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IT Professionals NEW ZEALAND

2: Application Guidelines

ITP New Zealand Degree Accreditation

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The ITP Degree Accreditation documentation has been derived with permission from the Degree Accreditation process of the Australian Computer Society (ACS).

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1. Introduction

This document is part of a series of seven documents that make up the ITP Degree Accreditation Document Set. These include:

1. Administrative Guidelines
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IT Professionals New Zealand (ITP NZ) is the professional body of the IT industry and provides Accreditation of computing-related Bachelor Degree programmes in New Zealand. ITP is a provisional signatory to the Seoul Accord (see http://www.seoulaccord.org/).

The Seoul Accord signatories accord mutual recognition to their respective accreditation schemes. Membership of the Accord requires accreditation schemes to consider a set of standard graduate attributes by demonstrating a mapping of scheme requirements to those attributes. The Seoul Accord Graduate Attributes[1] are mapped to ITP Accreditation Requirements for Professional Level Accreditation

[1] The graduate attributes for a Seoul Accord computing professional graduate are:

- Academic Education: Completion of an accredited programme of study designed to prepare graduates as computing professionals
- 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

in ITP Accreditation *Document 4: Seoul Accord Graduate Attributes*. This mapping ascertains that a programme satisfying ITP accreditation criteria will satisfy the Seoul Accord requirements, and forms the substance of future ITP adherence to the Accord.

This guidelines document has been prepared to guide institutions seeking accreditation. The accreditation criteria provide the basis for evaluation of ICT education programmes and also provide, for ICT educators, a resource for the review and development of the teaching and learning environment, for the educational design and review tasks, and for the processes of continuous quality improvement.

In this guidelines document each criterion is developed more fully to clearly establish the key requirements for compliance and performance expectations. The accreditation criteria are catalogued under the following section headings and the subsequent discussion is in accordance with this structure:

- Organisation and Resources (Section 3.1)
- Programme Design and Content (Section 3.2)
- Quality Assurance (Section 3.3)

2. Interpretation of Requirements

In the development of the criteria an attempt has been made to distinguish absolute requirements for accreditation from expected characteristics and performance levels and advice. Again, the emphasis is on encouraging excellence, innovation and diversity in the educational design, delivery and quality processes.

Statements often employ the words *must* and *should*. Statements containing must denote absolute requirements for the programme to be accredited. Statements containing should are not individually binding but for accreditation to be granted, it is expected that the programme will meet a high proportion of them, and accreditation panels will question seriously any failure to meet these requirements.

3. Guidelines to the Criteria

3.1 Organisation and Resources

3.1.1 Identifiable Organisational Structure and Demonstrated Commitment to ICT Education

There must be an identifiable organisational entity responsible for ICT education within the institution awarding the degree. Most commonly this will take the form of a division, faculty or school - a substantial organisational entity providing a key focus on and responsibility for ICT education and scholarship. In documents comprising the Accreditation Management Process, the organisational entity responsible for ICT education is referred to as the “ICT School”, or simply “School”. Other forms of organisation are acceptable but it is unlikely, for example, that an ICT programme would be accredited if it were taught and managed in isolation by a handful of staff, primarily qualified and practising in a non-ICT discipline.

It would normally be expected that the School would have leadership responsibility – subject to the approval processes of the host educational institution – for the educational design, delivery, support and management of the ICT programmes, for the management of associated resources, and for the appointment and professional activity of staff. If this is not the case, the Institution will need to demonstrate how sufficient ICT expertise is brought to bear on decisions in these areas.

The delegated accountability within the ICT School for the management and delivery of each ICT education programme should be clearly specified.

There must be evidence that the host Institution regards ICT education as a significant and long-term component of its activity, and has adequate arrangements for planning, development, delivery, and continuous quality improvement of ICT programmes, and for supporting the associated professional activities of staff. This would most commonly be evident from an institution's mission statement and strategic plans, from the approved mission statement and strategic plans of the ICT School, perhaps from corporate responses to ICT School planning submissions or initiatives, and from the outcomes of formal reviews and performance evaluations.

The host Institution must have in place adequate policies and mechanisms for funding its ICT School including generation of funds from external sources if required. Similarly there must be established policy and appropriate practices for attracting, appointing, retaining and rewarding well-qualified staff and providing for their ongoing professional development, and for providing and updating infrastructure and support services. The Institution must ensure that effective leadership is available to the ICT School through the appointment of highly-qualified and experienced senior staff in sufficient numbers.

There must be in place formal structures for the ongoing review and improvement of programmes and for formal approval of new programme proposals and programme amendments.

3.1.2 Academic and Support Staff Profile

The teaching staff must be sufficient in number and capability to assure the quality of the ICT programmes and the attainment of their stated outcomes.

ITP believes that a significant complement of staff appointed on a continuing basis, as opposed to a sessional basis, is necessary to provide the strong, cohesive environment necessary for curriculum maintenance, development of best practice pedagogy, quality assurance of assessment, consistent academic support of students and development of an appropriate learning culture in the ICT disciplines which will support bachelor degree level student learning.

As a guide, a viable ICT School would be expected to have a minimum of six full-time-equivalent ICT academic staff employed on a continuing basis.

The School would be expected to have not less than three full-time-equivalent staff with specialist ICT knowledge and experience in any field in which a designated degree or major is offered. In no case must a major programme be dependent on a single individual continuing staff member.

Only in very exceptional circumstances is it likely that ITP will judge an institution without such a staffing profile as meeting accreditation requirements.

There should be an acceptable balance of staff appointments across academic levels from tutor to Professor in order to provide appropriate academic leadership and at the same time providing the experience profile, the teaching expertise and student support appropriate to the programme. It would be expected that at least one staff member with significant involvement in ICT education provision is employed at least at associate professor level.

(It is recognised that in some multi-disciplinary schools, the senior staff who provide executive leadership of the School may not be ICT academics. In such cases, it must be demonstrated that there is adequate programme leadership at senior lecturer level, and that the School executive staff demonstrate thorough understanding of the requirements of ICT education to provide a suitable foundation for offering programmes dedicated to the education of future professionals.)

It is considered important that the staff should come from a diverse range of backgrounds, embodying a mix of academic experience and ICT-practice experience in non-academic environments, both internationally and nationally. The School's research and/or professional activities should include vigorous interaction with industry and the professional community.

In gauging the capabilities of staff, the Panel will look at qualifications (both in ICT and education), research and practical ICT activities, teaching experience, and contributions to the advancement of ICT knowledge, practice and education. Involvement in professional societies and effective participation in ongoing professional development are also relevant indicators of suitable capability.

Staff development programmes should aim at developing capabilities in educational design, the use of new delivery and assessment methodologies and in the development of learning quality management systems as well as at enhancing professional standing within a specific ICT discipline. Academics should be aware of the need to address gender, cross-cultural, inclusiveness and equity issues. Staff development programmes should reflect this need.

In addition to the full-time academic staff team, ICT schools are strongly encouraged to make use of the expertise of practising professionals in ICT and related fields for guest lecturing and other sessional teaching.

There must be adequate arrangements for the supervision and guidance of both regular and sessional staff.

The Panel will look for evidence that academic staff numbers and teaching loads are such as to permit adequate interaction with students and support for the range of learning experiences offered, with adequate opportunity available to staff for professional engagement outside of teaching. Arrangements for workload management, capacity planning and succession planning should be evident in support of these objectives.

There must be sufficient numbers of qualified and experienced technical and administrative staff to provide adequate support to the educational programmes.

The ICT School and/or the Institution must have sufficient staff and facilities to provide adequate levels of student counselling, support services, and interaction with relevant constituencies such as employers and graduates.

It is recognised that programmes will increasingly be staffed and delivered in a variety of modes, where students will be supported to undertake learning activities at locations other than the 'host' campus through workplace and cooperative learning programmes, distance delivery and offshore arrangements. Educational institutions will form partnerships with both traditional and non-traditional providers to facilitate the delivery of ICT education. The Institution/s awarding the degree will be considered responsible for assuring the capabilities of all staff involved, and the Panel will require evidence of how this is achieved.

3.1.3 Academic Leadership and Educational Culture

The Panel will look for evidence of an innovative and outward-looking intellectual climate in the ICT School. In particular, there should be awareness amongst teaching staff of current educational thinking and development, and of developments in research and practice in the relevant disciplines. There should be a proactive attitude to the adoption of practices recognised in industry as being good.

There should be significant, ongoing involvement of all teaching staff in the processes of setting educational outcome targets, detailed educational design, review and continuous quality improvement. A strategic approach for the design, implementation and maintenance of a particular programme requires the full involvement of all teaching staff as a team and this should be evident to students.

For each programme there should be a clearly identified leader of the teaching team. Terms of reference, accountabilities and reporting obligations for the teaching team and programme leader should be clearly defined and understood by all stakeholders.

The teaching team is expected to meet regularly to consider input and feedback from the full range of constituencies, and use this in the ongoing improvement of detailed learning strategies, structure, curriculum content and delivery. The teaching team should monitor, using clearly stated criteria, the attainment of outcomes for the programme as a whole as well as the delivery of learning outcomes within individual units of study.

Staff should model the attitudes evident in the Institution's graduate attributes, the programme outcomes and the ethos of the ICT profession and should be continually aware of their responsibility to do so.

There should be clear acknowledgment of the need to link research, industry and community interaction with teaching to enrich the experiences of students and facilitate the ongoing professional development of staff.

Teaching staff at off-shore and partner institutions should be fully consistent with the above requirements of staff.

3.1.4 Facilities and Physical Resources

For all students, whether on-campus, at partner campuses or undertaking external studies, there must be, as appropriate, adequate classrooms, learning-support facilities, study areas, library and information resources, computing and information technology systems, and general infrastructure to fully support the achievement of the targeted learning outcomes for each specific programme.

