CAPSTONE PROJECTS: INDUSTRY PARTNERING

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The integrated capstone project at Bond University is industry based and has a high research and dynamic content. Students work in groups of 3 or 4 (size depending on the task) with some groups working on the same client problem that has a number of dimensions and other groups working on an individual project where one analysis is sufficient. Emphasis is given laid upon scope definition and the understanding of the problem through a thorough literature review, data collection involving a range of techniques depending on the situation, analysis of the data and conclusions and recommendations. Client response to date after three years has been positive with clients requesting more involvement with this subject. Clients to date have included major national property developers, a government department, a local council and a multi-national surf clothing company.

Keywords: capstone project, partnering organisations.

INTRODUCTION: WHAT IS CAPSTONE?

Based on the literal meaning of the word capstone one may conclude that capstone projects are "fixed on top of something" (Oxford University Press, 2011) and indeed this bears a remarkable resemblance to the practical role such projects play in the educational sector. Based on the origin of the word and its focus on the finishing elements of a particular piece of work, the concept has been extended to include processes and activities of any kind to deliver formal completion. It is this exact purpose that Capstone Projects fulfil in the world of education.

Capstone Projects in higher education represent an ultimate application of the combined qualifications, skills and competencies that students have attained throughout their degrees. Regardless of the specific field, such projects have an element of practical relevance as well constituting an academic challenge above and beyond that of the often rather conceptually confined individual subjects or classes that form the components of the degrees. In a holistic and integrated fashion, such projects challenge students to demonstrate the comprehension of their particular fields of practice, requiring a review and synthesis of the entire spectrum of acquired knowledge from their degrees. Therefore, Capstone Projects not only act as a peaking experience that allows students to increase their awareness for all things acquired throughout their degrees in synergy, but also provide a platform for the active transition from academia and education into the professional workforce.

"A growing number of universities in Australia and internationally have considered the need to provide students with a 'crowning' academic experience that brings

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together the knowledge of an academic discipline or inter-disciplines and student transition to the world of work" (Holdsworth, *et al*. 2009:2). As far as the history of capstone is concerned, Gardner, *et al*. (1998) collected the senior year experiences (capstone) from various authors, including Levine (1998) and Cuseo (1998). These practices were noted as providing an appropriate vehicle for final year students to reflect, integrate, assess and summarise their course experiences. These courses placed great emphasis on the capstone or senior seminar experience.

Capstones are not new. Some evidence indicates that they were used as early as the eighteenth century to integrate philosophical and religious studies (Levine, 1978). In the 1970s Levine (1978) conducted a survey on the methods and goals of capstones. He found their incidence in the universities surveyed at a low 3%, but they could be found in 5% of institutions nationally (in the USA). Cuseo (1998) also reviewed experiences with senior seminars and capstones in the USA. This work centred on analysing capstones in terms of their types, goals and form of experience. Henscheid (2000) in a national US study conducted a desktop study of various databases and discovered that most capstone courses were connected and coordinated by a particular academic discipline or department. A related national survey identified nearly 900 instances of capstone subjects in US colleges and universities. These capstones were identified as falling into one of five types ranked by their occurrence in US tertiary education institutions:

- Discipline and Department Based– these summarise learning within a discipline or major.
- Interdisciplinary) – these synthesise and integrate interdisciplinary features of the courses.
- Transition– these prepare students for employment, graduate school and life after university and often involve career staff and external professionals.
- Career Planning– these encourage professional engagement using university career staff and others.
- Other– ones that do not fit into the types above and often these span courses, majors and commonly aim at addressing university goals.

The capstone at Bond University would primarily fall into the interdisciplinary category noted above. There is also an element of career planning involved with the professional and industry engagement facilitated by the projects selected. Also given the involvement of students with external professionals, as well as potential future employers in the scheme of the capstone project at Bond University, it may also be seen to reflect an element of transitory nature, thereby following another of Henscheid's categories. The practical necessity of stepping beyond this classification will be illustrated in the later sections of this paper.

CAPSTONES IN AUSTRALIA (A SHORT REVIEW)

There are a number of documented capstones in Australia, not all of which are in the built environment: Flinders University (2009), Adelaide in some graduate courses; Curtin University (2010), Perth in the Business School, Swinburne University (2010), Melbourne in the Business School and Queensland University of Technology (2010).

