

# (Re)developing Computing Qualifications: Processes and Outcomes

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## Abstract

This paper begins by outlining how the National Advisory Committee on Computing Qualifications and some of its member institutions have developed and updated certificates, diplomas and degrees to meet the changing needs of employers and students. It then details the processes and outcomes of a major redevelopment project completed last year at the author's institution.

*Keywords:* Computing education, qualifications.

## 1 Introduction

Information and communication technologies (ICT) change rapidly and the need for a well-qualified ICT workforce continues to grow. To help meet this need, tertiary institutions have to ensure that the ICT qualifications they offer are relevant, up to date and structured to meet the requirements of a diverse potential student body: mature students and school leavers, full-time and part-time, local and overseas students. Institutional responses range from the introduction of new elective courses within existing qualifications to developing brand new qualifications. Intermediate options include structural changes (e.g. changing credit values) and the introduction of new "endorsements", "majors", "pathways" or "threads".

This paper reviews some of the (re)developments reported by member institutions of the National Advisory Committee on Computing Qualifications (NACCQ) in the last 11 years and then describes the processes undertaken last year at one such institution to restructure four existing ICT qualifications and introduce a new one.

## 2 Background

Young and Joyce (1998) described how the NACCQ came into existence and was responsible for developing and maintaining a family of national computing qualifications, ranging from a level 3 Introductory Certificate in Computing (ICC) to a level 7 National Diploma in Business Computing (NDBC). They also observed that many NACCQ member institutions developed or "franchised" (Nelson and Joyce, 1998) computing degrees and obtained accreditation and

approval from the New Zealand Qualifications Authority (NZQA) to offer them locally. Mann and Cowan (2000) surveyed 12 NACCQ member institutions offering computing degrees and reported on the providers' experiences and "innovative approaches people are taking in development and management". The current NACCQ chairperson has been a strong advocate for a national degree, but progress towards that goal has been slow (Corich, 2001, 2006; Corich & Nesbit, 2004).

Unitec offered the full range of NACCQ qualifications, beginning in 1988 with the Certificate in Business Computing (CBC) and followed by the Advanced Certificate in Business Computing (ACBC) in 1989, the NDBC in 1990 and the ICC in 1991. Local replacements for these national programmes were developed during 1995 and 1996:

- a one semester Certificate in Computing (Introductory) to replace ICC
- a one year Certificate in Computing Systems (CCS) to replace CBC
- a two year Diploma in Computing Systems (DCS) to replace ACBC
- a three year Bachelor of Computing Systems (BCS) to replace NDBC.

As reported by Joyce, Billings, Comins, Fenton and McSporran (2002), "initially CC(I) followed the ICC approach of having lots of small courses, and allowing students to fail some (although not the communication and numeracy courses) and still obtain a certificate. It has since been restructured as six courses of 10 or 12 credits, with two at level 3 and four at level 4, and students who pass any five will obtain a certificate." Subsequently CC(I) was replaced by a level 4 Certificate in Information Technology (CIT), consisting of five 12 credit level 4 courses, with passes in all five required in order to gain a certificate.

CCS (120 credits) and DCS (240 credits) were offered as "exit qualifications" from the BCS to cater for students who were unable (perhaps temporarily) to complete the degree or needed a New Zealand qualification in order to secure employment or permanent residence. Because of local requirements to have credit values that were multiples of 6, BCS was structured with a capstone project of 36 credits and a mix of 18 credit courses (at levels 6 and 7) and 12 credit courses (at levels 4 and 5). To cater for perceived market needs and avoid the inflexibility (and potential expense) of formal NZQA-approved majors, several "pathways" or "threads" were identified, including networks and systems development.

All qualifications at Unitec are subject to review every five years. The first five year review of BCS took place in

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This quality assured paper appeared at the 22<sup>nd</sup> Annual Conference of the National Advisory Committee on Computing Qualifications (NACCQ 2009), Napier, New Zealand. Samuel Mann and Michael Verhaart (Eds). Reproduction for academic, not-for profit purposes permitted provided this text is included. [www.naccq.ac.nz](http://www.naccq.ac.nz)

2001 and involved a lot of data gathering and analysis, and meetings with staff, students, the advisory committee, and the review panel (Joyce, Goodwill, & King, 2001). The outcomes included:

- changes to prerequisites and corequisites
- introduction of new courses
- renaming of courses
- revision of course content
- replacing the 12 credit courses (at levels 4 and 5) by 18 credit courses (at level 5 only).