For all programmes and associated implementation pathways, there must be adequate facilities for student-staff interaction. For distance education with remote campus or offshore implementations there must be sufficient facilities to provide students with learning experiences and support judged to be equivalent (in quality, if not in kind) to that available through on-campus attendance.

Appropriate experimental facilities must be available for students to gain substantial experience in understanding and operating ICT equipment, and of designing and undertaking ICT project work. The equipment must be reasonably representative of contemporary ICT practice and facilitate sound learning design. Facilities need to support structured laboratory activities as appropriate to the flavour of the programme, and also offer support for more open-ended project based learning.

Where practical work is undertaken remotely from the host campus, such as at another educational institution or in an industry environment, the arrangements must be such as to provide appropriate facilities, supervision and equipment access and an assured equivalence of learning outcomes.

3.1.5 Funding

The funds provided through the host organisation, from all sources including government grant funds, fee income, and direct income earned through research and entrepreneurial activity, must be sufficient to support the current ICT education programmes and satisfy the resource aspects of the accreditation criteria. The strategic planning cycle and funding distribution models must ensure predictable levels of support and the ongoing viability of the ICT programme/s.

3.1.6 Strategic Management of Student Profile

Resources provided to the ICT School are frequently dependent on student numbers. A criterion for viability is therefore a continuing level of demand for admission from adequately-qualified candidates in sufficient numbers to maintain the programme.

The admission system must adequately publicise the qualifications required for entry and ensure that only qualified candidates are admitted. Where credit or advanced standing is offered (especially through articulation programmes), there must be demonstrable quality-assured processes for the analysis, assessment and verification of prior learning against programme outcomes. Generally, credit-transfer recognition for prior learning must be on the basis of study at a similar level in an institution of appropriate standing. (For example, in New Zealand credit transfer in respect of 100 or 200-level papers might be granted for work completed in a programme assessed at NZQF Level 5 or 6, such as a Diploma).

The ICT School should be able to demonstrate a reasonable relationship between admission standards and student retention and graduation rates.

3.2 Programme Design and Content

3.2.1 Specification of Educational Outcomes

To ensure that a systematic approach is taken for the balanced development of graduates, each programme submitted for accreditation must be supported by a published specification of educational outcomes tailored to the particular field(s) of practice and associated area(s) of specialisation targeted by the programme. The educational outcomes specification should justify the inclusion or omission of any specialist title. External stakeholder input is critical to the development, review and auditing of attainment of these outcomes.

The educational outcomes specification should include a statement of broad objectives as well as targeted graduate capabilities for the programme in the specified field of the programme. The rationale for the specification of outcomes should be founded on the needs of industry and the community[2], trends in professional practice and comparisons with programmes of a similar nature available nationally or internationally. Providers are strongly encouraged to make use of the categories and skills in the SFIA[3] framework in identifying particular vocational outcomes targeted by the programme.

The statement of educational outcomes should relate to the mission of the host Institution and reflect the specialist ICT focus of the programme, the anticipated career destinations of graduates, and the needs of appropriate external constituencies.

The educational outcomes specification is also expected to reflect the desired characteristics and/or capabilities and/or achievements of mature graduates within the first few years of their career following graduation. It also needs to be appropriate within a broad definition of ICT - a profession trusted by society for conceiving, designing, implementing, maintaining, managing and ultimately disposing of infrastructure, products, processes and services within broad contextual criteria.

Each graduate attribute must include measurable performance indicators to provide a basis for monitoring the level of attainment. The multidimensional performance metric in each case is likely to involve both quantitative and qualitative measures with inputs from a range of sources. Such measures would draw considerably on formal assessment processes from within academic units as well as from the feedback and direct input of various constituencies.

The specification of educational outcomes should provide a platform for subsequent educational design and review tasks and provide a key reference for mapping the aggregation of learning outcomes and assessment measures from individual academic units comprising the programme. In Section 3.2.3 a programme design methodology, initially presented in ACS's *The ICT Profession Body of Knowledge (May 2012)*, is suggested which proceeds from the initial specification of desired educational outcomes.

It is acknowledged that many institutions have their own internal policies and procedures relating to graduate attributes, and mechanisms for quality assurance of the educational processes that deliver

[2] It is acknowledged that some programmes may have specific graduate attributes and outcomes attuned to preparing students for postgraduate research study, and where this is the case, it should be identified and explained.

[3] Skills Framework for the Information Age (www.sfia.org.uk)

these outcomes. ITP does not wish to override these, nor to place onerous additional responsibilities on ICT schools. **Accordingly, in most cases reproduction of documents prepared for internal quality assurance purposes (or NZQA accreditations in the case of ITPs) will be acceptable evidence for ITP, perhaps augmented to address specific ITP requirements.**

3.2.2 Titles of programme and Award

ITP recognises that diversity among programmes is not only inevitable but desirable. ICT schools traditionally differentiate the requirements of programmes variously referred to as 'Computer Science', 'Information Systems', 'Computer Systems Engineering', 'Software Engineering' and 'Information [and Communications] Technology'. ITP acknowledges that there are many acceptable variations of these programmes. Further, there are new emerging programme areas such as 'Health Informatics', and more multi-disciplinary programmes are expected to emerge over the coming years.

A professional ICT programme must aim to deliver graduates with capabilities appropriate to a designated field of the ICT profession. This will most commonly be reflected in the title of the programme and/or degree, or cited as a major field of study in the academic transcript. It is not essential, however, for any nominated specialisation to appear in the degree title. The key requirement is that the programme engages students with a coherent area of ICT, providing an appreciation of current issues and developing competence in handling advanced problems in the area.

Where a title does denote a specialisation in a particular field of practice, the programme should impart high-level ICT (and in some cases domain or application) skills and knowledge in that specialisation.

New programme titles may be expected to arise in response to evolving industry and professional practice. Programmes may draw on several existing fields of specialisation, and may incorporate new knowledge or the application of knowledge in new practice environments.

ITP does not wish to be prescriptive about titles, nor does it wish to encourage a proliferation of specialist titles that may have transitory lifetimes and confuse stakeholders, especially school leavers. However it does reserve the right to query a title or field of practice which the panel regards as possibly inappropriate and to make recommendations about the appropriateness of any title.

3.2.3 Programme Structure and Implementation Framework for Professional level accreditation

The normal requirement of an accredited professional ICT programme in New Zealand is three (3) years of full-time-equivalent study, based on entry from a satisfactory level of achievement at school (12-13 years of primary and secondary schooling) or equivalent. Programmes offered via alternative implementation pathways (elective units and study sequences, workplace learning options, defined articulation routes, part-time attendance, distance mode, offshore and remote campus) must be demonstrably equivalent in terms of content, in the delivery of graduate outcomes as well as in the learning expectations of students.

The "conventional" academic year involves two semesters of formal study and examination, offering apparent scope for accelerated progression utilising the remainder of the calendar year. However many Institutions offer three or four terms. In considering any programme that offers completion in significantly less than three calendar years, the Panel must be assured that it provides adequate

opportunity for personal and professional skills development and delivers the full equivalence of defined outcomes. It is anticipated that there will be a growth in the number of programmes with the equivalent of three academic years of study that can be completed within two calendar years by utilising a trimester model, and generally such programmes may be acceptable.

Programme durations exceeding the normal three years of full time study will usually be appropriate in most circumstances – for example in engineering-accredited degrees. Assessment will always be based on the assumed delivery of an appropriate range of graduate attributes and body of knowledge embedded in the programme.

The curriculum must comprise an integrated set of tasks and structured learning experiences that lead to the delivery of the specified educational outcomes, and by implication, satisfactory attainment of the graduate attributes. The necessary opportunities and support mechanisms must be provided.

The programme structure and curriculum must be appropriate to the development of in-depth ICT competence in the designated field of practice and in nominated specialist areas.

The ICT Profession Degree Accreditation Body of Knowledge[4] proposes a programme design process that might be used to ensure that it meets the accreditation requirements. Whilst such a process need not be followed strictly, the graduate outcomes in respect of roles prepared for must remain the principal goal of any credible alternative process, and the accreditation application must demonstrate how the realised programme satisfies the outcomes specification.

Programmes designed for accreditation must satisfy the following specific requirements:

a. There must be a minimum of one and a half equivalent full time years of material in the programme (i.e. 50 per cent of the content of a typical three-year degree programme) that is focused on the development of the ICT outcomes and the body of knowledge required and defined for the programme.[5]

b. The programme must provide appropriate coverage of the Core Body of Knowledge (CBOK) and ITP Professional Knowledge Curriculum, and further explained in Section 3.2.4 below. Note that the extent to which some aspects of the CBOK are covered is context dependent, as indicated in the *ICT Profession Body of Knowledge* (Sept 2013) *(See Appendix 7: Extract from ICT Profession Body of Knowledge)*. For those aspects which are covered only briefly, a clear rationale must be given as to why this is so.

