ACS CORE BODY OF KNOWLEDGE FOR ICT PROFESSIONALS (CBOK)

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Skills Framework for the Information Age
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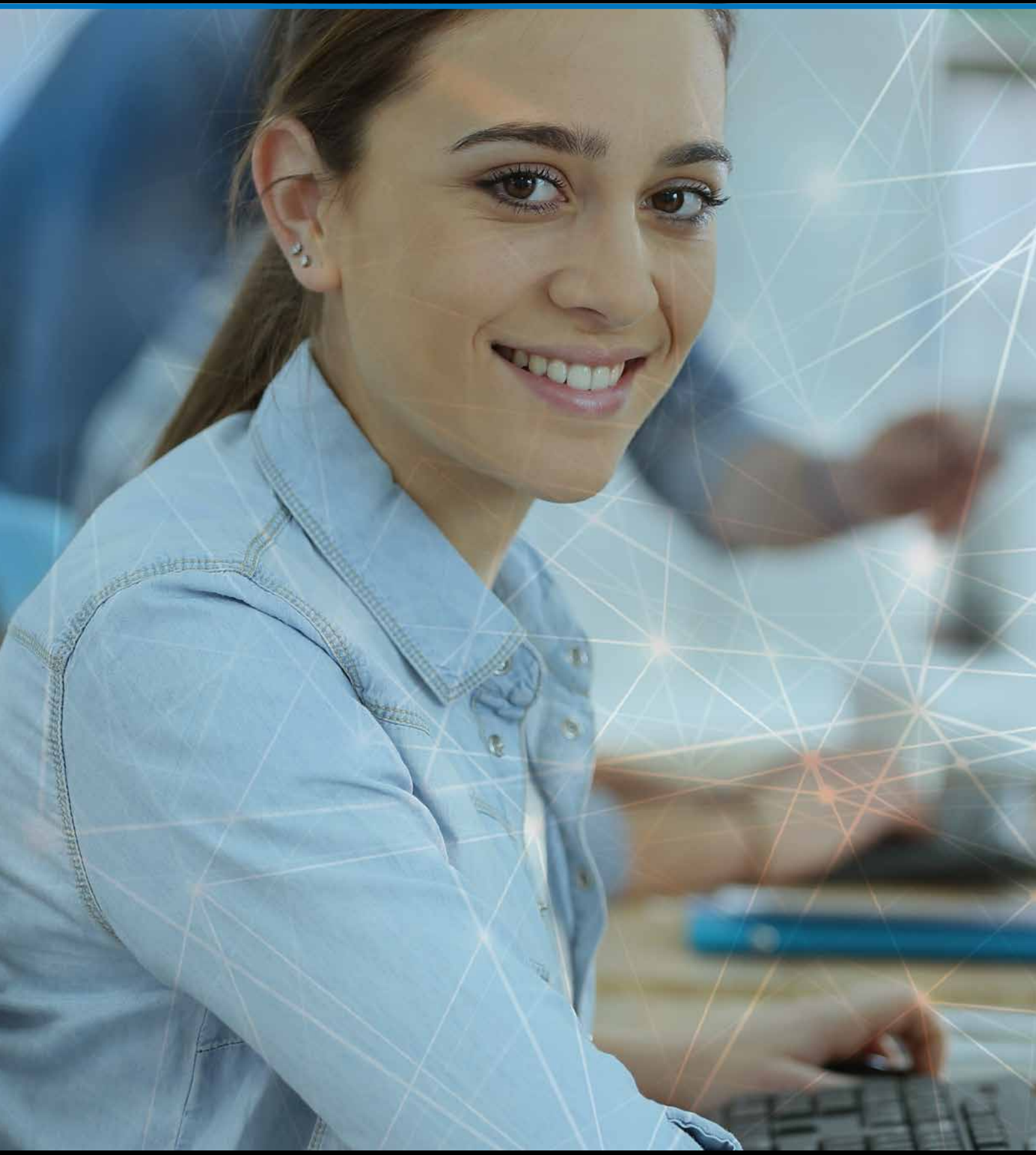
CONTENTS

ACS CORE BODY OF KNOWLEDGE



1.0. Introduction

There are 600,000 ICT workers in Australia with 52% employed in industries outside of ICT itself [1] . There are over 2 million trading businesses in Australia, with only 4% employing twenty or more staff [2] . This diversity results in a high degree of variability of competencies and skills applied within occupations. Larger organisations tend to employ specialists, while smaller organisations require employees with a breadth of ICT skills and not necessarily the depth expected in larger organisations.

