6** – Validation statements from professional accrediting bodies*												
22. Compile and submit the project report												
*23. **Project output #7** – Final project report*												
24. Engage project partners in dissemination of aspects of the project through scholarly, peer reviewed literature (journals, conferences)												

Site visits: Three universities have been nominated as sites for the testing and review of the draft academic standards statements, procedures and instruments for benchmarking program learning outcomes and assessments. Each site visit will involve one representative from each of the other two partner universities working with the site team over a day to review learning outcome exemplars. The three sites, and initial members of site teams are:

- Site 1 (Griffith University - QLD): *Steve Drew (GU), Wayne Pullan (GU), Ruben Gonzales (GU), Vallipuram Muthukkumarasamy (GU)*
- Site 2 (Central Queensland University - NSW): *Roger Hadgraft (CQU), Ergun Gide (CQU)*
- Site 3 (Federation University - VIC): *Richard Dazeley (Federation), Barbie Panther (Federation)*

Document reviews: ALTA members representing a wide range of universities and ICT programs have agreed to be document reviewers for the purposes of ensuring the ICT academics standards statement are as complete as possible. These people will also validate instruments and processes and be the initial members of the ICT Peer Review of Assessment Network.

Wanli Ma (UC), Chris Johnson (ACDICT), James Hamlyn-Harris (Swinburn), Jo Caldwell-Neilson (Deakin), Simon (Newcastle), Ann Nicholson (Monash), Peter Sutton (UQ), Brad Alexander (UAdelaide), Peta Wyeth (QUT), Wayne Pullan (GU), Ruben Gonzales (GU), Vallipuram Muthukkumarasamy (GU), Roger Hadgraft (CQU), Ergun Gide (CQU), Richard Dazeley (Federation), Barbie Panther (Federation)

To facilitate Australian Computer Society (ACS) and Engineers Australia's (EA) reviews of the academics standards there are several ACS representatives in ALTA (two in the reviewer list) and one from EA.

E. Project team and governance

Dr Steve Drew, Project Leader (Griffith University)

Dr Steve Drew is Director L&T for the Griffith Sciences Group at Griffith University with particular responsibility in leading change in STEM program, learning and teaching quality. He has a PhD in Computer Science (QUT) and Master of Higher Education by research. He is currently an executive member of the ACDICT Learning and Teaching Academy (ALTA) leading a portfolio to develop academic standards and benchmarking of learning outcomes in the ICT discipline. Steve has several university level L&T awards and has successfully led 3 University level strategic L&T grants in the areas of Embedding Peer Observation of Teaching and e-Learning Development and Support environments.

Dr Barbie Panther, Project Team Member 1 (Federation University)

Dr Barbie Panther is the Associate Dean for Learning and Teaching in the Faculty of Science and Technology at Federation University. She has published on science education and curricula and is an expert in online and technology enhanced learning. She is also an award winning teacher having received a number of awards including an OLT Citation for Outstanding Contribution to Student Learning. Dr Panther was involved in the process of development of the TLOs for chemistry and has significant leadership experience in curriculum development.

Adjunct Assoc. Prof. Chris Johnson, Project Team Member 2 (ANU)

Dr Chris Johnson is incoming Executive Officer for ACDICT. He was previously Associate Dean (Education) in ANU College of Engineering and Computer Science 2009-2012, Teaching and research academic, Head of Department, at Monash University, UNSW Duntroon, ANU 1983-2013. He is a senior member of the Australian Computer Society and has variously been

panel chair, panel member and visit manager (analysis and reporting) for ACS Professional Accreditation 2002-2015. He was Director Academic Board of Computer Science, ACS 2009-2012 and a previous investigator in OLT Commissioned Research Grant, Plagiarism and related issues in assessments not involving text (Ref: SP12-2312) 2012-13.

Assoc. Prof. Vallipuram Muthukkumarasamy, Project Team Member 3 (Griffith University)

Dr Muthu is the Deputy Head of School (L&T) for the School of ICT at Griffith University. He is responsible for program, learning and teaching quality at the school level and currently leads a team of program directors through program and school reviews. Dr Muthu has received many L&T commendations, awards and grants at the University level.

Project Reference Group

Assoc. Prof. Tanya McGill (Murdoch University)

Dr Tanya McGill is Associate Professor, Information Technology, and Head of Information Technology discipline in the School of Engineering and Information Technology at Murdoch University. Tanya has research interests including e-learning, end user computing and information technology education. She is author of over 100 journal articles, book chapters, and articles in conference proceedings. She was project leader for a successful ALTC priority project grant: 'Addressing ICT curriculum recommendations from surveys of academics, workplace graduates, and employers'. 2009 ($215,000).