[4] See Appendix 7, Section 1 for an extract of the relevant section from the ICT Profession Body of Knowledge

[5] In situations where there is less than 1.5 years' of specific ICT study, it must be clearly demonstrated that the appropriate number of other units directly relate to the specified vocational outcomes in a way that goes beyond merely providing a context for ICT to be applied. For instance a core subject without specific ICT content may be considered to "focus on the development of ICT outcomes and the body of knowledge required and defined for a programme" if it is a demonstrable prerequisite for a later core subject with direct ICT content, or can be linked to the intended ICT program objectives, graduate attributes, or vocational outcomes. Counting a core subject without specific ICT content, as focusing "on the development of ICT outcomes and the body of knowledge required and defined for a programme" will be based on the professional judgment of the accreditation Panel. Institutions should take care to explicitly demonstrate links between core subjects without direct ICT content to the skills required to achieve the ICT roles intended in their written accreditation submissions.

c. The programme must contain a unit (hereafter called a "capstone unit") in the final year that integrates the material of the programme that is focused on the principal role outcomes, and which allows the student to demonstrate that he/she has mastered the programme objectives. *(See Appendix 3: Capstone Unit)*

d. The programme must contain material that provides a structured learning experience to facilitate a smooth transition to professional practice or, in the case of programmes targeting a research role, further study in the discipline. (See Appendix 4: Professional Practice). This would include graduates being able to apply their knowledge to complex computing problems as defined by the Seoul Accord. (See Appendix 6: Complex Computing).

e. It is common, and to be recommended, that programmes include a final-year team-based project for a real client, that fulfils both of the preceding requirements. However, it is acceptable that these requirements be satisfied separately in other ways, as long as a rigorous argument is given for their fulfilment of the requirements. Accreditation panels will be particularly vigilant to assess points c. and d. above in such a case.

f. The required ICT material must progress through all years of the programme with at least one half of a full-time year of the ICT material at genuinely advanced level (generally final year) – topics which clearly provide extra depth in ICT. (A detailed definition of "advanced level", which will be used by accreditation panels, is provided in *Appendix 5: Advanced Level Study.)* The submission must show how these advanced units add depth to knowledge gained in earlier units, including identifying pre-requisite knowledge for the units. Depth can be developed through both process (as in a project) or through in-depth study in a particular area, but not through process alone. At least one quarter of a full-time year of the advanced material should consist of in-depth study as opposed to purely project work.

g. The structure of a programme should clearly promote a graded transition of learning experiences from a more directed beginning to a more independent learning approach in the final year.

h. The programme should address at least one ICT skill at SFIA level 3 or above in a specific area related to the intended career role.

3.2.3.1 Graduate Programmes for Initial Professional Practice

This document sets out the requirements for the accreditation of bachelor degree programmes. Postgraduate programmes which aim to prepare students for initial professional practice are likely to be eligible to be accredited provided that they meet the requirements set out in this document at some stage in the future, however at this stage only bachelor degree qualifications are eligible.

3.2.3.2 Dual Majors

Some programmes take the form of a dual major. ITP requires the present policy and criteria for single degrees to be met and demonstrated in full for both the single and dual major configurations. Any differences in the requirements between the single major and a dual major configuration of the degree should be documented.

3.2.3.3 Combined / Dual / Double Degrees

Some programmes take the form of combined or double degrees, combining an ICT outcome within a nominated specialist field with a second outcome in either another discipline altogether or in a second

specialist field of ICT, deemed equivalent to completing two bachelor degrees. (This does not include single bachelor degrees with dual majors, which are handled under Section 3.2.3.2) In most instances, two individual degree testamurs are awarded, but sometimes a combined outcome is specified on a single testamur. Typically, the combined programme occupies substantially less time than would the case if the two degree programmes were taken separately. The award of the combined / double degree is achieved by identifying content and learning experiences which may validly be counted towards both qualifications.

In all cases, for the accreditation of each professional ICT programme, ITP requires the present policy and criteria for single degrees to be met and demonstrated in full.

3.2.3.4 Honours degrees

Honours degrees may be awarded as an extension of a bachelor's degree. In this case the honours extension is not separately accredited since students already have accreditation from the basic bachelor's degree.

Honours degrees may also be awarded as an integral part of a bachelor's programme (e.g. programmes for which honours may be awarded). In this situation the programme is accredited as a whole since the honours component is an integral part of the basic bachelor's degree.

The honours year may count towards the experience requirements for ITP professional certification provided it is in an area relevant to the SFIA specialism(s) of the applicant when applying for Certified Technology (CTech) or Chartered IT Professional NZ (CITPNZ) [6].

3.2.3.5 Work-Integrated Learning (WIL)

Some educational institutions offer programmes in which students are required to gain substantial practical experience in industry, or other ICT-practice settings interspersed with the academic programme. These are generically known as Work-Integrated Learning (WIL) or in some cases Industry-based Learning (IBL) programmes, involving cooperation between the education provider, the student, and one or more ICT employers.

WIL programmes would normally include the following features:

- An ICT-practice experience requirement taken in periods of sufficient duration for substantial work to be undertaken, and completed prior to the final academic semester;
- Stated and assessed learning outcomes from this element of ICT practice experience;
- Comprehensive documentation of these requirements and how they are met; and,
- An office providing assistance to students in finding suitable practice experience placements.

ITP strongly encourages such programmes, and accredits them in the same way as any other professional ICT programme.

Where the work-based learning extends the study period beyond the normal three year programme, the WIL component may be counted towards the experience requirements for ITP professional certification.

[6] http://itp.nz/certification

Regardless of the length of a WIL or IBL programme, it may count at most one quarter of an academic year towards the requirements of points a. and f. (Section 3.2.3).

3.2.4 Curriculum and Body of Knowledge

As already alluded to, ITP has adopted the ACS core body of knowledge (CBOK) framework to guide ICT schools in the design of ICT bachelor degree and also conversion/professional masters programmes – this is described in detail in the ICT Profession Body of Knowledge *(See Appendix 7: Extract from ICT Profession Body of Knowledge)*. This CBOK is heavily linked to ACM and IEEE curriculums.

A goal of the framework is to facilitate the design of degree programmes that produce graduates with the skills necessary for given roles as ICT professionals. The level of autonomy and responsibility at which the skill is practised should also be established. Fundamentally, these skills require the application of underlying knowledge that is both broad and deep, and must include both technical and professional knowledge areas.

Whilst the CBOK represents that knowledge that all ICT professionals are expected to have, the depth of such knowledge required varies depending on the actual area within which a professional works. Accordingly, a programme, whilst required to cover all areas of the CBOK, need not cover them all to significant depth. (As an example, a programme primarily focussed on producing graduates who will assume the role of Business Analyst might cover the programming component of "Technology Building" quite briefly).

It is required that a number of areas of CBOK, particularly germane to virtually all areas of ICT employment, are treated in depth and assessed in all programmes.

The knowledge area "ICT Problem Solving" will be treated differently depending on the identified vocational outcomes for a programme, but must be covered in depth; the generic skill of problem-solving is a fundamental attribute of bachelor degree graduates.

The following areas **must** be covered to significant depth in all programmes:

From the Knowledge area of *Professional Knowledge*

- Ethics
- Professionalism
- Teamwork concepts and issues
- Interpersonal communication
- Societal issues/legal issues/privacy

From the Knowledge area of *Outcomes Management*

- ICT Project Management

The application for accreditation must address the Core Body of Knowledge for all programmes for which accreditation is sought. A pro-forma, requiring the mapping of all units of study against the CBOK with associated Bloom's levels is provided as Form 4 in Document 3 (Guidelines for Submission).

Usage of Bloom's is entirely optional, and other appropriate systems are acceptable.

It is suggested that this form be completed once for all undergraduate units of study and again for postgraduate units of study regardless of the number of programmes included in the accreditation application. Form 5 is then used to map the units of study (included in Form 4) to specific programmes.

3.2.5 ITP Professional Knowledge Curriculum

The ITP Professional Knowledge Curriculum (Document 7) outlines knowledge areas that practicing professionals should understand. It is expected that programmes will cover much of this material at a foundational rather than detailed level.

3.3 Quality Assurance

Appropriate policies, processes and practices must be in place at all levels within the Institution to assure the quality of ICT education. The dimensions of the educational quality system must embrace the following components.

3.3.1 Engagement with external stakeholders

A specific requirement of the Accreditation Policy is a formally-constituted advisory mechanism or mechanisms, involving programme constituencies generally, and industry in particular. The ICT School must secure the active participation of ICT professionals, graduates, professional bodies and leading employers of ICT graduates in defining, updating and evaluating specified outcomes for each programme.

An advisory body is expected to operate at the strategic level in monitoring and analysing industry needs and trends, as well as in the review and performance monitoring of the programme objectives and graduate capability targets. In addition, it should ideally have significant input to establishing performance standards and strategies for monitoring the development of technical competence, ICT application skills and personal and professional skills for each particular programme.

Depending upon organisation structures, there may be a case for a two-tiered approach, to provide strategic direction and advice on the one hand, and then specific input to the educational design, review and performance monitoring at the individual programme level on the other. In some instances this may be achieved by a single advisory body, with individual members or sub-groups accepting engagement to provide advice and assistance in learning design at a more detailed, operational level, and in others by quite separate strategically and operationally oriented bodies. Members of such bodies may well also serve as adjunct staff or assessors of student performance.

An effective and productive industry engagement is also crucial for providing students with the necessary range of exposure to professional ICT experience as well as providing opportunity for collaborative project work and the professional development of staff.

3.3.2 Feedback and stakeholder input to continuous improvement processes

There must be formal processes for securing specific and systematic feedback from constituencies such as students, graduates, employers and representatives of the wider community. There should be evidence of the systematic application of feedback in conjunction with other quantitative measures to setting, monitoring and reviewing outcomes at programme and academic unit level.

Direct involvement of the student body as partners in the processes of continuous quality improvement is strongly encouraged. Staff-student consultation forums, focus groups and commissioned submissions can facilitate productive involvement as well as providing direct educational experiences for the student in the processes of quality assurance.

External stakeholder feedback and input should provide an important dimension in monitoring the delivery and attainment of programme objectives and graduate capability targets.

3.3.3 Processes for establishing and reviewing educational outcomes

There must be formal, documented processes for setting and reviewing the detailed educational objectives and graduate capability targets for each programme as a whole. Reviews should be regular and ongoing. These processes should ensure that the outcomes specification remains aligned with accreditation requirements as well as external practices and specific industry needs. The specification of targeted graduate capabilities should cover enabling skills and knowledge, depth and breadth of technical competence, ICT application skills, as well as personal and professional capabilities.

Systematic review processes should be inclusive of all staff engaged in the delivery of the programme (including those engaged in the delivery of programmes at regional and offshore campuses and by partners), and involve the ongoing input of external constituencies as well as feedback and input from the student body.