One approach towards establishing a CBOK is to develop a set of knowledge requirements for each specific domain area (for example, distinguishing between computer science and information systems). In an environment of rapid technological innovation, this requires continual monitoring to ensure the knowledge areas remain current, with the risk being that updates are too slow to respond to changes in ICT occupation requirements.

An alternative approach is to specify common skills that all ICT professionals must hold and then require additional skills to specialise in specific ICT occupations (see Appendix A).

The second approach is adopted in this revision of the CBOK to enhance flexibility and best support variances in localised occupation requirements across Australia.

1.1. Using this document

The CBOK has been developed as a framework for assessing capability across a variety of contexts such as the education system and professional practice within industry.

This development has been informed by other frameworks such as the Australian Qualification Framework (AQF) and the Skills Framework for the Information Age (SFIA), and mutual recognition arrangements such as the Seoul Accord.

To maintain currency of the CBOK, other frameworks referenced are included in the appendices. The purpose of this approach is to enable the CBOK to be updated immediately should one of these other frameworks be modified, without the CBOK undergoing a review outside of its own maintenance cycle.

[1] Deloitte Access Economics, Australia's Digital Pulse 2015, p1.
[2] ABS Cat. No. 8165.0 http://www.abs.gov.au/ausstats/abs@.nsf/mf/8165.0

2.0. Acronyms

ACDICT	Australian Council of Deans of ICT
ACPHIS	Australian Council of Professors and Heads of Information Systems
ACS	Australian Computer Society
ANZSCO	Australian and New Zealand Standard Classification of Occupations
AQF	Australian Qualifications Framework
BCS	British Computer Society – The Chartered Institute for IT
CBOK	Core Body of Knowledge
CIPS	Canadian Information Processing Society
COBIT	Control Objectives for Information and Related Technology
ICT	Information and Communication Technologies
IEEE	Institute of Electrical and Electronics Engineers
ITIL	Information Technology Infrastructure Library
SFIA	Skills Framework for the Information Age

3.0. Authority

The Professional Standards Board is the delegated authority of ACS chartered for the development and oversight of professional standards including ethics, the code of professional conduct and the disciplining of members. Review and continuous improvement of the ICT Profession Core Body of Knowledge (CBOK) rests with the Professional Standards Board.

4.0. Purpose

The CBOK is the framework used by ACS to determine whether an individual holds the appropriate knowledge and can apply the appropriate skills for initial and ongoing professional practice.

5.0. Scope

The CBOK is used by ACS for the accreditation of degree and post-graduate degree programs of study (where applicable), and for assessing capability through ACS professional certifications. Certified Professional is one of a number of pre-requisites for inclusion in the ACS Professional Standards Scheme as covered by the Professional Standards Act 1994 (NSW).

6.0. The ICT Profession

Professions Australia defines a profession as being:

"… a disciplined group of individuals who adhere to ethical standards and who hold themselves out as, and are accepted by the public as possessing special knowledge and skills in a widely recognised body of learning derived from research, education and training at a high level, and who are prepared to apply this knowledge and exercise these skills in the interest of others." [3]

6.1. Defining the ICT Profession

Given the pervasiveness of ICT enabling all business operations, it is problematic to definitively define the ICT profession. Occupations and professional ICT skills however provide a strong context. There are two frameworks that assist with this context:

- ANZSCO; a statistical classification used by Federal Government for jobs and occupations
- The Skills Framework for the Information Age (SFIA).

ANZSCO is an Australian all of industry classification model and doesn't necessarily represent contemporary ICT occupation titles. Despite this, as it is used by the Australian Bureau of Statistics (ABS) and reported on via data captured through the national census, it is an important framework for understanding employment patterns across ICT occupations. ICT occupations contained within ANZSCO can be reviewed in Appendix B.