A study from the University of Melbourne has documented (Holdsworth *et al*., 2009) several capstone projects in five Faculties of that university:

- Project Planning Studio, Faculty of Architecture, Building and Planning;
- Business Practicum (3rd year), Faculty of Economics and Commerce

- Capstone Design projects (System Modelling and Design), Melbourne School of Engineering
- Experimental Research project (Zoology), Faculty of Science
- Knowledge Transfer Project, Case Competition (Marketing), Faculty of Economics and Commerce
- Finance and Law capstone units at the Queensland University of Technology (QUT, 2010a, 2010b)

Baccarini (2009, 2010) has also documented the planning and implementation of capstone projects in similar built environment programs and in a similar action research approach.

TYPES OF CAPSTONE

Capstones can be based on a number of approaches. Holdsworth, *et al*. (2009) describes the types of capstone that capture the range of approaches to capstones:

- Problem Based Learning (PBL)
- Project Based Learning (PjBL)
- Case Study Analysis
- Field, clinical or work placements
- Internships
- Simulations or Virtual Situated Learning Environments (VSLE)
- Travel study tours and immersion experiences
- Service Learning
- Volunteering

The number and types are diverse and aim to satisfy the teaching objectives of specific courses and it would be incorrect to describe capstone subjects as 'one size fits all'. Program coordinators and lecturers need to identify the specific aims and objectives of the capstone and continuously alter the program design and tasks to meet the contemporary context and the requirement to engage students purposefully within this.

The Bond University capstone subject has elements of the various types of capstone noted above and specifically it is:

- A final year, final semester subject.
- Enabling students to apply a range of knowledge and skills sets to a partially structured industry and profession based problem.
- Designed to promote program consistency and relevance of the chosen major.
- An important exercise in testing the student's communication and research skills and other graduate capabilities and attributes.
- Aimed to integrate and combine knowledge, skills and learning from previous semesters and subjects over a range of different topic areas. This allows students and lecturers to connect their previous studies and learning. (Huber and Hutchings, 2004).
- Supporting graduate career choices and preparing students for the transition between final semester studies and their employment selection.
- Providing potential employers with examples of student work in their employment related areas and demonstrates their problem-solving capabilities..
- Useful for students to be confronted with a controlled real-world professional environment which they can reflect on with peer review and personal diaries.

- Useful for students within their groups and between groups to develop a sense of common purpose and working together to tackle a common problem.
- A means by which other staff can judge the effectiveness of their subjects in preparing students for integrated project work. The capstone provides a vehicle for some staff to contribute their subject expertise to the project.

CAPSTONE AT BOND UNIVERSITY

Bond University's Institute of Sustainable Development and Architecture (ISDA) has developed a unique approach to the Capstone Project that seeks to synergistically combine the individually potent elements of academic rigor, professional practice and practical relevance. Through continuous refinement of objectives and methodologies used in the selection, preparation and execution and critical review of the Capstone Projects, the program now has matured. It provides for the achievement of a variety of conceptually interlinked, yet practically often neglected, goals in education. The ISDA Capstone Projects provide benefits beyond the student learning experience by means of contributing effectively to real-life projects, fostering closer ties between the academic and the professional spheres. This leads to a regular interplay between academia and practice creating mutual benefits for all involved.

In fact, it is interesting to review Moore's (2008:8) goal for capstone, based in a different teaching environment (communications):

"The capstone course integrates coursework, knowledge, skills and experiential learning to enable the student to demonstrate a broad mastery of learning across the curriculum for a promise of initial employability and further career advancement".

This is similar to the approach adopted by the ISDA at Bond. Whilst common models of Capstone Projects rely purely on research or hypothetical reproductions of real-world scenarios, Bond University's industry oriented philosophy and its track record of successful collaborations with external organizations, businesses and entities has promoted a suitable environment for the creation of educationally focused as well as practically integrated student projects. Now in its 4th year (2008-2011) of operation, the Capstone Project program at Bond University has provided a platform for and continues to deliver added benefits on selected projects to a multitude of significant local, state and national organizations, including amongst others, Gold Coast City Council, Billabong International, Queensland Health, Emerald Shire Council, Point Project Management, Delfin Lend Lease and the Varsity Lakes Community Ltd. Positive feedback from many of the project partners has demonstrated that the Capstone Projects not only provide a practically placed opportunity for applied learning to the students, but have also catered for the requirements of the increasingly complex world revolving around the built environment.