3.3.4 Strategic approach to educational design and review

A systematic and strategic approach to educational design, review and continuous quality improvement must be evident. This may be similar to the process outlined in Section 3.2.3 above, but need not agree in all aspects. What is essential is a conscious, defined process designed to achieve specified outcomes.

Beginning with the specification of educational objectives and targeted graduate capabilities, a strategic approach to learning design should next determine the specific and measurable learning outcomes for each unit of study (subject) within the programme.

At the unit (i.e. paper or course) level, the learning design process should continue by developing the appropriate learning activities and the formative and summative assessment approaches which monitor and measure the delivery of the learning outcomes. Closing the loop on learning outcomes, learning activities and assessment measures at the academic unit level should be a prime objective.

A mapping of the learning outcomes from individual units of study to the targeted graduate capabilities for the programme as a whole should be a prime reference tool emerging from this process and underpin the outcomes-based educational design. Subsequently, tracking this aggregation of learning outcomes and assessment measures from individual units to close the loop on the delivery of graduate capabilities at the programme level is a key component of the ongoing review and improvement process.

Again, the educational design, review and continuous quality process should be inclusive of all programme teaching staff through regular interactions, and involve the ongoing input and feedback of

the student body. Performance assessment at every level should involve a variety of measures, as well as input from an appropriate range of stakeholders, and drive the improvement cycle.

The overall goal of the learning design process is to ensure that the curriculum as a whole addresses the educational outcomes set for the programme in a substantial, coherent and explicit way.

ITP expects that all staff at all locations delivering a programme are well informed on programme objectives and have input to the design process.

3.3.5 Approach to assessment and performance evaluation

The development of assessment and performance monitoring systems must be an integral part of the overall educational design process for any particular programme.

There should be evidence that the assessment tools and evaluation processes within each course are rigorously aligned with the designated learning outcomes for the programme.

At the programme level, assessment measures from within individual academic courses, along with a range of inputs, feedback and performance measures gleaned from the full range of constituencies, will come together to provide multi-dimensional data appropriate for evaluating performance against the standards set for each of the targeted educational outcomes. Substantiating delivery of the prescribed outcomes in this way will validate satisfactory attainment of the capabilities and thus ensure that the generic attributes specified in the Accreditation Policy are developed to a sufficient degree in all graduates.

Summative and formative assessment tools may include examinations, tests, quizzes and project reports; self, peer, and mentor appraisals; portfolios and journals; oral examinations and interviews; and behavioural observations. It is expected that almost all units would not rely solely on multiple choice questions but on assessment demonstrating application, analysis and synthesis.

It is important that students on a programme be required to perform in at least one assessable situation involving a significant open-ended and wide-ranging challenge, drawing on knowledge and capability from different subject areas. The capstone unit(s) and/or other advanced units should address this requirement.

There should be a documented system for setting, reviewing and monitoring the delivery of learning outcomes associated with professional experience.

The assessment regime should address the full range of graduate capabilities, including personal and professional skills development.

A rigorous moderation process should be in place to monitor and manage the assessment processes within units of study.

3.3.6 Management of alternative implementation pathways and delivery modes

There must be rigorous processes for monitoring and managing alternative implementation pathways within a particular programme definition, and for assuring the equivalence of educational outcomes for the programme as a whole. Such alternative implementation pathways will range from specialised entry

routes and elective academic units within an established home campus programme, right through to an offshore or remote campus offering of such a programme. (See Appendix 2: Multiple Campuses and Partnership Arrangements)

This includes online delivery (see Appendix 1: Distance Education), external (off-campus) teaching and programmes delivered by partner organisations both within Australia/New Zealand and overseas.

Accreditation of the programme requires that the programme be accredited at all locations and in every form of delivery. Where such alternative pathways are available the application must address these requirements for each alternative pathway.

3.3.7 Benchmarking

ICT schools should engage in some form of comparative analysis to ensure that exit-level performance standards are comparable with national practice, and preferably international practice for the full range of graduate capabilities. Comparative analysis could include exchanges of teaching and assessment materials, external moderation, discussion forums, visitation teams and/or the use of external examiners, if so desired. Beyond this, more systematic benchmarking could help in identifying best practices and specific directions for improvement.

The accreditation process will evaluate programme standards, but education providers should do so as part of the process of setting the performance criteria and monitoring targeted graduate outcomes, and not rely on the accreditation system for this.

3.3.8 Approval processes for programme management

There must be formal approval processes associated with programme and curriculum planning and review, with due reference to demand analysis, the input of external constituents, and quality management processes.

4. Introducing New Programmes

4.1 New programme Implementation on the Home Campus

An ICT School with accredited programmes may choose to introduce a new programme within the context of an existing operating framework and established quality system already considered by the Accreditations Board as part of the most recent general review[7] of programmes.

Where the new programme is in a pioneering field of ICT, or where an educational institution is contemplating the establishment of a new school of ICT, advice might be sought from the Accreditations Board. In such cases, the Committee may appoint an experienced person to respond to questions, or may suggest persons who may be consulted directly.

Provision of such advice expressly does not constitute any guarantee of ultimate accreditation. Further, the Accreditations Board or any of its members will not involve themselves in any way in the engagement as consultants, or actively contribute to programme design.

[7] i.e. the normal 5-yearly accreditation visit.

Where the intention is to seek accreditation for a new programme then ITP (through the Accreditations Board) should be notified in writing of the proposal prior to commencement of the first student cohort. It is suggested that this notification be instigated at the time the proposal is submitted for approval though the internal institutional processes.

Application for provisional accreditation of the new programme should be made in the first year of operation. Where this falls within the normal five-year general review cycle, the written submission should be prepared as a supplement to the most recent written submission for general review.

The submission for provisional accreditation should be developed against the accreditation criteria outlined in Section 3.2.3. It should not, however, duplicate material already submitted for the most recent general review.

In most instances the criteria dealing with the organisation and resources and the quality system will have been substantially addressed in the most recent general review submission. It is only necessary to respond to an individual criterion where circumstances or issues are differentiated for the new programme or where changes in the environment have occurred since the most recent general review.

With regard to the academic programme criteria, it will be necessary to develop an appropriate response addressing the specific objectives, educational outcomes, title, structure, content, implementation details and professional practice exposure issues unique to the new programme.

It is particularly critical that a clear rationale is presented for the new programme. This should demonstrate appropriate consultation with industry and other research that has established projected demand for graduates, led to the choice of title and underpinned the development of the graduate outcomes specification, programme structure and content.

The new programme cannot be considered for full accreditation until the first sizeable, regular cohort of students enters the final stages of the programme close to the point of graduation. Again, ITP should be advised in writing once this cohort enters its final year of study. An update on the submission for provisional accreditation should be prepared, again responding to the accreditation criteria by addressing any changes in circumstances and the experiences and outcomes arising from implementation of the programme. It is particularly important that the submission for full accreditation reports in detail actions and progress made on the recommendations in the report of the provisional accreditation evaluation Panel.

4.1.1 Consideration of Provisional Accreditation

For a new programme in a well-established school in good standing, provisional accreditation of a new programme can occasionally be given on the basis of a desk-top assessment of the submitted documentation. “Good standing” means that all programmes offered by the school for accreditation were accredited at the last general review without significant difficulty.

In the majority of circumstances the Accreditations Board will require a Panel visit to consider a new programme for provisional accreditation. This would normally occur in the first year of operation, where a sizeable cohort of students has been enrolled.

The Accreditations Board has the discretion to determine whether a visit is required and when provisional accreditation is appropriate.

4.1.2 Transition to Full Accreditation

Key considerations for the transition to full accreditation will be the School's documented response to recommendations made in the report of the provisional accreditation evaluation Panel and the quality of assessed student work in the latter study years of the programme.

A visit will normally be necessary to assess transition to full accreditation. This assessment will follow a formally documented submission from the School. Assessment could be undertaken as early as during the final semester of study of the first graduating cohort, provided sufficient access can be provided to representative examples of assessed final year student work, and also to a representative group of graduating students.

At the very latest, full accreditation should be sought at the next scheduled general review following the emergence of the first graduates.

Where full accreditation is considered in between general review visits and the School is in good standing, a visit by one senior Panel member (or the relevant Visit Manager acting on behalf of the Panel) may be sufficient to recommend full accreditation. In other cases a full visit may be necessary.

4.2 New programme Implementation for a Regional or Offshore Campus

For an established regional or offshore campus with accredited professional ICT programmes already in place, the accreditation of a new programme offering should follow the guidelines detailed in 4.1.1 above.

Where the new offering is a fresh implementation of a programme already established and accredited at the home campus or on other campuses, then the documentation for both provisional and subsequently full accreditation may well build on documentation already submitted previously for implementations of the programme elsewhere.

Where an established programme on the home campus is to be newly implemented at a regional or offshore campus or where a new programme is to be introduced for the first time at a regional or offshore campus, the Accreditations Board will normally require a visit to occur for consideration of provisional accreditation.

Where a new regional campus or offshore operation is first being established and provisional accreditation is to be considered for the first programme offerings then the submitted documentation will need to be more comprehensive than that expected for just a new programme offering within an established operating environment.

The submitted documentation in this case will need to respond to all aspects of the accreditation criteria, with particular attention to the sections dealing with the quality systems and the operating environment. It is critical that the submission analyses all aspects of the development, delivery and management of the programme and in particular the differentiating features associated with the new operating environment.

5. Programme Amendment

The Accreditations Board must be informed in writing, via ITP, of significant changes to established, accredited programmes and to the operating environment within a school. The terms of accreditation will normally provide for the ongoing development of programme structures and content and in fact encourage enhancement and innovation within the defined quality management framework.

Changes to programme structure and content within the existing specification of educational objectives and targeted graduate outcomes are welcomed and expected within the accreditation cycle as part of the process of continuing quality improvement.