SFIA is a mature framework having been first published in 2003 and undergoing regular reviews since that time. It best represents the global nature of ICT profession given it's adoption in nearly 200 countries.

Professionals purport to have specialist skills which can be relied upon. Consequently laws require that a Professional exercises the required skill to an appropriate level expected by that profession. Any damage arising from a failure by the Professional to exercise the required level of skill may mean that a legal judgement is made against them if their lack of professionalism caused loss to others.

In Australia, ICT professionals do not require a licence to practice. To provide a form of self-regulation for the profession, ACS has influenced professional standards for ICT through Professional Standards legislation and the establishment of the ACS Professional Standards Scheme.

Professional Standards Schemes are legal instruments that bind occupational associations such as ACS to monitor and improve the professional standards of their members in order to protect consumers of ICT professional services.

Requirements of ACS to participate in the Scheme include having the following systems in place:

[3] Professions Australia Definition; http://www.professions.com.au/about-us/what-is-a-professional

- Admission requirements to the association
- Continuing Professional Development (i.e. continuing occupational education) of its members
- A publicly accessible Complaints and Discipline process
- A Code of Ethics
- Compulsory standards for Professional Indemnity Insurance for all its members, up to a specified level of liability
- Risk Management systems that monitor all of the above, and track claims made against any members

6.2. Definition of an ICT Professional

The historical entry point into a profession is through a relevant degree. ACS provides an accreditation service to ensure ICT degrees are appropriate for initial professional practice.

In Australia however, 43% of workers in ICT occupations studied courses other than ICT or engineering [4]. ACS Professional Certifications provide the bridge between the historical entry point and current practice within the ICT Industry. The International Standard, ISO/IEC 17024, alludes to why this bridge has presented itself:

"...it is necessary to distinguish between situations where certification schemes for persons are justified and situations where other forms of qualification are more appropriate. The development of new certification schemes for persons, in response to the ever increasing velocity of technological innovation and growing specialization of personnel, may compensate for variations in education and training and thus facilitate the global job market." (p. iv)

The CBOK addresses these trends by ensuring all persons seeking professional membership of the ACS hold an in-depth understanding of the skills and knowledge areas common to all ICT professional occupations. These core knowledge areas are:

- Problem solving, abstraction, design
- Ethics & Professionalism
- Teamwork concepts and issues
- Interpersonal communication

Independent of any specific ICT occupation, an ICT professional is expected to hold an in-depth understanding in each of these four areas.

At a minimum, they are also expected to have at least a conceptual understanding of the general ICT knowledge areas (Technical Resources, Technology Building, and ICT Management). In relation to ACS Professional Certifications, given that 43% of workers in ICT studied courses other than ICT or engineering, an outputs based assessment method is adopted. That is, if a candidate can demonstrate competency in the SFIA categories supported by the ACS General ICT Knowledge (see Appendix A), it is assumed that the person has sufficient underlying ICT conceptual knowledge to satisfy the General ICT Knowledge requirements.

[4] Deloitte Access Economics, Australia's Digital Pulse 2015, p1.

6.3. ICT Graduate Attributes

Graduate attributes for initial professional practice in ICT form a set of individually-assessable outcomes that are indicative of the potential competency of a professional beginning his/her professional practice. The graduate attributes are exemplars of the attributes expected of a graduate from an accredited program. Each attribute is a discrete statement of an expected capability, qualified, if necessary, by a range of indicators appropriate to the type of program.

ACS Accreditation evaluates how ICT Graduate Attributes have been addressed by each program submitted for accreditation. It also validates how each program addresses the CBOK core knowledge areas and general ICT knowledge areas. A qualification at AQF level 7 (or above) is a basic requirement for an ACS accredited program for initial professional practice. Hence the AQF level 7 graduate attributes are adopted as the starting point (see Appendix C). They are refined with knowledge specific requirements for the ICT industry.