In addition to restructuring BCS, five new qualifications were introduced between 2000 and 2006:

- a 240 credit level 6 Diploma in Applied Computer Systems Engineering (DipACSE)
- a 120 credit level 7 Graduate Diploma in Computing (GradDipComp).
- a 120 credit level 8 Postgraduate Diploma in Computing (PGDipComp)
- a 240 credit level 9 Master of Computing (MComp)
- a 360 credit level 10 Doctor of Computing (DComp).

In contrast to the undergraduate qualifications, all credit values at levels 8, 9 and 10 are multiples of 15. For example, DComp students are required to complete two 30 credit courses, one 60 credit course and a 240 credit thesis and MComp students are required to complete a research methods course which is worth 30 credits and either a 60 credit dissertation plus ten 15 credit courses or a 120 credit thesis plus six 15 credit courses (Joyce, 2002). Until this year (see below), GradDipComp students could mix PGDipComp courses worth 15 credits with BCS courses worth 18 credits and DipACSE consisted of ten 12 credit courses.

Meanwhile other NACCQ member institutions have been actively reviewing their computing qualifications, and their reviews have also led to (re)developments. Kelly (1998) reported on lessons learned by the Universal College of Learning (UCOL) from the experience of introducing an NZQA qualification, and subsequently Snell and Conley (2000) explained how and why UCOL decided to offer NACCQ's Introductory Certificate in Business Computing (ICBC) in place of an equivalent NZQA qualification.

Lovell (2000) described the processes undertaken at the Central Institute of Technology to review their Bachelor of Information Technology degree. Changes made included introduction of new courses, renaming of courses and revision of course content and offering a conversion programme (in addition to one already in existence for ACBC students) for CBC students to enter the degree with "advanced standing". The introduction of "exit qualifications" was considered but rejected. More recently, Bayler and Fraser (2008) explained the reasons for replacing a one semester level 4 certificate by a one year certificate at the same level.

Responses to the emergence of new technologies and to industry's demands for particular technical skills have varied. Bekesi and Hanson (1998) reported on research undertaken to identify knowledge, skills and abilities needed in software development, which led to the

introduction of new courses on 4GL programming and systems integration. Sarkar and Clear (2000) described the reasons for, and processes involved in, introducing a networks and telecommunications course into a software development degree.

In the case of electronic commerce, some institutions have added appropriate content to existing courses and others have introduced one or two "ecommerce" courses. At Waikato Polytechnic an electronic commerce "endorsement" of the BInfoTech degree was established (van der Westhuizen, 2001) and at the Christchurch Polytechnic Institute of Technology a Graduate Diploma in eCommerce was developed (Nesbit, 2003).

### 3 Restructuring

In 2007 the academic board of the author's institution decided that all programmes should have credit values that are multiples of 15. This created significant challenges for all schools, particularly those (like ours) that offered courses with credit values of 12, 18 and 36. The author's school was faced with restructuring four qualifications: CIT, DipACSE, BCS and GradDipComp. Restructuring the first two largely involved taking the existing content (packaged in 12 credit courses) and redistributing it into a smaller number of 15 credit courses. Restructuring the last two largely involved taking the existing content (packaged in 18 credit courses) and redistributing it into a larger number of 15 credit courses. However, restructuring was also seen as an opportunity to re-evaluate the relevance of course content and, as appropriate, add or delete topics or even alter the compulsory/elective mix.

Many institutions have made a feature of "staircasing" from certificate and diploma programmes to degrees (Joyce, 1999). This may involve conversion programmes, like those described by Lovell (2000) and by Nesbit and McCarthy (2007). The approach taken by the author's school since CBC was introduced in 1988 has been to ensure that students can progress from one level to the next (e.g. ICC to CBC, CIT to BCS, BCS or GradDipComp to MComp, MComp to DComp) without undertaking additional work. However some students have struggled with making the transition from CIT to BCS and some BCS students have needed to obtain employment before reaching level 7. To meet the needs of both groups we decided to explore the development of a two year level 6 diploma, eventually named Diploma in Information Technology Support (DipITS), that incorporates CIT and provides a good basis for entry into support positions in industry as well as into BCS with "advanced standing". Reactions of contacts in industry and external academics were positive.