The Accreditations Board will monitor programme amendments through written advice received from the Institution. The provider should ensure that all changes are within the accreditation guidelines, such that programme and the school as a whole continue to comply with the accreditation criteria.

ITP uses the same definition as *NZQA Type 2 changes* to determine a major structural change. This includes changes to components that change the programme as a whole, for example:

- changes to the qualification to which the degree programme leads such as:
    - qualification type (e.g. certificate, diploma)
    - title
    - level
    - credit value
    - outcome statement
    - specification
- changes to the degree programme including:
    - structure of the degree programme
    - regulations
    - delivery methods (e.g. from classroom learning to distance learning)
    - components (e.g. levels, credits, learning).

Under such major changes the Accreditations Board, once satisfied that the accreditation criteria continue to be met, will make a decision on whether to continue the current accreditation status or to accord provisional accreditation to an essentially new programme definition.

The following programme changes would normally trigger an additional site visit:

- introduction of a new major

- changes to the mode of delivery
- delivery at another site (including overseas sites)
- significant changes to the structure of the degree programme.

Formal review of other, more minor changes will normally occur at the next scheduled general review of programmes.

Appendix 1: Policy on Distance Education

1. INTRODUCTION

It is recognised that new approaches to teaching and learning, including for delivery in distance education mode, are constantly being developed, and are to be encouraged.

Without being unduly prescriptive about criteria that might apply to distance education, it is incumbent upon an accreditation Panel to ensure that the knowledge and attributes appropriate for entry to the profession are attained by all graduates of the programme through whatever delivery mechanism.

2. POLICY STATEMENT

Programmes will be evaluated for accreditation which are delivered fully or partly in distance mode.

"Distance education", according to this Policy Statement only, includes those programmes where there is no third party involvement in the delivery of the programme. Where a third party is involved, the programme will be considered under the policy on partner campuses (see Appendix 2 – Policy on Multiple Campuses and Partnership Arrangements).

The accreditation criteria and processes are set out in the ITP Accreditation Manual to which this is an appendix.

ITP may modify these guidelines from time to time, and input is invited from education providers.

3. GUIDELINES

These guidelines are the basis for the evaluation of programmes delivered in distance education mode. The guidelines are not prescriptive but where the Institution does not follow them the Panel will wish to be convinced that any alternate approach has the same outcomes.

1. A distance education programme should generally be built on an existing programme that is delivered concurrently to on-campus cohorts; however programmes offered in purely distance mode can also be considered.

2. Electronic and/or face-to-face opportunities must be provided to allow distance education students to interact with staff and in particular to ensure that group and team based learning experiences are included in the programme.

3. The educational design, learning activities and assessment measures must be purpose-built to support the student in a comprehensive and independent manner.

4. There must be equitable access (equivalent in quality, if not in kind) to student services, academic and administrative support for distance education students.

5. There must be specific and adequate mechanisms for the tracking of professional and personal skills in the distance education mode to ensure the satisfactory delivery and assessment of the required outcomes.

6. It is encouraged that distance education students be required to participate in residential on-campus learning activities to allow the Institution to ensure that professional and personal skills outcomes are attained. Although most practical experience may be gained off-campus it is important that staff be convinced of a student's practical capabilities first hand. If there is no residential component, the Institution must demonstrate convincingly how these capabilities will be assessed.

7. The bandwidth, performance and accessibility of electronic communication systems must be adequate to ensure the quality and effectiveness of learning support.

8. The academic staff must be committed, equipped and adequately trained to support distance education mode.

There must be an overarching quality system that includes the distance education mode and engages the students as a key stakeholder in the process.

Appendix 2: Policy on Multiple Campuses and Partnership Arrangements

1. INTRODUCTION

ITP recognises that New Zealand tertiary institutions often offer programmes at secondary or multiple campuses, and sometimes in partnership with other providers both within NZ and overseas. The accreditation process requires accreditation of such programmes to ensure compatibility of outcomes with the programme offered on the home or primary campus.

2. PARTNERSHIP ARRANGEMENTS

Partnership Arrangements are formal arrangements with other providers, either within New Zealand or overseas, whereby students undertake the initial stage/s of a programme at the other institution and then transfer to the institution being Accredited, with predetermined credit, to complete the programme and qualify for the award. This is a formally-agreed arrangement with another provider which envisages significant cohorts of students and specifies credit, usually for an integral number of years of a programme.

A Partnership Arrangement in this context may involve recognition by the institution that the first two years (say) of an overseas or New Zealand institution's curriculum is equivalent to its own, or that a sub-degree qualification completed at another institution will attract a defined level of credit and recognised entry point to their degree programme.

Alternatively, it may involve an overseas institution specifically teaching the first two years (say) of the New Zealand institution's curriculum, with or without some assistance from the NZ institution's staff.

3. POLICY STATEMENT – PARTNERSHIP ARRANGEMENTS

Where no more than one year of the programme is completed at the Partner institution (either in New Zealand or overseas), substantial reliance is placed on the programme's second and third years, at the Institution being Accredited, as sufficient tests of the quality of the initial part of the programme. Accreditation policy should still require the institution to explain what mechanisms it uses to assure quality in the partner-delivered component and that required outcomes are attained.

Where the first two years are completed at the Partner institution (either overseas or in New Zealand) and only the final year is taken in New Zealand, the approach to accreditation will depend on whether the partner-delivered programme follows identically the curriculum of the programme being accredited, or whether it is an separate curriculum recognised as equivalent.

If the institution being accredited can certify that the first two years of the partner-delivered programme follows essentially their curriculum, if there are substantial formal examinations which are set and marked in common between the two programmes, if other forms of assessment can be shown

to be essentially identical, and if all these aspects are part of the formal partnership agreement, then it will normally not be necessary to visit the partner institution.

In all other cases, ITP will require documentation through the institution being accredited, and will conduct a visit to the partner campus (either in New Zealand or overseas), on a full-cost-recovery basis (i.e. as an additional cost for accreditation). In the case of off-shore campuses, ITP will liaise with the local professional associations.

4. POLICY STATEMENT – ALTERNATE AND OFF-SHORE CAMPUSES

Documentation submitted for accreditation of a programme must include information about all major locations at which the programme is offered, to the same depth and level of detail. Similarly, it is expected that the accreditation Panel will visit all such locations and will interview staff and students at each.

Where a programme is offshore and the offshore programme is separately identified from the home programme, it will normally be treated as a separate accreditation exercise and each programme will be evaluated for accreditation in its own right. In such a case, the offshore programme must be identified in some way that is evident from the graduate's testamur; for example the award title may be different, or the delivery location must be shown.

Where graduates of the offshore and the home programmes hold identical testamurs, and the two are represented by the Institution as one programme offered in multiple locations, then the Accreditations Board will evaluate and accredit the programme as a single entity. The accreditation criteria must be met at all locations or combinations of locations through which the programme can be completed.

The programme cannot be accredited at any one location (including the "home" campus) unless it is accredited at all locations, since by the Institution's own statement, there is no distinction.

5. GUIDELINES – OFFSHORE AND SECONDARY CAMPUS VISITS

1. In all cases (i.e. where a campus visit is deemed necessary to either a secondary campus or a partner campus, in accordance with the policy above) ITP will receive documentation from the Institution and will arrange an accreditation visit to the alternative location under the normal procedures. It is particularly important that the documentation be received well ahead of the proposed visit, so that any apparent difficulties can be identified in advance and the visit rescheduled if necessary.

2. The ITP Accreditations Board will determine how many panel members need to visit each campus. Unless the alternative campus is a major delivery centre, it's likely only 2-3 panel members will need to visit secondary campuses.

3. The Institution concerned must reimburse ITP for all costs associated with an offshore or secondary campus accreditation visit. This will also include an additional administrative fee.

4. ITP wishes to undertake offshore accreditation activities only where these are acceptable to relevant authorities in the host country.

5. A check list of the information required is included in Section 6.

6. INFORMATION REQUIREMENTS FOR THE ACCREDITATION OF PARTNERSHIP, SECONDARY, AND OVERSEAS CAMPUSES

The Accreditations Board is interested to learn about the structure and operation of the partnership campuses of the Institution.

In general, the Panel will wish to be assured that the campus offers educational experiences, facilities and standards comparable to those on the home campus of the Institution and that quality assurance mechanisms are in place to ensure the Institution maintains control of the educational programme.

The overriding criterion is that students have the same opportunities to achieve the programme outcomes.

- *Structure*
    - Arrangements with commercial partners (where applicable)
    - Review processes of the arrangement
    - Host Institution educational vision

- *The Campus*
    - Physical facilities
    - Library
    - Computing facilities
    - Recreation and cultural development
    - Other student support services

- *Academic staff*
    - Profile and qualifications
    - Selection procedures
    - Contracts of employment
    - Research activities
    - Student/staff ratios
    - Knowledge of programme outcomes and design principles

- *Support staff*
    - Profile
    - Selection procedures

- *Selection of students*
    - Criteria
    - Procedures
    - Control of Institution admission criteria
    - Who decides credit/advanced standing (where applicable)?

    - Where are the final decisions made?

- *Curriculum*
    - Equivalence to main campus offerings
    - Variety of choice
    - Inculcation of professional and personal skills
    - Access to industry and the profession
    - Access to real life projects and IBL (if present on home campus)

- *Teaching arrangements*
    - Class sizes, locations

- *Quality assurance processes, including, for example*
    - Oversight by senior faculty of home campus
    - Assessment of student's work
    - Moderation processes
    - Management of student progression
    - Feedback on teaching
    - Feedback on student support services
    - Graduate outcomes
    - Graduate satisfaction
    - Progression rates

Appendix 3: Policy on Capstone Units

1. INTRODUCTION

Accredited degree programmes should be holistic in design, leading to comprehensive skills and knowledge required for professional practice in a given ICT discipline or focus area. A Capstone Unit (often, and ideally, implemented as a final year team project) is one way that students can demonstrate comprehensively a coherent attainment of the intended skills and knowledge set as objectives of the programme, and also model professional practice in the discipline.