ICT Graduate Attributes:

1. Graduates will have broad and coherent knowledge and skills for ICT professional work and/or further learning in a global economy [5] . This knowledge should extend to being innovative and entrepreneurial as appropriate to the ICT occupation they are pursuing.
2. Graduates will have broad and coherent theoretical and technical knowledge with depth in one or more disciplines or areas of practice in ICT
3. Graduates will have well-developed cognitive, technical and communication skills to select and apply methods and technologies to:
   a. analyse and evaluate information to complete a range of activities in their ICT area of expertise
   b. analyse, generate and transmit solutions to unpredictable and sometimes complex ICT problems
   c. transmit knowledge, skills and ideas to others
4. Graduates at this level will apply knowledge and skills to demonstrate autonomy, well-developed judgement and responsibility:
   a. in contexts that require self-directed work and learning
   b. within broad parameters to provide specialist advice and functions

To support international mobility of ICT graduates, ACS participates in the Seoul Accord. The Accord provides mutual recognition of accredited academic computing programs that prepare graduates for professional practice. For comparative purposes, the Accord's documented graduate attributes are summarised in Appendix D.

[5] Graduates should have an understanding of working in a global ICT industry. This would include understanding issues such as cultural differences, legal/regulatory differences, etc.

7.0. Knowledge Areas: CBOK

The CBOK is used in two ways to support the accreditation and certification processes. It provides:

- Essential Core ICT Knowledge required for any ICT professional. This includes ICT Professional Knowledge and ICT Problem Solving.
- General ICT Knowledge which provides graduates with a breadth of understanding of the ICT industry regardless of his/her ICT job role. This includes Technical Resources, Technology Building, and ICT Management.

7.1 Essential Core ICT Knowledge

All graduates are expected to have an in-depth understanding of two knowledge areas: ICT Professional Knowledge and ICT Problem Solving.

Knowledge Area: ICT Professional Knowledge

This area includes

:• Ethics
- Professional expectations
- Teamwork concepts and issues
- Interpersonal communication
- Societal issues/legal issues/privacy
- Understanding the ICT profession

It is expected that Professional Knowledge topics will need to be addressed at multiple levels in different stages of professional development. The very nature of professional work means that some knowledge and skills are best developed through experience and that understanding of complex issues such as ethics grows with maturity. Thus, the goals for developing professional knowledge/skills will be different at entry-level (graduate) than at full professional level (a certification program). Appendix E demonstrates this continuum using three of the seven SFIA responsibility levels.

Ethics

Topics covered should include:

- Fundamental ethical notions (virtues, duty, responsibility, harm, benefit, rights, respect and consequences);
- Basic ethics theories;
- Integrity systems (including, the ACS Code of Professional Conduct ethics committees and whistle blowing);
- Methods of ethical analysis;
  - Methods of ethical reflection
  - Methods and procedures of ethical repair and recovery;
- ICT specific ethical issues (professional – e.g. compromising quality and conflict of interest, and societal – e.g. phishing and privacy).

Professional Expectations

Topics covered should include: expertise, certification, competence, autonomy, excellence, reflection, responsibility and accountability.

Teamwork Concepts and Issues

Topics covered should include: collaboration, group dynamics, leadership styles, conflict resolution, team development and groupware.

Communication
Topics covered should include: oral and written presentations, technical report writing, writing user documentation and the development of effective interpersonal skills.

Societal Issues
Topics covered should include: history of computing and the ICT discipline, privacy and civil liberties, cybercrime, intellectual property and legal issues.

Understanding of ICT Profession
Professionals should have some knowledge of where and when their discipline began and how it has evolved, in addition to understanding of ongoing issues in the discipline.

Knowledge Area: ICT Problem Solving
This requires knowledge of how to use modelling methods and processes to understand problems, handle abstraction and design solutions.

The methods and tools that are used for handling abstraction could vary a great deal with the branch of ICT, from circuit diagrams to data modelling tools to business process modelling.

It is important to recognise this area because it captures some of the creativity and innovation that is required of ICT professionals, and the excitement that is present in their jobs. Recognising this component also assists in identifying what is unique about ICT and what differentiates it

from other disciplines. In no other discipline is there such an emphasis on developing artefacts (e.g., computer and information systems) which are so abstract and complex and where modelling tools and methods are essential. The systems that ICT professionals deal with cannot be seen or handled in the same simple and direct manner as products of other applied disciplines (e.g., buildings, bridges, chairs, drugs). Consequently, highly developed problem solving skills and the need for methods to handle abstraction and modelling are absolutely vital.

