Multiple Perspectives on a Capstone Project

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Abstract

This paper applies a value proposition model in the consideration of a computing capstone project performed for a real client. The value of student industry projects are considered in terms of value of product, benefit of process, and in terms of quality of work. Nine different stakeholders in the project (students, mentor, academic, client, industry assessors) were asked to rate the project and describe its characteristics according to the model.

Keywords: capstone projects, computer education, value proposition, multiple perspectives.

1   Introduction

Mann and Smith (2006) described a model for characterising the value of capstone projects. In this paper, the authors consider the importance of differing perceptions of success. A case study is presented along with an analysis of the various perspectives used to value the work performed on the project.

Many computing degrees include a capstone project (Fincher and Petre 2001, Mann and Smith 2004, 2005). Chamillard and Braun (2002) argued that "the most critical aspect of the (software engineering/ capstone) sequence is the use of real projects, with real customers" (p227).

Value is often claimed for individual projects (eg Garrett *et al.* 2003), for whole courses (eg Bruhn and Camp 2004). The value of capstone projects is of interest for several reasons: assessment (Mann and Smith 2005); design (Cockton 2004); project management (Boehm 2003); and commercial potential (Tidd *et al.*2001).

Mann and Smith (2006) argued that the value of student projects is more complex than a saleable value (whether real or notional). They explored options including attempting to calculate a figure for client satisfaction.

Most client based capstone projects require a client satisfaction letter of some sort. A difficulty with these letters is that after working with students for a year, unless the interaction has gone very badly, most clients will try to say positive things (the school report phenomenon). A further difficulty is inconsistency of language.

Nevertheless, clearly there would be many projects where a positive client response lines up with what we would consider to be a good project. Similarly, a bad project will often elicit a tempered response. Most capstone supervisors will also recognise mismatches of client response and quality of project ("Great project – fail", or "Terrible project – pass"). The consideration is further complicated by the type of project, not just hardware/software etc, but also the intended value proposition, that is, a project where the client is expecting a new product to sell differs greatly from an infrastructure support project or a research investigation.

The value proposition model aimed to unpack these different perceptions of value by examining four characteristics of a project based on "earned value" (Ergdogmus 2002, and Huang and Boehm, 2005). This

recognises that the benefits ascribed to a development should be tempered by other factors, in our case, the quality of the work.

Use of product: the extent to which interacted with by live user within expected lifespan of product; both frequency and intensity of interaction are considered.

Value of process: the extent to which being involved in the process generates follow-on business value (to both client and institution).

Quality of work: quality of produced product or process.

**Pedagogical benefits:** student learning from the project.

It was recognised that while these are not entirely independent measures Mann and Smith (2006) found that examining capstone projects against the three measures (excluding pedagogical benefits) highlighted substantial differences in earned value.

Mann and Smith (2006) applied the model to a corpus of projects (n=102). Each project was classified high/medium/low for each measure. The summarised data are shown in Figures 1 with key clusters shown in Figure 2.

A limitation of Mann and Smith's (2006) study was the somewhat arbitrary classification of the corpora of projects to cells on the model. Different stakeholders in a project might be expected to have differing perceptions of the value of the project. Jugdev and Müller (2005) review the important of differing perceptions of success in project management (as have Whetton, 2005 in health care, Higgins *et al*. 2002, in education etc).