2. POLICY STATEMENT – CAPSTONE UNIT

Accredited degree programmes must contain a unit (called a "Capstone Unit"), or collection of units, that integrates the skills and knowledge developed throughout the programme.

3. GUIDELINES – CAPSTONE UNIT

These guidelines should be used in designing and implementing a Capstone Unit. These guidelines are not prescriptive. Where the Institution does not follow them, the Panel will wish to be convinced that their alternative approach addresses the objectives outlined in the Policy Statement.

The Capstone Unit should be designed, implemented, and assessed according to the following guidelines:

- The Capstone Unit should require the integration of skills and knowledge acquired throughout the course. This includes skills and knowledge from the building blocks defined in the ICT Profession Body of Knowledge[8]:
    i. **SKILL** – Graduate skills defined by the programme;
    ii. **CORE** – Core Body of Knowledge, including ICT Problem solving and professional skills;
    iii. **SPEC** – ICT Role Specific Knowledge; and
    iv. **COMP** – Complementary knowledge from non-ICT areas defined by the programme.

- Ideally, the Capstone Unit should provide a learning experience that is based on the type of professional experiences that a graduate is likely to encounter following graduation from the programme, allowing students to apply the whole range of knowledge and skills learned on their programme to a challenging real problem related to the specified programme outcomes.

- ITP strongly recommends that the Capstone Unit should involve a team project conducted in conjunction with a real industry client, as it believes that this is the optimal structured learning experience to facilitate a smooth transition to professional practice or further study in the discipline (see Appendix 4). Artefacts generated during such a project should require a student to analyse information such as project requirements, evaluate and justify design decisions, and create new products, positions, or points of view. Assessment rubrics should measure

[8] See Appendix 7 for an extract of the relevant sections from the ICT Profession Body of Knowledge

achievement of both technical outcomes and of professional skills such as project management, leadership and teamwork. Marks should be based on authentic project artefacts developed by students over a period of time, and generally not be based on tests and exams. Additional consideration should be given to critical reflections on learning submitted by relevant stakeholders. Stakeholders may include students, academic supervisors, and industry partners.

- The Capstone Unit should be of significant scope, requiring student effort at least equivalent to that associated with 25% of a full-time semester load.

- Projects in Capstone Units requiring additional effort or spanning multiple semesters are strongly encouraged, but not required. The Capstone Unit will normally occur during the final year of study. Exceptions must be strongly argued.

Appendix 4: Policy on an Introduction to Professional Practice

1. INTRODUCTION

Accredited degree programmes should enable students to demonstrate comprehensively the attainment of the intended skills and knowledge set as objectives of the programme, and also model professional practice in the discipline. Often this will be achieved through projects which implement the requirements for Capstone Units (see Appendix 3).

2. POLICY STATEMENT – PROFESSIONAL PRACTICE

Accredited degree programmes must facilitate for graduates a smooth transition to professional practice or further study in the discipline.

In the case that the Capstone Unit (see Appendix 3) is not oriented towards a transition to professional practice, the programme must include other experiences which do facilitate such a transition.

3. GUIDELINES – PROFESSIONAL PRACTICE

The programme should provide students with an authentic learning experience in relation to its intended professional outcomes. It should enable students to understand, and preferably engage in, the type of professional experiences that they are likely to encounter following graduation from the programme. This would include the application of their knowledge to complex computing problems.

In many cases, this will be achieved through Work-Integrated Learning (WIL), which is very strongly encouraged, and / or an industry project conducted in conjunction with an industry partner or client.

On-campus learning experiences involving engagement with industry professionals, of significant scope and integrated across the extent of the programme, are also acceptable, provided the learning experiences strongly capture significant aspects of professional practice for a graduate in the discipline.

Often the Capstone Unit (see Appendix 3), implemented as a team project for an external client, will address this requirement.

Appendix 5: Policy on Advanced Study Units

1. INTRODUCTION

Accredited degree programmes must contain the equivalent of one semester of advanced study directly related to the specified outcomes of the programme. This policy provides guidance to educational organisations and accreditation Panel members in determining what is advanced study.

2. POLICY STATEMENT – ADVANCED LEVEL STUDY

At least half the units in an accredited programme contribute directly to the development of an ICT professional. One third of the ICT units must be advanced level, equivalent to one semester of full-time study.

3. GUIDELINES – ADVANCED LEVEL STUDY

- These guidelines should be used in designing and implementing advanced study units. These guidelines are not prescriptive. Where the Institution does not follow them, the Panel will wish to be convinced than any alternate approach addresses the objectives outlined in the Policy Statement.

- Advanced units would normally add to knowledge and skills attained in earlier units of study. The submission must show how these units add depth to knowledge gained in earlier units, including specifying the pre-requisite knowledge for the units. Depth can be developed through both process (as in a project) or through in-depth study in a particular area, but not through process alone.

- A Capstone Unit or Project is one way that students can undertake advanced study; however, it is expected that at least half of the advanced units will contribute towards the development of specialist knowledge rather than just requiring the application of such knowledge acquired in earlier units. *(See Appendix 3 : Capstone Units)*

- To demonstrate that a unit is advanced, the subject must:
    - require pre-requisite knowledge from at least one other unit, the content of which is contained within the Role Specific Knowledge (Block 2);
    - use assessments that demonstrate cognition at the Application Level (Level 3) or higher as defined in Revised Bloom's Taxonomy (see below); however, they should also require elements of analysis, evaluation and synthesis (Levels 4, 5 and 6) of the taxonomy[9].

Revised Bloom's Taxonomy provides a means of categorising the cognitive level to which knowledge is used. It consists of six levels. These are: (1) Remembering; (2) Understanding; (3) Applying; (4) Analysing; (5) Evaluating; and (6) Creating. These are further described in the table below:

[9] It has been argued that the hierarchy of Bloom's taxonomy does not ideally recognise the prevalent requirement to engage in analysis, evaluation and synthesis in order to apply ICT knowledge and skills to solving real problems.

Revised Bloom's Taxonomy

Level	Bloom's Category	Description
1	Remembering	Recognizing or recalling knowledge from memory. Remembering is when memory is used to produce definitions, facts, or lists, or recite or retrieve material.
2	Understanding	Constructing meaning from different types of functions be they written or graphic messages activities like interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
3	Applying	Carrying out or using a procedure through executing, or implementing. Applying related and refers to situations where learned material is used through products like models, presentations, interviews or simulations.
4	Analysing	Breaking material or concepts into parts, determining how the parts relate or interrelate to one another or to an overall structure or purpose. Mental actions included in this function are differentiating, organizing, and attributing, as well as being able to distinguish between the components or parts. When one is analyzing he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations.
5	Evaluating	Making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation. In the newer taxonomy evaluation comes before creating as it is often a necessary part of the precursory behaviour before creating something.
6	Creating	Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way or synthesize parts into something new and different a new form or product. This process is the most difficult mental function in the new taxonomy.

- Note that the a unit being offered in the third year of a programme is not sufficient to identify it as being advanced; in contrast, some units taught in the second half of second year might, in exceptional circumstances, qualify as advanced.

Appendix 6: Policy on Complex Computing

1. INTRODUCTION

Graduates from accredited degree programmes should be able to apply their knowledge to complex computing problems as defined by the Seoul Accord.

The Seoul Accord defines a complex computing problem for a Computing Professional graduate as **c**omputing problem having some or all of the following characteristics:

- Involves wide-ranging or conflicting technical, computing, and other issues;
- Has no obvious solution, and requires conceptual thinking and innovative analysis to formulate suitable abstract models;
- A solution requires the use of in-depth computing or domain knowledge and an analytical approach that is based on well-founded principles;
- Involves infrequently-encountered issues;
- Is outside problems encompassed by standards and standard practice for professional computing;
- Involves diverse groups of stakeholders with widely varying needs;
- Has significant consequences in a range of contexts;
- Is a high-level problem possibly including many component parts or sub-problems; and
- Identification of a requirement or the cause of a problem is ill defined or unknown.

2. POLICY STATEMENT – PROFESSIONAL PRACTICE

There is an expectation that students will be progressively be exposed to more complex computing problems as they progress through their programme.

3. GUIDELINES – PROFESSIONAL PRACTICE

Institutions should identify which complex computing attributes are addressed by individual units to show where students are required to apply their knowledge to complex computing problems and that this exposure is progressively acquired throughout their programme.

It is expected that all advanced units (including the capstone unit) should provide an opportunity for students to apply their knowledge to a complex computing problem.

Appendix 7: Extract from ACS ICT Profession Body of Knowledge[10]

1. Designing ICT Undergraduate Programmes

1.1 Overview

It is proposed that course designers define degree programmes using a common framework and nomenclature across the many disciplines that comprise ICT. This framework depends on identifying ICT professional skill sets and designing the programme building blocks that lead to the development of these skills.

Key components common to the proposed framework, as shown in Figure 1, are:

- ***SKILL* Block:** The technical and professional skills developed during a given programme of study that qualify graduates to undertake one or more ICT roles;
- ***CORE* Block:** The Core Body of Knowledge (CBOK) shared by all ICT programmes, encompassing (i) ICT problem solving; (ii) Professional knowledge; (iii) Technology building; (iv) Technology Resources; (v) Services management; and (vi) Outcomes realization.
- ***SPEC* Block:** Knowledge that is specific to a particular degree programme or ICT discipline, and that is necessary to undertake the intended ICT roles(s);
- ***COMP* Block:** Complementary knowledge that broadens a student's education, enhances employability and prepares graduates for ICT careers in the global economy, and to be of service to society and the local community.