7.2 General ICT Knowledge
As well as have essential core ICT knowledge (ICT Problem Solving and ICT Professional Knowledge), it is essential that all graduates have a conceptual understanding of ICT as a broad discipline [6] .

Knowledge area: Technology Resources
This area includes:
- Hardware and software fundamentals
- Data and information management
- Networking.

[6] Note: In addition, for a program to be accredited at the Professional level, it must ensure graduates have developed ICT Role Specific Knowledge at SFIA level 3 or above. This will be assessed during the accreditation process.

Hardware and Software Fundamentals

An understanding of the basic components of computer systems is required, including:

- Computer architecture and organisation - including processors, memory, storage systems and input/output devices;
- Systems software – Operating systems and application system software.

Data and Information Management

An understanding is required of how data is captured, represented, organised and retrieved from files and databases. Topics include:

- Data modelling and abstraction
- Database Management Systems (DBMS)
- Information assurance and security in a shared environment
- Acquisition, custodianship and eventual disposition of information
- Nature of data, information and knowledge transformation through technologies.

Networking

This area requires an understanding of data communications and networking fundamentals. Topics include:

- Network concepts, protocols and standards
- Network security
- Wireless and mobile computing
- Distributed systems.

Knowledge Area: Technology Building

This area includes:

- Human factors
- Programming
- Systems development
- Systems acquisition.

Human Factors

This area requires an understanding of the importance of the user in developing ICT applications and systems, and involves developing a mindset that recognises the importance of users, their work practices and organisational contexts.

Programming

This involves an understanding of the fundamental concepts of a programming language. It is expected that the requisite knowledge of programming fundamentals would be best developed by engaging students in software developments tasks (programming). However, the range of programming languages and tools that could be used to develop this knowledge is wide and will vary with the expected ICT job role of the graduate.

Systems Development and Acquisition

An understanding is required of how to develop or acquire software (information) systems that satisfy the requirements of users and customers. All phases of the lifecycle of an information system should be understood including: requirement analysis (systems analysis) and specification, design, construction, testing, and operation and maintenance. There should also be knowledge of methodologies and processes for developing systems.

Knowledge Area: ICT Management

This area includes:

- IT governance and organisational issues
- IT project management
- Service management
- Security management

IT Governance and Organisational Issues

Topics covered should include:

- Fundamental governance principles (e.g. structures to encourage moral behaviour within organisations and corporations, and moral behaviour by organisations and corporations);
- Organisational context, including business processes, organisational culture, change and risk management.

IT Project Management

This area involves an understanding of the factors required to successfully manage systems development projects. Topics include: team management, estimation techniques, cost/benefit analysis, risk analysis, risk management, project scheduling, quality assurance, software configuration management, project management tools, reporting and presentation techniques.

Service Management

Service management deals with the ongoing operation of ICT in an organisational context and includes frameworks for structuring the interactions of ICT technical personnel with business customers and users. Many frameworks exist to guide ICT service management, for example, the Information Technology Infrastructure Library (ITIL) and Control Objectives for Information and Related Technology (COBIT).

Security Management

Topics covered should include:

- Computer system security: CPU, Peripherals, OS. This includes data security.
- Physical security: The premises occupied by the ICT personnel and equipment.
- Operational security: Environment control, power equipment, operation activities.
- Procedural security: By IT, vendor, management personnel, as well as ordinary users.
- Communications security: Communications equipment, personnel, transmission paths, and adjacent areas.

The General ICT Knowledge areas are mapped against the SFIA categories that they support in Appendix A.

8.0. Conclusion

The use of the CBOK ensures that all persons seeking professional membership of the ACS have an in-depth understanding of the ICT Essential Areas (ICT Professional Knowledge, and ICT Problem Solving) plus a conceptual understanding of the General ICT Knowledge Areas (Technical Resources, Technology Building and ICT Management).

The ACS Accreditation process looks at how the ICT Graduate Attributes have been addressed by each program submitted for accreditation. It also checks how each program addresses both the ICT Body of Knowledge (both ICT Essential Areas as well as General ICT Knowledge areas).