The aim of this paper is to explore the value perceptions of stakeholders in a project.
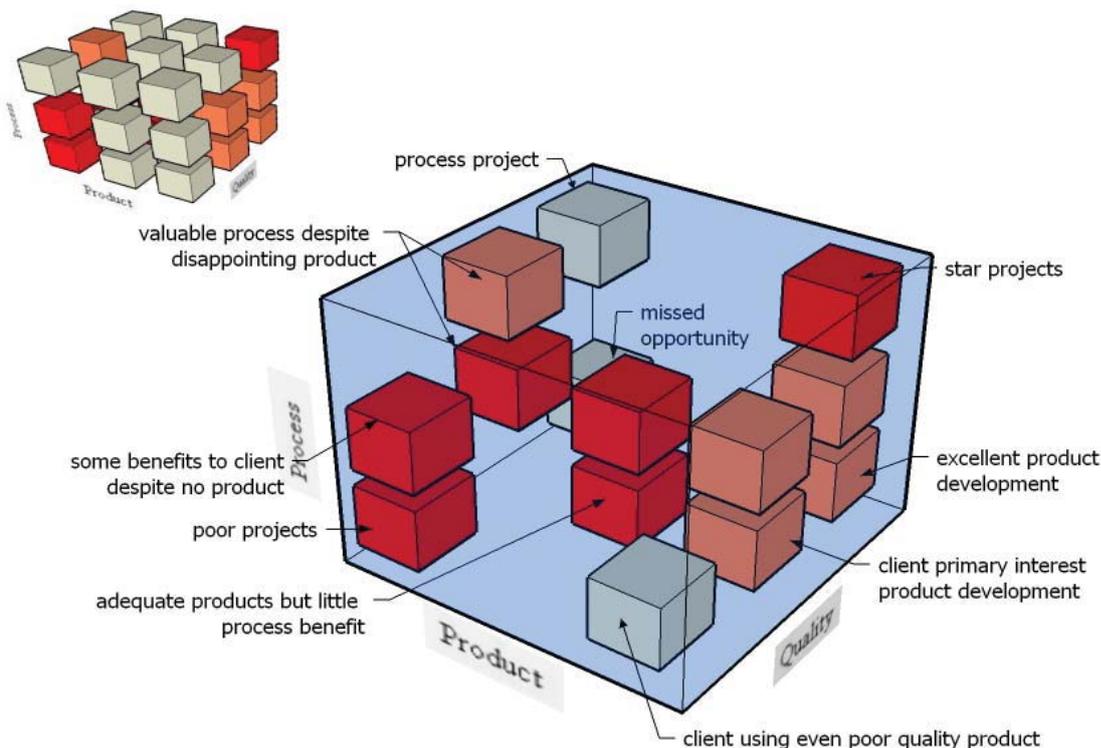
Figure 1: Value proposition model (from Mann and Smith 2006)
as a datacube (shaded according to frequency light none or <3; medium between 4 and 7; and dark 8 and above, axes low/medium/high,

2   Methodology

We invited nine stakeholders (students; mentor; academics; the client; and industry assessors) to rate a project and describe its characteristics according to the value proposition model.

A project was chosen that was completed within the last year. This is a compromise between a short time to adequately recall the project process, and enough time elapsed to properly determine ongoing product use.

The "Creating Customer Value" (CCV) project was undertaken for the Client Support Manager for a large local authority. The Department of Information Systems is responsible for the provision of IT services and communications services to all other Council departments. The CCV is the first step in a major programme planned to eventually integrate all information and data systems Council-wide (Total Information Management System (TIMS).

Within TIMS, the most pressing issue was the timely billing of client departments by the IS Department, and documentary justification of the charges made. The project aimed to develop a stand-alone application to demonstrate concepts involved in developing such a solution. In addition to being a functional system, the project was to act as an inspiration and training of in-house development staff.

A structured interview technique was used with the participant being sent a copy of their responses for confirmation.

- How would you describe the CCV Project, in terms of it being a product that has value to the client?
- From your perspective, how would you value the development process of the CCV Project?
- How do you perceive the quality of the CCV Project?
- Please describe what you think the students might have gained from the CCV project.
- In summary, on a scale of Low, Medium, High (or Not Applicable), how do you rate the value of the CCV Project in terms of:
  - i. how much it has actually been utilised by its intended users?
  - ii. your involvement in the process of its development?
  - iii. your perception of the quality of development of the project?
  - iv. any learning benefit the students might have gained from the CCV project

3   Results

As the aim of this paper is to examine multiple perspectives, it is appropriate that the stakeholder comments are not interpreted at this stage. Instead, it is intended that these narratives form the body of this work. Emergent themes are described in section 3.5.

3.1   Product value

Client:

The CCV Project had great value to the client. The big issue from my point of view is the need for understanding cost of developing such projects, and the administration of this. An example involves recent changes to a system here - an amazing amount of money was spent, and it is only after looking behind the delivered functionality that it makes sense. Another example was a request for the provision of a few cell-phones for the exchange of texts messages - the required administration, security and other aspects needed to be considered.