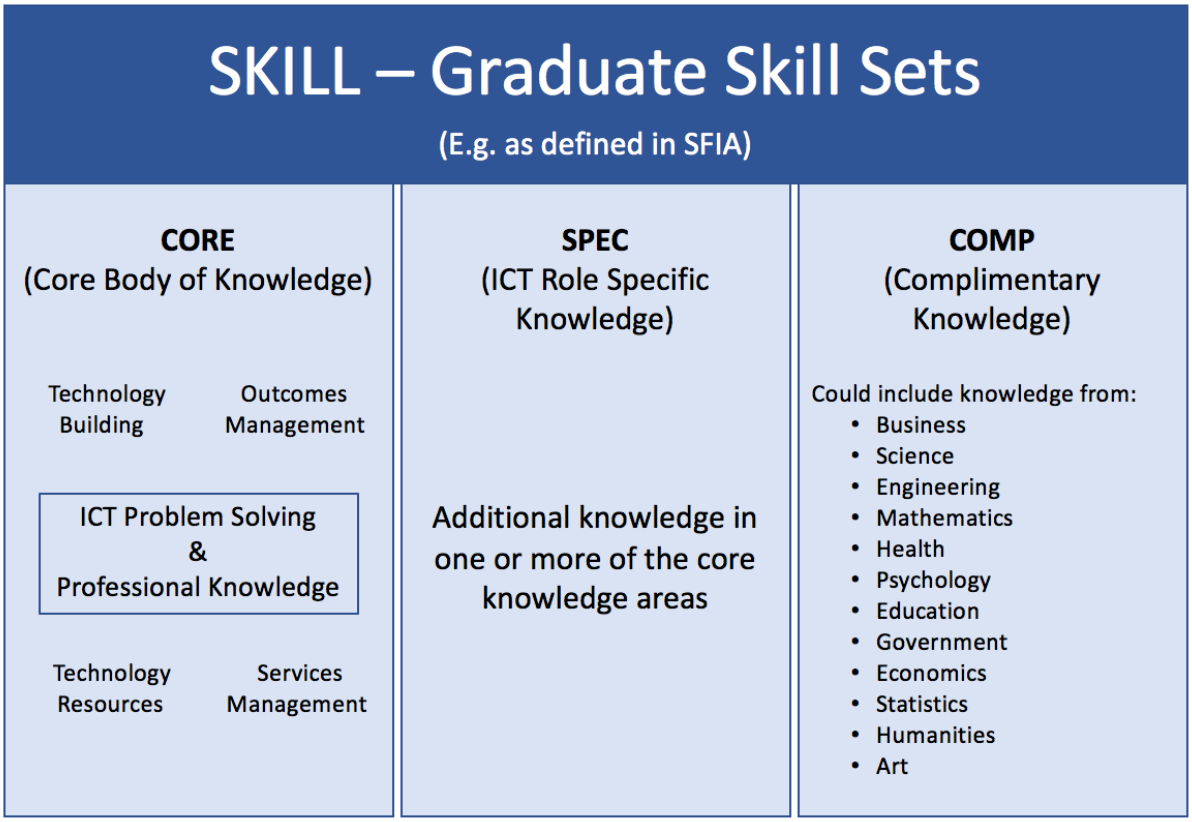

Figure 1: Framework for ICT programme Design

[10] ICT Profession Body of Knowledge, Sections 3-4

1.2 A Structured Approach to Programme Design

A goal of the proposed framework is to facilitate the design of degree programmes that produce graduates with the skills required for defined ICT roles. The level of autonomy and responsibility at which the skill is practised should also be established. Fundamentally, these skills require the application of underlying knowledge that is both broad and deep, and must include both technical and professional knowledge areas.

When designing a course, it is necessary to do the following:

- **Identify potential ICT roles that could be undertaken by graduates of a given programme of study.** These roles might be generic, such that all graduates from a particular degree programme would be qualified to undertake a range of graduate roles within a given ICT discipline. However, a programme may to choose to place more emphasis on certain roles within that discipline. This might be because an institution has recognised expertise in a given area or because there are regional employment opportunities for graduates with a particular focus.
- **Identify the skills required by professionals in a given ICT career role.** Identify the type of tasks that a professional working in given ICT career role(s) would normally be capable of performing. These may be the type of tasks that are normally required to work in industry, or they may be the type of tasks more frequently associated with a research focussed career path.
- **Identify the level of autonomy and responsibility developed.** It should be possible to demonstrate that graduates of a programme operate at reasonable levels of autonomy and responsibility as defined by SFIA.
- **Identify the ICT Role-Specific Knowledge required to practise the skills.** Where possible, internationally recognised curricula and bodies of knowledge should be used to assist in identifying Role-Specific Knowledge. For ICT areas that lack a formal curricula or body of knowledge, supporting knowledge should be identified using other appropriate sources in consultation with the programme's Industry Advisory Board. It should be possible to demonstrate that students acquire knowledge to a suitable depth and breadth.
- **Identify Complementary Knowledge that supports the skill set or that broadens student employability.** As software-based products or services are usually offered in conjunction with a business, many ICT career roles will require knowledge of business functions and processes. Additionally, employment prospects might be enhanced from regionally significant complementary disciplines. For example, knowledge of avionics might be useful in regions where aerospace organisations are prevalent.
- **Design a course structure that incorporates ICT Role Specific Knowledge with the Core Body of Knowledge and other Complementary Knowledge as part of a holistic programme of study.** For example, a course structure should scaffold advanced knowledge on top of programming fundamentals and project management topics from the ICT Knowledge Area of the CBOK.
- **Collect artefacts to demonstrate that skills have been developed by students to an appropriate level.** This generally requires that a representative sample of student work be collected to demonstrate that skills have been developed to an appropriate level. Samples will be made available to accreditation panels for inspection. Artefacts produced by students in conjunction with a capstone project are a good source of material for demonstrating the skills attained by students.

2. Building Blocks for ICT Programmes of Study

2.1 SKILL Block: Graduate Skills

The skills developed by the academic programme should be identified, including the level of autonomy and responsibility at which each skill is practised by graduates.

The SFIA has been adopted by the IFIP IP3 programme as the framework by which the professional programmes of member societies will be judged. Consequently, ITP recommends that academic institutions consider modelling graduate skills on those from the SFIA. In those cases where an institution chooses not to base graduate skills on the SFIA, it will be necessary to demonstrate that the skill set used is equivalent to a similar set defined using the SFIA.

In some cases, the SFIA terminology might introduce problematic nomenclature for a given discipline area. Within reason, it would be appropriate to modify skill definitions accordingly.

For example, the SFIA defines the ***Database/Repository Design (DBDS)*** skill as:

> *"The specification, design and maintenance of mechanisms for storage and access to both structured and unstructured information, in support of business information needs."* (SFIA, 2011)

Some programmes may find the word "business" to be problematic in this skill definition. In such cases, it would be reasonable to omit the word business or to substitute an alternative word like "organisation".

2.2 CORE Block: Core Body of Knowledge

A principal aim of identifying the Core Body of Knowledge was to identify fundamental knowledge common across all ICT programmes of study. This common knowledge is shown in the *CORE* Block of Figure 2 and represents the knowledge that is shared by **all** ICT Professionals, regardless of their specific ICT discipline or domain. This building block has six sub-components.

- ICT Problem Solving (PS)
- Professional Knowledge (PK)
- Technology Building (TB)
- Technology Resources (TR)
- Services Management (SM)
- Outcomes Management (OM).

Core knowledge areas were identified by the Professional Standards Board through workshops and an analysis of the content overlap in international curriculum documents for Information Systems, Computer Science, Software Engineering, Information Technology and Computer Engineering (IS2002, CS 2001, SE 2004, IT 2005, CE2004). See Appendix A of the original document for a more in-depth treatment of the methodology and data used in this analysis.

It should be noted that:

- The core knowledge areas are a **minimal core**. They contain only those areas on which there is broad consensus that some knowledge of the material is **essential** for anyone who is an ICT professional. In some roles, ICT professionals would require only a basic knowledge of some of

the areas that are not central to their role (that is, they may have had only the equivalent of about six hours of study in some areas, and they would be expected only to know the topic well enough that they could explain it to others, i.e. at Bloom's Level 2).

- The core is **not a complete specification** of the knowledge needed by an ICT professional. Because the core is defined as minimal, it does not contain sufficient knowledge for any specific ICT professional. Each ICT professional role would have additional knowledge needed for its particular requirements. For example, in some of the knowledge areas, the professional would be able to operate at a very high level, being able to design solutions to problems and to make judgments about alternative courses of action.
- The core knowledge areas may be less likely to change than other more specialised knowledge, however, it will still be necessary to **review and update** the core knowledge areas on a regular basis
- We recognise that the **terminology** will vary across different areas in ICT. We are attempting to find common terminology that is relatively acceptable across the different areas so we have some underlying understanding from which to work. The descriptions below use indicative wording to describe the topics in each area. However, for definitions of the topic area as understood in different ICT disciplines, the appropriate curriculum should be consulted (see Appendix B).

KNOWLEDGE AREA: ICT PROBLEM SOLVING (PS)

This requires knowledge of how to use modelling methods and processes to understand problems, handle abstraction and design solutions.

This knowledge area is somewhat different in type from the other knowledge areas, as it is seen as an underlying base for all of them. The ability to handle both **abstraction** and **design** solutions has been recognised as a fundamental requirement in computing disciplines over a long period (Dahlbom and Mathiassen, 1997; Kramer, 2007; Turner, 1991).

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 computing 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 so 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.

KNOWLEDGE AREA: PROFESSIONAL KNOWLEDGE (PK)

This area includes:

- Ethics
- Professionalism
- Teamwork concepts and issues
- Interpersonal communication
- Societal issues/Legal issues/Privacy
- History and status of discipline

The issue of "Professionalism" is important and wide-ranging. Other bodies have provided in-depth treatment of the issue and this document should be read against that background. For example, CC2001 has a chapter on "Professional Practice" (Ch 10, pp. 55-61), which is useful. The IP3 Taskforce is currently focusing on the issue in the context of professional certification. The previous ITP CBOK (Underwood 1997) specified the requirements for *Ethics/Social Implications/Professional Practice* and *Interpersonal Communications*.