Assessing the conceptual knowledge (as seen in the ICT General Knowledge component of the ICT Body of Knowledge) is more difficult for persons applying for CT/CP status who have not undertaken an accredited ACS degree. Here it is recommended that an outputs based method be applied to determine if the applicant has satisfied this component. If the candidate can demonstrate competency in the SFIA categories and subcategories (Appendix A) supported by the ACS General ICT Knowledge, it is assumed that the person has sufficient underlying ICT conceptual knowledge to satisfy the General ICT Knowledge requirements.

Appendices

Appendix A
Mapping of General ICT knowledge against SFIA categories

SFIA version 6 has six skills categories. The General ICT Knowledge Areas which all graduates are expected to hold a conceptual understanding of, are grouped under four of the six SFIA categories: Strategy and Architecture, Change and Transformation, Development and Implementation, and Delivery and Operation. These four SFIA categories are the ones most likely to apply for ICT programs that prepare students for initial professional practice. The aim for this grouping is to reinforce the linkage between SFIA and the ICT Body of Knowledge.

Knowledge Area: Technology Resources

SFIA Skill	Skill Description	CBOK Alignment
IT Infrastructure (ITOP)	The operation and control of the IT infrastructure (typically hardware, software, data stored on various media, and all equipment within wide and local area networks) required to deliver and support IT services and products to meet the needs of a business. Includes preparation for new or changed services, operation of the change process, the maintenance of regulatory, legal and professional standards, the building and management of systems and components in virtualised computing environments and the monitoring of performance of systems and services in relation to their contribution to business performance, their security and their sustainability.	Hardware and software fundamentals
Information management (IRMG)	The overall governance of how all types of information, structured and unstructured, whether produced internally or externally, are used to support decision-making, business processes and digital services. Encompasses development and promotion of the strategy and policies covering the design of information structures and taxonomies, the setting of policies for the sourcing and maintenance of the data content, and the development of policies, procedures, working practices and training to promote compliance with legislation regulating all aspects of holding, use and disclosure of data.	Data and information management
Data management (DATM)	The management of practices and processes to ensure the security, integrity, safety and availability of all forms of data and data structures that make up the organisation's information. The management of data and information in all its forms and the analysis of information structure (including logical analysis of taxonomies, data and metadata). The development of innovative ways of managing the information assets of the organisation.	Data and information management
Network Support (NTAS)	The provision of network maintenance and support services. Support may be provided both to users of the systems and to service delivery functions. Support typically takes the form of investigating and resolving problems and providing information about the systems. It may also include monitoring their performance. Problems may be resolved by providing advice or training to users about the network's functionality, correct operation or constraints, by devising work-arounds, correcting faults, or making general or site-specific modifications.	Networking

Knowledge Area: Technology Building

SFIA Skill	Skill Description	CBOK Alignment
User Experience Design (HCEV)	The iterative development of user tasks, interaction and interfaces to meet user requirements, considering the whole user experience. Refinement of design solutions in response to user-centred evaluation and feedback and communication of the design to those responsible for implementation.	Human Factors
Programming/ Software Development (PROG)	The design, creation, testing and documenting of new and amended software components from supplied specifications in accordance with agreed development and security standards and processes.	Programming
Systems Software (SYSP)	The provision of specialist expertise to facilitate and execute the installation and maintenance of system software such as operating systems, data management products, office automation products and other utility software.	Systems Development and Acquisition

Knowledge Area: ICT Management

SFIA Skill	Skill Description	CBOK Alignment
IT Governance (GOVN)	The establishment and oversight of an organisation's approach to the use of information, digital services and associated technology. Includes responsibility for provision of digital services; levels of service and service quality which meet current and future business requirements; policies and practices for conformance with mandatory legislation and regulations; strategic plans for technology to enable the organisation's business strategy; transparent decision making, leading to justification for investment, with appropriate balance between stakeholder benefits, opportunities, costs, and risks.	IT Governance and organisational issues
Project Management (PRMG)	The management of projects, typically (but not exclusively) involving the development and implementation of business processes to meet identified business needs, acquiring and utilising the necessary resources and skills, within agreed parameters of cost, timescales, and quality.	IT Project Management
IT Management (ITMG)	The management of the IT infrastructure and resources required to plan for, develop, deliver and support IT services and products to meet the needs of a business. The preparation for new or changed services, management of the change process and the maintenance of regulatory, legal and professional standards. The management of performance of systems and services in terms of their contribution to business performance and their financial costs and sustainability. The management of bought-in services. The development of continual service improvement plans to ensure the IT infrastructure adequately supports business needs.	Service Management
Information Security (SCTY)	The selection, design, justification, implementation and operation of controls and management strategies to maintain the security, confidentiality, integrity, availability, accountability and relevant compliance of information systems with legislation, regulation and relevant standards.	Security Management