### 4 Processes

The processes followed varied according to the nature and context of the programme concerned. The simplest was DipACSE where a small group of subject experts worked with the programme director to repack the ten existing 12 credit courses into eight 15 credit courses. BCS and GradDipComp were more complicated because

there were two sets of programme regulations to work within and many more courses and lecturers involved. CIT was complicated because of the decisions made early on to incorporate it in the proposed DipITS and to replace the existing introductory professional skills course by a tertiary study skills course from another school.

Other complications included the (sometimes conflicting) needs to:

- create programmes and courses that are attractive to students
- minimise prerequisites while at the same time ensuring students are properly prepared
- minimise gaps and overlaps between courses in the same subject area at different levels
- meet the requirements of the institution and NZQA
- meet the needs of employers.

In order to meet these needs, development teams were set up for each programme, and courses were subject to multiple levels of scrutiny by:

- academic teams (responsible for courses in related subject areas)
- programme teams (responsible for courses in particular programmes)
- school (responsible for maintaining an overview of all the school's programmes)
- programme committees (one for CIT and another for the "undergraduate" programmes)
- five year review panel (for CIT only)
- advisory committee (responsible for giving advice about all the school's programmes)
- external academics (for new or substantially altered courses)
- degree monitor (for new or substantially altered degree courses)
- boards of studies (one for CIT and another for the "undergraduate" programmes)
- academic board (for all major changes and new programmes)
- NZQA (for all major changes and new programmes).

In addition, advice was sought from the institution's Academic Quality Office.

Nearly all staff in the school were involved in the development process to some extent. To gather a range of views about the process, a questionnaire (see Appendix 1) was sent to seven staff with varying degrees of involvement (head of school, programme directors, academic team leaders, development team members). Information they supplied has been incorporated in this paper and some of their comments are included below. The present author has also talked to other staff and chaired the school meeting where the structure of the programmes was finalised.

#### *Perceived advantages*

Advantages identified by questionnaire respondents included:

- students being able to take courses from other programmes

- opportunity to include new/relevant material and remove the outdated
- opportunity to look closely at each of the courses and how they were integrated
- DipITS meets a student and industry need and is attractive to international students.

#### *Challenges/problems*

Three respondents identified problems with structure. One observed that

One of the problems was getting the lecturers teaching the level 5 courses to agree to the contact time for the course. There were also problems with getting one of the academic teams to not make all their level 5 courses compulsory.

Another respondent stated that

Getting consensus on what should be a prerequisite course was an issue across a number of discipline streams. Everybody thinks somebody else should teach the "basics" and the "basics" should be a prerequisite to the course. Too many "basics" or prerequisites then make it impossible for a student to complete in the required length of time.

A third respondent listed five questions that had to be addressed:

1. if we add a course, what other course will we take out?
2. will this be compulsory or elective (compulsory courses can have major implications)?
3. what will the pre-reqs be (we can pre-req courses out of existence if we are not careful)?
4. should this be a shared course with other programmes?
5. if so, will they be able to do the same pre-reqs or should we put in others for them?

#### *Communication*

According to one respondent, the changes were communicated in a variety of ways:

Affected academics were involved throughout the process. Admin staff were informed prior to the changes going to boards of studies if not before. Major changes were communicated to students via meetings, handouts, emails and the offer of one-on-one interviews at least a semester prior to the change taking place.

#### *Other comments*

Comments on the overall process included the following:

Any change in structure should be workable for all students regardless of the academic area they choose within the programme. At times this has needed arbitration by the head of school or another senior academic not involved in the affected programmes. At this point, we would look to see how a student in each academic area could achieve their goal. If some areas become more difficult the issue must be resolved and staff have been sent away to try to find a solution and meet back a couple of days later. Change to any programme is not easy with all the processes that must be gone

through. It is made harder with shared courses as this can affect multiple programmes. The sequencing of these approvals is also important. Changing from 18 credits to 15 credits for the BCS and the GDipComp plus the advent of the DipITS, was a very large undertaking and proved difficult for readers, monitor and BOS approval team to understand and get into the right sequence (respondent 1).

