

Capstone Projects – An NACCQ Retrospective

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Abstract

Membership of the National Advisory Committee on Computing Qualifications (NACCQ) has consisted of staff of Business Computing departments drawn mainly from Institutions that make up the Institute of Technology/Polytechnic part of New Zealand's Tertiary sector. NACCQ has a long history of close affiliation with those sections of the business sector requiring graduates with Business Computing skills, and has worked closely with them to ensure that in a rapidly changing business environment, the content of Business Computing courses remains relevant. A key experience for students is completion of their capstone project at the culmination of their capstone course. This paper reviews presentations that NACCQ members have been making about Capstone Projects at NACCQ conferences 1998-2007.

Keywords: Computing Capstone projects,

1 Introduction

Membership of the National Advisory Committee on Computing Qualifications (NACCQ) has consisted of staff of Business Computing departments drawn mainly from Institutions that make up the Institute of Technology/Polytechnic part of New Zealand's Tertiary sector. NACCQ has a long history of close affiliation with those sections of the business sector requiring graduates with Business Computing skills, and has worked with them to ensure that in a rapidly changing business environment, the content of Business Computing courses remains relevant. A programme's Capstone Course, where students complete a capstone project is seen as one of the key points of contact with Industry.

Business Computing course designers have a responsibility to keep in contact both with Industry and with their academic colleagues, to ensure students are exposed to courses that draw on the best of practice from both worlds. NACCQ has facilitated this process for its member Polytechnics and Institutes of Technology in New Zealand as they have (since 1990) developed and introduced courses and programmes leading to the following qualifications:

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National Diploma in Business Computing
Bachelor level degrees (several names))
Master Level degrees (several names) and
Doctor of Computing

All of the above have the equivalent of a capstone course where students are to produce some form of product at the end of a Capstone Project process.

The advent of the Internet and search engines such as Google Scholar (which identifies academic articles published or papers presented), has meant that it is now easier to seek evidence as to whether a particular topic is of interest to the academic community at large. A recent Google Scholar "Capstone Projects" keyword search (May 2008) returned a total of 1,110 articles or papers on the topic, while a refined "Capstone Projects" + "New Zealand" search returned 56 articles, of which around 30 appearing to deal with New Zealand capstone projects with a computing flavour. One could conclude from this that the topic of Capstone Projects is of interest in academic community.

Capstone projects can take a number of forms.

In their paper Framework for Organization and Control of Capstone Design/Build projects, Massie & Massie (2006, p36) state

"Senior design capstone projects frequently require team members to self organise for a project and then execute the design/build project with limited resources. This is challenging for inexperienced students who struggle with technical issues as well as program management and team building issues." (Massie & Massie, 2006, p. 122)

while Beasley (2003, p. 122) states"

"A senior capstone course in computing permits the student to experience, in a real-world context, the entire software process – from problem survey through implementation and delivery."

NACCQ member Clear's involvement and experience at a number of levels of computing Capstone Projects provided background for his input into their paper "Resources for instructors of capstone courses in computing" (Clear, Goldweber, Young, Leidig, & Scott, 2001) the authors provide a thoughtful and comprehensive coverage of "the important issues that must be addressed when designing and conducting capstone courses, which involve capstone projects.

They say:

“Whatever the form of the capstone course, one of its unique characteristics is the balance it strikes between product and process. Capstone courses usually involve completion of a finished product, e.g. research-type paper, formal presentation, software artefact, formal report. Yet at the same time their emphasis is on the methodology and process involved” (Clear et al., 2001, p. p. 1)

A further text NACCQ members found useful was “Computer Science Project Work in Computer Science Education” (Fincher, Petre, & Clarke, 2001)

2 Methodology

An inductive methodology is used to explore the research question: “What conclusions can be drawn (if any) from an analysis of papers reporting on Capstone Project courses offered at NACCQ Institutions, that have been presented at NACCQ conferences over the last ten years”

In attempting to answer the question, this author will analyse the above papers. Mapping them to the list of nine questions outlined below.