Appendix B
ICT Occupations Contained within ANZSCO

135111 Chief Information Officer
135112 ICT Project Manager
135199 ICT Managers NEC

223211 ICT Trainer

225211 ICT Account Manager
225212 ICT Business Development Manager
225213 ICT Sales Representative

261111 ICT Business Analysts
261112 Systems Analysts

261211 Multimedia Specialist
261212 Web Developer

261311 Analyst Programmer
261312 Developer Programmer
261313 Software Engineer
261314 Software Tester
261399 Software and Application Programmer

262111 Database Administrator
262112 ICT Security Specialist
262113 Systems Administrator

263111 Computer Network and Systems Engineer
263112 Network Administrator
263113 Network Analyst

263211 ICT Quality Assurance Engineer
263212 ICT Support Engineer
263213 ICT Systems Test Engineer
263299 ICT Support and Test Engineer NEC

263311 Telecommunications Engineer
263312 Telecommunications Network Engineer

313111 Hardware Technician
313112 ICT Customer Support Officer
313113 Web Administrator
313199 ICT Support Technicians NEC

313211 Radiocommunications Technician
313212 Telecommunications Field Engineer
313213 Telecommunications Network Planner
313214 Telecommunications Technical Officer or Technologist

621211 ICT Sales Assistant

Appendix C
Graduate Attributes –
Adapted from the Australian Qualifications Framework

	Bachelor Degree (AQF Level 7)	Masters Degree (AQ Level 9)
Knowledge	Graduates of a Bachelor Degree will have a broad and coherent body of knowledge, with depth in the underlying principles and concepts in one or more disciplines as a basis for independent lifelong learning.	Graduates of a Masters Degree will have: • a body of knowledge that includes the extended understanding of recent developments in a discipline and its professional practice • knowledge of research principles and methods applicable to the discipline and its professional practice
Skills	Graduates of a Bachelor Degree will have: • cognitive skills to review critically, analyse, consolidate and synthesise knowledge • cognitive and technical skills to demonstrate a broad understanding of knowledge with depth in some areas • cognitive and creative skills to exercise critical thinking and judgement in identifying and solving problems with • intellectual independence • communication skills to present a clear, coherent and independent exposition of knowledge and ideas	Graduates of a Masters Degree will have: • cognitive skills to demonstrate mastery of theoretical knowledge and to reflect critically on theory and professional practice • cognitive, technical and creative skills to investigate, analyse and synthesise complex information, problems, concepts and theories and to apply established theories to different bodies of knowledge • or practice • cognitive, technical and creative skills to generate and evaluate complex ideas and concepts at an abstract level • communication and technical research skills to justify and interpret theoretical propositions, methodologies, conclusions and professional decisions to specialist and non-specialist audiences • technical and communication skills to design, evaluate, implement, analyse and theorise about developments that contribute to professional practice
Application of knowledge and skills	Graduates of a Bachelor Degree will demonstrate the application of knowledge and skills: • with initiative and judgement in planning, problem solving and decision making in professional practice and/or scholarship • to adapt knowledge and skills in diverse contexts with responsibility and accountability for own learning and professional practice and in collaboration with others within broad parameters.	Graduates of a Masters Degree will demonstrate the application of knowledge and skills: • with creativity and initiative to new situations in professional practice and/or for further learning • with high level personal autonomy and accountability • to plan and execute a substantial research-based project, capstone experience and/or professionally focused project.