In a recent debriefing for a Capstone Project with members from the Mirvac Group (another continuing partner for Bond's Capstone Projects), it was mentioned that:

"… working with Bond University, under the heading of the Capstone project, provides us with vital and powerful research and knowledge. This type of intensive and objective research and analysis is often sacrificed in practice due to time and monetary constraints, but it is essential as it not only allows us to make better decisions, but in many cases provides us with the convincing supporting arguments to make more sustainable improvements to our developments".

This statement demonstrated the distinct value that the Capstone project can provide to create better built environment outcomes and provide commercial partners with the required knowledge and research to make better decisions in the real world.

Representatives from the industry partner organizations are also involved in formulating the conceptual frameworks laying out the most appropriate way in which their particular set of knowledge and skills can provide the most significant contribution to the projects at hand. Given the diversity of the projects as well as the backgrounds of the individual students and groups, there is significant variation in the particular areas that will be investigated and in which students will make recommendations to the industry partners even within the same semester. Through the preparation of a detailed project scope document prior to the practical commencement of any study, the particulars of the work that is to be executed by the students is specified. The scope also includes roles, responsibilities as well as milestones and ultimate objectives, whereby the practical feasibility and relevance of the projects is assured. This process not only provides a common understanding between partnering organizations, the academic staff and the students, but it also enables and ultimately empowers students to increase their own awareness of their capacity to contribute to real-life projects towards the end of their degree. In doing so it provides students with confidence and assurance of the worth of their studies in the achievement of their own goals in their professional careers.

Upon the completion and authorization of the scope documents and potential sectional adaption, students enter the period of focused research and analysis. During this period, academic staff members provide relevant advice on the design and execution of the pertinent methodologies, relating insight in regard to information finding and synthesizing as well as the preparation of a professional semi-academic report. In this context, the term semi-academic relates to the mixture of an academic and a professional consultant report that the ultimate Capstone Project report is intended to constitute. These reports serve the dualistic purpose of informing the client of the work executed by the students as well as any recommendations that arose from such reports, whilst also epitomizing the essence of academic standards and work as learned by the students throughout their degrees. Whereas the expectations of the industry partners are commonly based around convenience and easy navigation of the reports, the academic requirements, such as appropriate referencing and formatting of the reports must not be neglected. As can be expected, the 'problem of two masters' creates a challenging scenario that must be met with a dedicated focus towards the ultimate goal of providing synergistic outcomes in both the academic and professional realm. Whilst certain compromises may need to be made in the process of preparing reports for these multi-layered expectations, the importance is that the essence of the purposeful integration of the reports in both spheres is not compromised.

In the final stages of the Capstone Projects, the student groups are asked to find the most appropriate form of relating their information to the partnering organizations. Even though the common format is the preparation of a report and associated presentation that summarizes the content of the earlier, experience has shown that by providing students with an adequate platform and an open mindset, creativity is spurred and ever new means are found to effectively communicate concepts and findings. At Bond, this has brought about, amongst others, the construction of both virtual and physical display models, the integration of various illustrative props, interactive web-based tools as well the formation of community based activities. The diversity of communication and delivery methods is matched only by the diversity of

student backgrounds, their creativity and the application of their skills in the respective projects.