3 Capstone Project Positioned

A capstone project is produced by a student at the end of a Capstone Course. To get the “flavour” of a capstone course (balance between process and product) Clear et al (2001) state that there are a number of issues that need to be addressed when designing and conducting a capstone course.

“ These issues are addressed through a series of (nine) questions with answers reflecting the way different institutions have chosen to handle them (for their different programmes) The questions cover the areas of :

- Q1 Goals of the course
- Q2 Characteristics of Projects
- Q3 Project deliverables
- Q4 Sponsors
- Q5 Teams
- Q6 Prerequisites and Preparation
- Q7 Grading and Assessment
- Q8 Administration and Supervision
- Q9 Reflection, Analysis and Review.”

(Clear et al., 2001, p. 1)

4 Designing Capstone Projects– NACCQ Member’s Experience

While a consortia of NACCQ members helped to develop the PJ000 Capstone Project, for the National Diploma in Business Computing (first offered in 1990) it fell to the individual institutions to develop their own flavour of Capstone Project as they began developing and introducing their own Degrees (post 1994) for their Institutions (N. C. Bridgeman, 2000), (Damjanovic-Zivic, 2000), (Buchan, Clear, & Hughes, 2002), (Joyce, 2002), (N. C. Bridgeman, 2003), (Joyce, 2003), (Bidois, Clear, Gates, & Talbot, 2004), (Joyce, 2004). However, this

was not necessarily an easy task, and at the time NACCQ members were addressing the issue of balance of need for Industry experience, versus /research background, in a capstone project, Sun and Decker (2004, p. 211) of Washington University Topeka, KS were writing:

“The Computer Information Sciences (CIS) department at our University is in the process of charting the future direction of its required capstone experience.....Our research is leading us toward a two-option experience, one for those students destined for graduate school and another for those who will seek employment immediately after graduation. Proposed for the former is a research class and for the latter the establishment of a faculty directed but student staffed consulting group with the mission of supporting non-profit social service organisations.”

Similar questions were being faced by NACCQ designers who were coming to broadly similar decisions (Joyce, 2002), (Joyce, 2003), (N. C. Bridgeman, 1998), In particular, the expected destinations of their students required different programmes (Diploma or Undergraduate Degree or Postgraduate Degree) to have differing forms of Capstone project. There is some evidence that NACCQ members were exposed to the issue (N. C. Bridgeman, 1998), (Joyce, 2002) of possible difference between what was expected of an NDBC Capstone Project and a degree or postgraduate degree capstone project.

5 NACCQ Capstone Projects– Reporting on Experiences

NACCQ members began reporting on their Capstone Project experiences in 1998.

Table 1 lists the number of papers or posters presented at the various NACCQ conference over the last ten years, that have covered some aspect of Capstone Projects as defined by Clear et al (2001).

Table 1: Papers or Posters about Capstone Projects Presented at NACCQ Conferences

Year	No. of Papers
1998	1
1999	2
2000	3
2001	1
2002	2
2003	8
2004	8
2005	7
2006	1
2007	2
Total	35

For each of the papers presented (above), a judgement was made as to whether there were parts of the paper that address aspects of the nine Clear et al. (2001) questions that need to be answered and/or where choices have to be made by Institutions, as they design and deliver their

programmes/courses which incorporate a Capstone Project.

Tables 2 lists the results of such an analysis of the above papers, with one paper being allocated to more than one choice area, if appropriate.

Table 2: Aspects of Capstone Projects

Paper	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
1	X	X	X				X	X	X
2	X	X		X			X		
3	X	X							
4	X								
5	X								
6	X								
7			X						
8	X								
9	X								
10	X								
11		X	X	X					X
12			X						
13			X						
14	X					X			
15						X		X	
16				X					X
17									X
18	X	X					X		
19	X	X					X		X
20				X					X
21				X					X
22			X						
23							X		
24			X						
25				X					X
26									X
27								X	
28								X	
29									X
30			X	X				X	
31									X
32			X						X
33	X								X
34				X					X
35			X						
Total	13	6	10	8	0	2	5	5	14