Dr Sara Booth (UTAS)

Dr Sara Booth has a background in learning and teaching, originally based in the Faculty of Education, at the University of Tasmania (UTAS). She has received various University level L&T awards and fellowships. From 2009-2011 she led and coordinated three institutional-wide benchmarking projects for UTAS which included formal benchmarking partnerships with the universities of Wollongong (UOW) and Deakin. In 2011-2012, she facilitated the involvement of UTAS in two Australian academic standards projects (Teaching Standards Project and the ALTC Inter-university Moderation Project). She also led the testing and coordination of an institutional wide project on UTAS Academic Standards during 2012.

Professor Roger Hadgraft (CQU)

Professor Roger Hadgraft has more than 20 years involvement in leading program renewal in engineering education, with a particular focus on problem/project-based learning (PBL) supported by educational technology, at RMIT, Monash and Melbourne Universities. He is an Australian Learning and Teaching Council Discipline Scholar in Engineering and ICT, having co-developed the draft national academic standards for the discipline (the Threshold Learning Outcomes). He is a passionate advocate of national and international cooperation in engineering education, particularly the sharing of best-practice learning materials. Roger is currently Deputy Dean, Learning and Teaching, in the School of Engineering and Technology at CQ University at the Melbourne Campus.

F. Project budget

Estimate based on airfare comparisons for a range of Australian destinations. Lead institution will cover printing and office consumables costs for meetings.

		Budget Year 1

		OLT	*Other $*	*Total $*
A.	**PERSONNEL**			
	Casual Research Assistant / Project Administrator - RA1.2 @ $50.17/ hr (inc 25% on-costs) x 44 weeks x 10hrs	22,074		22,074
	Project Leader – Level C @ $65/hr x 4hr x 48weeks (in-kind)		12,480	
	Project member 1 – Level C @ $65/hr x 6hrs/month x 12 months (in-kind)		4,680	
	Project member 2 – Level D @ $75/hr x 6hrs/month x 12 months (in-kind)		5,400	
	Project member 3 – Level D @ $75/hr x 6hrs/month x 12 months (in-kind)		5,400	
	Sub total for section A	**22,074**	**27,960**	**50,034**
B.	**PROJECT SUPPORT**			
	Catering			
	- **Site visits x 3**	450		450
	Report production (pdf) – **RA1.2 @ $50.17/hr (inc on-costs) x 15 hrs**	760		760
	Web development – **RA1.2 @ $50.17/hr (inc on-costs) x 20hrs**	1010		1010
	Sub total for section B	**2,220**		**2,220**
C.	**PROJECT ACTIVITIES**			
	Site visits x 3 – (2 visiting assessors) includes airfares, taxis, meals & accommodation @ $2000 per visit per assessor	12,000		12,000
	Sub total for section C	**12,000**		**12,000**
D.	**OLT COMPULSORY ITEMS**			
	Editing costs**	1,000		1,000
	Sub total for section D	**1,000**		**1,000**
E.	**INSTITUTIONAL OVERHEAD LEVY** **@ 10% x (B + C + D)**			
	Sub Total	**1,522**		**1,522**
Total per Stage/Year		**38,816**	**27,960**	**66,776**

	OLT	**Other**	**Total**
TOTAL PROJECT BUDGET #	*38,816*	27,960	66,776

G. Budget Justification

Personnel:

There are 5 budget lines in this section.

- OLT funding will be used employ a research assistant / project administrator who will undertake literature review, document production and reporting.

- In-kind support for the project leader is estimated at 4hrs per week for 48 weeks @ academic Level C
- In-kind support for the project team members 1 to 3 is estimated at 6 hrs per month at the relevant academic levels. The time is estimated based upon 2hrs per month attending project meetings, 2 hrs per month document reading, reviewing and reporting, and 2 hrs per month engaged with site visit matters.

Project support:

There are 3 budget lines in this section:

- Catering (morning tea & lunch) will be provided at each of the 3 site visits and is estimated at $150 per visit
- Report production will require an RA with media skills to create an effective presentation of the report outcomes and recommendations
- Web development will require a suitably skilled individual to create a project website that is suitable for a high quality outward facing presentation.

Project activities:

There is 1 complex or compound budget line in this section:

- Each of 3 site visits will involve 2 project personnel travelling to a site to conduct reviews of programs and assessment items as 'mock' evaluations against the draft academic standard. Personnel will travel to the location on the day before the site visit, stay overnight, conduct the site visit the following day and return home at the end of the second day. The $2000 per person per visit ($4000 per site visit) is based upon an estimate of:
    - Return economy airfares (Virgin Flexi fare) Coolangatta – Melbourne – Coolangatta ~$1400 + Taxi fares ~$250 + Accommodation ~$160 +Meals ~$100 = ~$1910 + error margin → $2000

OLT Compulsory costs

There is 1 budget line in this section:

- Editing of final report before dissemination

Institutional overhead

There is one budget line in this section:

- Calculated as 10% of sections B, C & D to cover costs of administering the project funds and payments