The SFIA in its Levels of Autonomy and Responsibility Axis mentions degrees of autonomy, influence and complexity, and "Business Skills" including knowledge of standards, problem solving, communication, planning and scheduling, quality, health and safety, acquiring new knowledge, and appreciation of industry activities and organisational contexts.

It is understood 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).

The topics for the Professional Knowledge Areas were developed by mapping commonalities across the different disciplinary curriculum specifications (CC 2005) (see Appendix A). Appendix B gives relevant references for each Knowledge Area in the curriculum documents for each discipline area.

Ethics

Topics covered should include:

- Fundamental ethical notions (virtues, duty, responsibility, harm, benefit, rights, respect and consequences);
- Basic ethics theories;
- Integrity systems (including, ITP Code of Ethics, ITP Code of 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).

Professionalism

Topics covered should include:

- Basic concepts of professionalism (expertise, certification, competence, autonomy, excellence, reflection, responsibility and accountability);
- ICT specific professionalism issues.

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, computer crime, intellectual property and legal issues.

History and status of discipline

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: TECHNOLOGY RESOURCES (TR)

This area includes:

- Hardware and software fundamentals
- Data and information management
- Networking.

Hardware and software fundamentals

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

- Computer architecture and organisation - *Form, function and internal organisation of the integrated components of digital computers (including processors, registers, memory, and input/output devices)* (CC 2001, p. 52);
- Systems software – *Operating systems functions and types, operating system modules, processes, process management, memory and file system management* (IS 2002, p. 27).

Data and information management

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

- Data modelling and abstraction
- Physical file storage techniques
- Database Management Systems (DBMS)
- Information assurance and security in a shared environment.

Networking

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

- Network concepts and protocols (e.g., Web standards and technologies)
- Network security
- Wireless and mobile computing
- Distributed systems.

KNOWLEDGE AREA: TECHNOLOGY BUILDING (TB)

This area includes:

- Programming
- Human-computer interaction
- Systems development
- Systems acquisition.

Programming

This involves an understanding of the fundamental constructs of a programming language, the behaviour of simple programs, efficiency and effectiveness analysis.

The principles, concepts and practices of successful software development (software engineering) should be understood, including program/software testing.

Given the applied nature of software development, 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.

Human-computer interaction

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. Topics covered could include user-centred design methodologies, interaction design, ergonomics, accessibility standards and cognitive psychology.

System 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.

Terminology for this area varies from 'systems development' in Information Systems to 'software engineering' in Software Engineering and Computer Science, to 'systems acquisition and integration' in Information Technology.

The feature that distinguishes this area from 'programming' is that systems development/software engineering knowledge is applied to larger software systems, where no one person has complete knowledge of the whole system. Of course, many of the principles involved in developing larger software systems also apply to smaller pieces of software (programs).

KNOWLEDGE AREA: SERVICES MANAGEMENT (SM)

This area includes:

- Service management
- Security management.

ICT 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. The area is concerned with the "back office" or operational concerns of the organisation and could be referred to as "operations architecture" or "operations management".

Many frameworks exist to guide ICT service management, e.g., The Information Technology Infrastructure Library (ITIL) and Control Objectives for Information and Related Technology (CobiT).

KNOWLEDGE AREA: OUTCOMES MANAGEMENT (OM)

This area includes:

- IT governance
- IT project management
- Change management
- Security policy.

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);
- ICT specific governance issues, and requirements of ICT management;

- Organisational context, including business processes, organisational culture and change 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.

Change management

Change management is a structured approach to transitioning people and organisations from a current state to a desired future state. In project management, change management refers to a project management process where changes to a project are formally introduced and approved.

Security policy

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.

2.3 SPEC Block: Role Specific Knowledge

The CBOK defines the Core Body of Knowledge shared by all ICT professionals, whereas the Role Specific Knowledge prepares students for career roles in a particular ICT discipline or focus area. Examples of ICT disciplines include, but are not limited to: Software Engineering, Information Systems, and Communications Technology. Examples of focus areas include, but are not limited to: Enterprise Architecture, E-commerce, Computational Science, Simulation and Visualisation.

Role-specific knowledge developed by a degree programme should:

- Build on the foundational knowledge identified in the *CORE* Block as appropriate;
- Share a common focus, providing breadth of treatment within an identified ICT discipline or focus area, and not be a mere collection of unrelated ICT subjects;
- Consist of an appropriate number of subjects and levels as specified in accreditation requirements to be defined later; and
- Facilitate the development of intended skills.

Role-specific knowledge will include advanced knowledge that builds on basic knowledge defined in the CBOK. For example, a Business Analyst (Information Systems) programme may include an advanced treatment of database systems for application in a business context. This would typically be at an advanced level that is beyond that of the simple data storage and retrieval requirement defined in the CBOK.

In many cases, discipline knowledge will be developed that is not directly identified in the CBOK. For example, knowledge of computer graphics is not required by all ICT professionals, but is likely to be important to those working in computational science or simulation and visualisation.

Demonstrating a Common Focus and Breadth of Treatment

Knowledge developed in a degree programme should constitute that required for a well-defined ICT discipline or focus area. There should be an appropriate breadth of treatment.

Where possible, a recognised body of knowledge for a given discipline should be used to demonstrate the common focus and breadth of treatment for a given programme.

For example:

- A joint taskforce (ACM/AIS/IEEE-CS) has given an overview of Computing Curricula (CC 2005), which points to more detailed curricula for a range of computing disciplines. These include Computer Science (CC 2001), Computer Engineering (CE 2004), Information Systems (IS 2002), Information Technology (IT 2008) and Software Engineering (SE 2004).
- Updates for Information Systems can be found in Topi et al. (2007).
- Additionally, the Software Engineering Body of Knowledge (SWEBOK, 2004) has been compiled by the IEEE Computer Society. It defines 10 software engineering knowledge areas that are further decomposed into 251 topics. It excludes knowledge from related areas such as computer science. However, it is reasonable to assume that some of these excluded topics are included in the CBOK. An appendix uses Bloom's Taxonomy to identify the expected level of knowledge cognition attained after four years of professional practice following graduation from an undergraduate programme in software engineering.

In those cases where there is no recognised Body of Knowledge for a given discipline or focus area, a custom body of knowledge can be developed. However, doing so is necessarily more complicated and must be justified in supporting accreditation documentation. Developing the custom body of knowledge must be done in strict consultation with an Industry Advisory Panel whose members represent the focus area, and who are potential employers of programme graduates. It is essential to demonstrate that the custom body of knowledge facilitates the holistic development of intended skills and career roles. This should not merely be a list of subjects. For example, in a degree programme with a computer games focus, it is likely that graduates would have a knowledge of physics. However, it would not be sufficient to list "knowledge of physics" without decomposing this to "dynamics". It would also be necessary to demonstrate the relationship of this to other knowledge areas such as computer graphics. Together, knowledge of dynamics and computer graphics support the skill that enables one to design, implement and test computer games that simulate realistic motion using Computer Graphics Imagery (CGI).

Demonstrating Depth of Treatment

Accreditation requirements will specify the number of ICT subjects that are required at an advanced level. To demonstrate that a subject is advanced, the subject must:

- Require pre-requisite knowledge from at least one other subject, the content of which is contained within the *SPEC* or *CORE* Block; and
- Use assessments that demonstrate cognition at the Application Level (Level 3) or higher in the Revised Bloom's Taxonomy; however, they should also require elements of analysis, evaluation and synthesis (Levels 4, 5 and 6) of the taxonomy.

Revised Bloom's Taxonomy provides a means of categorising the cognitive level to which knowledge is used. It consists of six levels. These are: (1) Remembering; (2) Understanding; (3) Applying; (4) Analysing; (5) Evaluating; and (6) Creating. These are further described in the table below:

Revised Bloom's Taxonomy

Level	Bloom's Category	Description
1	Remembering	Recognizing or recalling knowledge from memory. Remembering is when memory is used to produce definitions, facts, or lists, or recite or retrieve material.
2	Understanding	Constructing meaning from different types of functions be they written or graphic messages activities like interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
3	Applying	Carrying out or using a procedure through executing, or implementing. Applying related and refers to situations where learned material is used through products like models, presentations, interviews or simulations.
4	Analysing	Breaking material or concepts into parts, determining how the parts relate or interrelate to one another or to an overall structure or purpose. Mental actions included in this function are differentiating, organizing, and attributing, as well as being able to distinguish between the components or parts. When one is analyzing he/she can illustrate this mental function by creating spreadsheets, surveys, charts, or diagrams, or graphic representations.
5	Evaluating	Making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation. In the newer taxonomy evaluation comes before creating as it is often a necessary part of the precursory behaviour before creating something.
6	Creating	Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way or synthesize parts into something new and different a new form or product. This process is the most difficult mental function in the new taxonomy.

Note that the third-year level alone is not sufficient to identify an advanced subject and, in contrast, some subjects taught early often require advanced levels of cognition.

Under normal circumstances, a final-year Capstone project would meet the criteria for an advanced subject.

2.4 COMP Block: Complementary Knowledge

Complementary Knowledge from outside the ICT area that supports the skill set should be included in the programme.

Complementary Knowledge should be defined to:

- Support the Graduate Skill Set (*SKILL* Block);
- Enhance the employability of graduates, particularly with respect to subjects that are significant for regional employability;
- Broaden the education of students;
- Prepare students who will practise as ICT professionals in industries like science and the environment, mining and resources, banking and aerospace, public administration and education; and,
- Include subjects from related areas that are pre-requisites for ICT subjects, such as subjects from business, management, mathematics or computer engineering.