Adapted from AQF 2nd Edition: http://www.aqf.edu.au/

Appendix D
Graduate attributes – Seoul Accord

	Seoul Accord Computing Professional (equivalent to AQF Bachelors Degree)
Knowledge for Solving Computing Problems	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
Problem Analysis	Identify and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
Design/ Development of Solutions	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs.
Modern Tool Usage	Create, select, or adapt and then apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
Individual and Team Work	Function effectively as an individual and as a member or leader of a team in multi-disciplinary settings.
Communication	Communicate effectively with the computing community about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
Computing Professionalism and Society	Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.
Ethics	Understand and commit to professional ethics, responsibilities, and norms of professional computing practice.
Life-long Learning	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

Adapted from Seoul Accord Graduate Attributes:
http://www.seoulaccord.com/accord/contents.jsp?menu_l=144&menu_m=195&menu_s=236

Appendix E
Graduate attributes – SFIA Responsibility Matrix

	SFIA Level 3 (Apply)	SFIA Level 5 (Ensure, Advise)	SFIA Level 6 (Initiate, Influence)
Autonomy	Works under general direction. Uses discretion in identifying and responding to complex issues and assignments. Usually receives specific instructions and has work reviewed at frequent milestones. Determines when issues should be escalated to a higher level.	Works under broad direction. Work is often self-initiated. Is fully responsible for meeting allocated technical and/or project/supervisory objectives. Establishes milestones and has a significant role in the assignment of tasks and/or responsibilities.	Has defined authority and accountability for actions and decisions within a significant area of work, including technical, financial and quality aspects. Establishes organisational objectives and assigns responsibilities.
Influence	Interacts with and influences colleagues. Has working level contact with customers, suppliers and partners. May supervise others or make decisions which impact the work assigned to individuals or phases of projects.	Influences organisation, customers, suppliers, partners and peers on the contribution of own specialism. Builds appropriate and effective business relationships. Makes decisions which impact the success of assigned work, i.e. results, deadlines and budget. Has significant influence over the allocation and management of resources appropriate to given assignments.	Influences policy and strategy formation. Initiates influential relationships with internal and external customers, suppliers and partners at senior management level, including industry leaders. Makes decisions which impact the work of employing organisations, achievement of organisational objectives and financial performance.
Complexity	Performs a range of work, sometimes complex and non routine, in a variety of environments. Applies methodical approach to issue definition and resolution.	Performs an extensive range and variety of complex technical and/or professional work activities. Undertakes work which requires the application of fundamental principles in a wide and often unpredictable range of contexts. Understands the relationship between own specialism and wider customer/ organisational requirements.	Has a broad business understanding and deep understanding of own specialism(s). Performs highly complex work activities covering technical, financial and quality aspects. Contributes to the implementation of policy and strategy. Creatively applies a wide range of technical and/ or management principles.
Business Skills	Demonstrates an analytical and systematic approach to issue resolution. Takes the initiative in identifying and negotiating appropriate personal development opportunities. Demonstrates effective communication skills. Contributes fully to the work of teams. Plans, schedules and monitors own work (and that of others where applicable) competently within limited deadlines and according to relevant legislation, standards and procedures. Appreciates the wider business context, and how own role relates to other roles and to the business of the employer or client.	Advises on the available standards, methods, tools and applications relevant to own specialism and can make appropriate choices from alternatives. Analyses, designs, plans, executes and evaluates work to time, cost and quality targets. Assesses and evaluates risk. Communicates effectively, both formally and informally. Demonstrates leadership. Facilitates collaboration between stakeholders who have diverse objectives. Takes all requirements into account when making proposals. Takes initiative to keep skills up to date. Mentors colleagues. Maintains an awareness of developments in the industry. Analyses requirements and advises on scope and options for continuous operational improvement. Demonstrates creativity, innovation and ethical thinking in applying solutions for the benefit of the customer/stakeholder.	Absorbs complex information and communicates effectively at all levels to both technical and non-technical audiences. Manages and mitigates risk. Understands the implications of new technologies. Demonstrates clear leadership. Understands and communicates industry developments, and the role and impact of technology in the employing organisation. Promotes compliance with relevant legislation. Takes the initiative to keep both own and colleagues' skills up to date.

Adapted from SFIA Version 6: http://www.sfia-online.org/en"

10. VERSION CONTROL

Authors	Graham Low	Andrew Johnson

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Approvals

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