Table 1: The Capstone Projects

Industry Partner	Project
Billabong	International Headquarters
Billabong International is a multifaceted business with active operations in various fields, including the "marketing, distribution, wholesaling and retailing of apparel, accessories, eyewear, wetsuits and hard-goods in the board-sports sector". After the recent acquisition of a significant land parcel adjoining their existing international headquarters in Burleigh Heads, Queensland, Billabong approached Bond University for the inception and preparation of integrated and sustainable development plans for a new 'board-sport precinct' to be formed on the combined sites.	
Mirvac Group	Bromelton Intermodal Hub
Representatives from the Mirvac Group, one of Australia's leading real estate groups and sponsoring partner to Bond University's School of Sustainable Development, approached Bond University for the instigation of a Capstone Project based on a current intermodal hub development at Bromelton, Queensland. Students were asked to contribute to the project in a variety of areas including sustainability, transport efficiency and planning, strategic synergies, land use planning, development staging and international benchmarking.	
Varsity Lakes Community Ltd.	Boathouse
Varsity Lakes Community Ltd., a non-for profit organization in charge of community development and the oversight of community assets and activities in Varsity Lakes, Queensland, has collaborated with Bond University on several occasions. In a Capstone Project, students supplied valuable background research and insight to improve the delivery of a $1.8 million community sport house facility. Amongst others, students investigated building materials, strategic alliances and partnering, value adding and income generating uses on the site, funding and grant schemes as well as sustainable inclusions for the facilities.	
Gold Coast City Council	Southport/Light rail
The strategic planning department of Australia's second largest council, the Gold Coast City Council, collaborated with Bond University on a Capstone Project relating to the master planning of one of Gold Coast's central business districts, Southport, in 2010. In the project, students were asked to evaluate a recently prepared draft master plan and make recommendations on its improvement. Students also prepared strategies to increase resident acceptance and usage of the planned light rail as well as proposals for transit oriented developments in the area.	
Point Project Management	9 Mile Development
Members of staff from Point Project Management, including three alumni from Bond University's Institute of Sustainable Development and Architecture, are currently involved with the execution of a Capstone Project based on a development in Papua New Guinea managed by the firm for a local superannuation fund. The project, which involves the creation of a sustainable and affordable housing community close to Port Moresby, requires students to investigate matters relating to infrastructure delivery, project staging, housing designs and construction materials, project feasibility and community safety as well as active transport strategies.	

The final completion of Capstone Projects at Bond University's Institute of Sustainable Development and Architecture involves a full project debriefing during which students are encouraged to exchange the lessons that they have learned whilst working on their individual projects as well as throughout their degrees and the practical value that they have gained from such work for their future careers in the field. At this stage, the industry partners also provide feedback on the work of the students as well as the relevance that the Capstone Project has or is likely to be associated with in the real-life built environment related projects. By means of this process, an interactive dialogue is usually generated that provides valuable insight on the linkage between academia and practice as well as the transition of students from

education into practice. The projects completed, or in progress to date (mid-2011) have included the following and a summary description is included in Table 1.

THE SERVANT OF TWO MASTERS

The fundamental goal of capstone projects lies in the facilitation of unique finalizing experiences that test students' skills in an integrated manner, yet the sole focus on this objective is likely to compromise an ongoing capstone program and lead to its ultimate demise. Without objection, the authors agree that the most important function of the capstone projects is the industry associated conveyance and testing of student abilities for the purpose of their skill enhancement and in order to ease their transition into the workforce. However, in order to operate a functional capstone program that endures semester after semester with the potential to produce increasingly valuable outcomes, academic staff and facilitators must step outside of their usual spheres and rethink and realign their roles as well as reassess the format and content of ultimate results from students.

In the opinion of the authors and based on experience gathered throughout various different capstone projects, the predetermined type and goals of a project stand at equal ranking with the student qualifications and motivation with respect to achieving successful outcomes. Naturally, real life industry projects that are to be considered as the basis for university capstone projects must provide a suitable platform for the application of the various students' skills that are on offer within the group of the respective semester. Depending on the program and other contiguous factors, these skills may always be the same or vary each semester, requiring variation in the type of project or at least the constituent component and approach that the students are required to take in order to add value to such. Matching the project with the particular students' skills is not only essential with regard to the enhancement of the learning experience, but it is also vitally important in the production of useful and valuable outcomes for the industry partners. To be able to do so, facilitators should seek to establish good relationships with appropriate stakeholders from projects that are diverse enough in nature to cater for a variety of value adding student activities to be executed.

Furthermore, no single project should ever be relied on to serve as the basis over multiple semesters and therefore for multiple groups of students, requiring facilitators to build a repertoire of projects to allow for the use in capstone projects. This in turn not only demands ongoing project acquisition for capstone activities through industry engagements, but also calls for a high degree of professionalism in network care and maintenance. Keeping concurrent relations with a range of partnering industry organizations that have been found to prove as good parties in cooperatively executing capstone projects is therefore critical in operating a successful capstone program. Specific qualities that may be found to be of central importance with regard to the partnering organizations in this respect are factors such as their willingness to provide information, their ongoing interaction with the students throughout the project (usually mediated through a university official or facilitator), the extent to which feedback on progress and ultimate outcomes can be obtained from the partner as well as their appreciation for the students' work and the realism of their expectations. Ultimately many of these factors depend on the individual program and its circumstances, but facilitators should develop a checklist of characteristics that they seek in an industry partner and attain the meeting of such factors when establishing engagements.