This table draws from the following papers: (N. C. Bridgeman, 1998), (N. C. Bridgeman, 1999), (Claxton & Clear, 1999), (N. C. Bridgeman, 2000), (Brown, 2000), (Damjanovic-Zivic, 2000), (Gotterbarn, 2001), (Buchan et al., 2002), (Joyce, 2002), (Garrett, Youngman, McCormack, Rosescu, & Mann, 2003), (Wieck, 2003), (Charkova, Lin, Clear, & Lomax, 2003), (Chard, Lloyd, Strode, & Wempe, 2004), (Garrett et al., 2003) (Clear, McHaney, & Gotterbarn, 2003), (N. C. Bridgeman,

2003), (Joyce, Barbour, Fielden, & Muller, 2003), (Joyce, 2003), (Snell, Snell-Siddle, & Whitehouse, 2003), (Wieck, 2003), (N. Bridgeman & Way, 2004), (Smith & Mann, 2004), (Mann & Smith, 2004) (Bidois et al., 2004), (Gotterbarn, Clear, & Kwan, 2004), (Joyce, 2004), (Chard & Wempe, 2004), (Smith & Mann, 2004), (Smith & Mann, 2005a), (Mann & Smith, 2005a), (Mann & Smith, 2005b), (McLay, Corich, & Millman, 2005), (Smith & Mann, 2005b), (Mann & Smith, 2005c), (Chard, Lloyd, & Proctor, 2005), (Mann & Smith, 2006), (Strode & Clark, 2007), (Goodwin & Mann, 2007)

While there were many other International Journal Papers published and Conference Papers presented about Capstone Projects over the time covered by this review (including a number by NACCQ members) this review has been restricted to using the NACCQ member authored framework (Clear et al., 2001) as a measure against which those papers presented at the various annual NACCQ Conferences (1998 – 2007) could be compared.

Table 3 Summary of Aspects of Capstone Projects

Questions to be Addressed	No.of Times addressed
Q1. Goals of Course	13
Q2. Characteristics of Projects	6
Q3. Project Deliverables	10
Q4. Sponsors	8
Q5. Teams	0
Q6. Prerequisites and Preparation	2
Q7. Grading and Assessment	5
Q8. Administration and supervision	5
Q9. Reflection, analysis and review	14

Table 3 Summarises the data from Table 2. While the judgement calls made might be debatable, this author's analysis would seem to indicate that there has been the most interest around the areas of:

- Q9 Reflections, analysis and reviews
- Q1 Goals of the (Capstone Project) course and
- Q3 Project Deliverables.
- with least discussion about
- Q5 Teams and
- Q6 Prerequisites and Preparation

Over the period 1998-2007, almost all NACCQ member institutions have either just introduced or introduced one or more business computing degree programs which contains some form of capstone course containing a capstone project, thus it perhaps is not surprising the number of papers that included either some aspect of Q1 Goals of Course or Q9 Reflections, analysis and review or include aspects of both.

Table 4 Summary of Presenters

First Author of Paper	No.of Staff
One paper presented as First Author	13
Two papers presented. as First Author	1
Three papers presented as First Author	2
Four papers presented as First Author	1
Five papers presented as First Author	2
Total Staff presenting as First Author	19
Total Papers Presented 13+2+6+4+10	35

Fourteen out of 35 or 40% of the papers, were presented by just three staff members from three different institutions.

6 Findings

Every year surveyed (1998 – 2007) has seen from one to eight papers (about different aspects of Capstone Projects), presented at the annual NACCQ conferences, which would seem to indicate an on-going interest in Capstone Projects.

Although 40% of papers presented have come from 3 First Authors, the remaining 60% have come from another sixteen authors, which indicates a breadth of interest in the subject.

Future research could involve a questionnaire to Institutions asking specific questions of interest, which would allow for more focused conclusions to be drawn about the process-product connections for given capstone projects.

7 Conclusion

There has been a steady on-going interest from NACCQ members in the subject of Capstone Projects. This has resulted in the presentation of 35 papers at NACCQ Annual Conferences over the last ten years, with a major focus being on Reflection, analysis and review of Capstone Courses and their outcomes, plus comments on the goals of the capstone courses.

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