The redevelopment of all the courses in the BCS was a massive operation and would not have succeeded with the cooperation and goodwill of all the parties. The concept of using workshops which were attended by all lecturers to initiate the redevelopment and finally to review changes was an important strategy to get the redevelopment done in a relatively short time (respondent 2).

The process was by and large effective because it had

- enthusiastic initiation by enthusiastic staff members
  - timely championing by the head of school
  - efficient allocation of tasks and deadlines for efficient execution
  - appropriate provision of templates and advice
- (respondent 3).

CIT staff willingly did this on top of their already busy workloads ... at the same time as we worked through our 5 year review, plus the development of the new Diploma. So it was quite a major for us (respondent 4).

## 5 Outcomes

The CIT now consists of one 15 credit level 3 course:

- Tertiary Study Skills 3

and three 15 credit level 4 courses:

- Introduction to Information Technology
- Problem Solving
- Software Applications 1.

The DipACSE now consists of three 15 credit level 5 courses:

- Client Operating System Environment
- Communication and Problem Solving in an IT Network Environment
- Server Operating System Environment

and five 15 credit level 6 courses:

- Exchange Servers in Networks
- Network Directory Infrastructure
- Network Implementation and Administration
- Network Planning and Design
- Security for Client.

The BCS now consists of a level 7 project of 45 credits, six 15 credit level 5 courses:

- Hardware Fundamentals
- Information Systems in Business

- Introduction to Databases
- Operating System Fundamentals
- Professional Skills for IT Practitioners
- Programming Fundamentals

two 15 credit level 6 courses:

- Information Gathering
- Project Planning and Control

and an approved selection of electives worth 195 credits (including at least seven more 15 credit BCS courses: one at level 5 and three each at levels 6 and 7).

The DipITS consists of the four CIT courses plus one 15 credit level 4 course:

- Introduction to Programming

six 15 credit level 5 courses:

- Hardware Fundamentals
- Information Systems in Business
- Networking Fundamentals
- Operating System Fundamentals
- Professional Skills for IT Practitioners
- Software Applications 2

two 15 credit level 6 courses:

- Project Planning and Control
- Software Applications 3

and three 15 credit level 6 courses chosen from

- Hardware Technology
- Help Desk
- Network Administration and Support
- Testing and Quality Assurance in ICT.

Students who have completed DipITS can cross-credit five level 5 courses and four level 6 courses to BCS and finish their degree studies in two years.

## 6 Conclusions

All five programmes are underway and no major problems have arisen at the time of writing this paper. Enrolments in CIT, DipACSE, BCS and GradDipComp are very healthy (reversing extended declines in CIT and BCS) and a small number of students are enrolled in DipITS (not surprising given its late approval by NZQA). Continuing students in DipACSE, BCS and GradDipComp have been given the appropriate advice for making the transition from 12 or 18 credit courses to 15 credit courses, and most seem happy with the changes.

Last year's (re)developments involved a lot of effort for most academic staff and also impacted administrative staff and students. Now that we have all had a chance to "catch our breath" we can see that we now have a very tidy and up-to-date suite of programmes to meet the needs of employers and students. The benefits begin to seem worth all the effort!

## 7 Acknowledgements

The author acknowledges the contributions of Bob Beechey, Becky Blackshaw, Shirley Elliot, Kay Fenton, Donald Koh, Hira Sathu and Alison Young who answered the questionnaire at a busy time of year.

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### **Appendix: Questionnaire**

1. Where did the move to redevelop originate (within the school, board of studies, outside)?
2. What were the perceived advantages of the redevelopment?
3. Who led the redevelopment process within the school?
4. Who else within the school was involved in the redevelopment?
5. Did they volunteer or were they “shoulder-tapped”?
6. Who outside the school was involved in the redevelopment (e.g. other staff, advisory)?
7. Who was involved in the approval process (e.g. academic team, programme committee, board)?
8. What were the challenges/problems (e.g. agreeing structure, determining course content)?
9. How were the challenges/problems met/resolved?
10. How were the changes communicated to affected staff and students?
11. What responses were received from affected staff and students?
12. What other comments would you like to make?