Naturally, the fulfilment of a dualistic purpose poses its own unique challenges that go beyond those of more theoretical subjects delivered for the sole reason of academic advancement. Without doubt, these challenges will vary from program to program and from discipline to discipline, but the establishment and facilitation of good industry partnerships is central, regardless of the application, for the continued success of any such program. The following section of this paper will outline experiences and critique on capstone projects, but it is worthwhile mentioning at this point that many of the drawbacks can be overcome by good and suitable industry partnering with a variety of partners in order to be able to offer engaging projects to students semester after semester.

EXPERIENCES AND CRITIQUE

The authors have been involved with the Bond University capstone for the last three years and their experiences are summarised below as part of an action study research approach.

Additionally, the capstone students are surveyed at the end of each semester for their views and opinions and these have also provided the basis of the summary provided for the sweet and sour components of the subject.

Advantages

Capstone has the following significant benefits:

- Draws together disciplines (construction management and quantity surveying, urban planning and design, facilities and event management, urban development and sustainability, property and property valuation as well as architecture and environmental management) to establish closer links between areas of skills, knowledge and environmental context in the various majors;
- Provides a significant and different opportunity to assess and evaluate the students' learning in a context related to their chosen majors, a professional environment and in many cases operating with imperfect information;
- Gaps in knowledge and skills become apparent in this project environment where the capabilities of the student are often tested to the limit;
- The expectation is that students work and perform at a higher level due to group activities, the involvement of external clients and the need to present a professional report based on research, analysis, evaluation and recommendations. Business engagement, a feature of the Bond University capstone, generates high performance due to the desire to impress the client(s) especially through the interim and final presentations to the client group.

Drawbacks

- Assessment of performance can be difficult when the project can contain several dimensions that each group may tackle uniquely and the overriding concern of the assessors (internal and external) is to remain objective and not be too prescriptive in assessing the outcomes;
- Some students find the capstone environment outside their 'comfort' zone and may react badly to tackling a real world project where a 'right' answer cannot be provided, nor expected. Students lacking motivation need attention and coordinators need to be mindful and vigilant that poor performing students in a group can be disruptive and early intervention measures have to be adopted to solve these emerging problems;

- Coordinators must have great sensitivity to the volatile environment as individuals and groups can feel helpless and stressed about the requirements to successfully complete the project. Previously high performing students as well as the less motivated can suffer from this problem and intervention in the form of confidence building or project and scope clarification are necessary immediately when this becomes apparent;
- Problems can emerge if regular briefings, progress meetings and progressive evaluation methods are not established in the program and assessment regime;
- In extreme cases some students may not have the capability to complete the task within a group and coordinators must have a strategy to cope with the situation to the satisfaction of all concerned;
- High expectations are embedded in the capstone project and this may disturb some lesser performing students. Early intervention and advice are essential where these comments are made by students;
- Strategies for coping with failure and problems are unlikely to be prescriptive or straightforward. Each situation is handled taking account of the individual circumstances and separate resubmissions may be necessary. Only in the extreme cases of non-performance would failure be accepted.

CONCLUSION

The Capstone subject is demanding of staff and student time and requires detailed management and organisation for it to succeed. The subject is a risky one in terms of its outcome as the staff cannot control a large number of the variables in the subject and the final outcome. In fact, there may be times when staff are faced with a situation where they have to rely on the goodwill of the industry sponsors of the project, the faith of the students and mine their own problem-solving skills to ensure that the project can be completed and the subject aims and objectives are achieved. Staff and students have to be versatile, flexible, forgiving and innovative if their project is to be completed to a satisfactory standard. There have been a few occasions when the road map at the start of the project briefing process has had to change as a result of exogenous factors, some benign, some serendipitous and others negative. Whilst some students may find this environment too challenging causing them to complain because they are taken out of their comfort zone for their studies, the vast majority begin to appreciate that not all projects have complete or perfect information and part of their role as professionals is to cope with this situation. This is the message students take with them into practice and in the opinion of the authors this is good training for the volatile world they will find themselves in soon enough.

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