Academic:

This client runs the IT infrastructure for a large organisation. While we have done several projects for them in the past, and have had successful implementation, only one has been deployed (and that was "under the radar" of the central administration). Everyone elsewhere in the organisation has lots of great ideas for IT projects that would suit our projects but the centralised administration of their IT infrastructure basically makes it impossible for the satellite systems (library, marketing, visitor centre, aquatic services etc) to even investigate this sort of development. When we started this project we were determined that this time the system would be implemented and deployed. This led us to seek the team leader as the client – assuming that he would have the ability to develop a system that could and would be used. This project was designed as a first step in a larger scale redevelopment that the client was undertaking. This meant that it didn't have to integrate with existing systems but was to be deployed and actually used and also as a signal for how the major redevelopment was taking place. About halfway through the project it became apparent that the client didn't actually want a product but was rather using the project as a

means to explore options. I don't think that this was malicious, I think that this project helped the clients realise the enormity of the major redevelopment. The project group was disappointed with this outcome and were worried about the effects of non-deployment on their project assessment. In several meetings we negotiated a "deployed to mothball" solution – the system was tested, deployed and ready to run but not actually used.

Student K (individual student responses are coded K, N, and R):

I think that the CCV project has immense value to the client as it has the potential to elevate any problems they currently have or will have in the future around interdepartmental costs and calculations.

Even though I am happy with the outcome and value of the project, I believe with more time the worth would increase immensely.

Student N:

Our purpose was to build a prototype on which our client can do further development. CCV was very good software development project. Our client had raw thoughts and we put them to together and result was our successful CCV project.

Student R:

I believe the CCV Project had value to the Client, but did not fulfil its potential. This was caused by a combination of factors, including relatively low and diffuse client expectations, combined with limited capacity of the development team. The development team limitations were caused by a number of factors; I shall restrict comment to those factors involving myself.

Assessors:

My recollection of this project was that it attempted to allow the DCC IT department to manage accounting, billing and reporting between the various departments of the DCC – the main one being the IT Department. I was somewhat surprised to learn that no such system was in place, and that therefore a system that was workable and reliable would be an asset. My recollection of the project was that the system was not put in place, and so without consulting the client, it would be hard to determine whether the client placed value, or what amount, on the project.

3.2 Development process value

Client:

I found myself fully involved in the CCV Project, as it began with my own concept. What was delivered met all requirements as a concept program, but there were a couple of instances of scope drift. I was also aware of the development team's efforts at creative input too.

Academic:

I don't think that the development was very smooth. I think the project group had quite mixed abilities and energies and in trying to make sure the group pulled its weight, more could have been achieved.

Student K:

I value my involvement in the development of CCV project to be one of a needed addition with different skills from other group members.

Student N:

Our team implemented Software Development Life Cycle (SDLC) in our CCV project development process. We adopted agile methodology in CCV project development. Our team maintained very good relationship with client. Work was divided equally between group members. Our team worked in a happy environment and everyone was enjoying doing CCV project.

Student R:

If I had not been involved in the development process, the CCV Project would almost certainly have failed, but this says little, as the development team was constructed for me to manage. My original purpose in undertaking the project course was to make useful contacts in the local region to help me find work. It became apparent to me fairly early that I would not be seeking employment with the Client, leaving me with just two main drivers to complete the project successfully: get my team mates through, and not waste my money and time failing the course. These were enough for me to pull the team through, but only just.

3.3 Quality value

Client:

The quality of the CCV Project was only determined at the end of development. It was confirmed by the excitement of our senior management evaluation panel, which could see the benefit & value to the DCC.

Academic:

I think that the project was useful to the client, perhaps more so than we realised at the time. It was difficult, though to see past code (etc) that didn't seem to be quite there and decisions that seemed strange.

Student K:

My perception of the development process was that it was of a good quality.

Student R:

The quality of the development process was very poor. I had limited experience of recent development methodologies, and did not apply the discipline necessary to keep things on track. The only reason that this did not derail the project completely was because of the skills that the team acquired in interacting with the Client, and in presenting our work in the best light.

Assessors:

It seemed that the quality of the development process was acceptable, although I believe that many problems can be solved by the adoption of existing software. I find it hard to believe for example, that similar size enterprises as the (client's) do not have propriety accounting or billing packages.

3.4   Education value

Client:

The first thing I learned from the CCV Project was that Council support of the local education cluster is very important. Indeed, I have learned that Otago Polytechnic provides valuable system development resources, available for the whole city. If running such a project myself, I would have run differently, given business constraints (time, cost, quality), but the development team did a great job.

Academic:

I think the group learnt a lot from the project. The weaker members of the group realised that they weren't going to be carried, the stronger members learnt about the difficulties of balancing quality of work and encouraging other members of their team.

Student K

I learnt from the project a good understanding of development process, team/group work and that there is an immense work load and paper work evolved in a project of this kind.

Student N

(The other students) were doing all paper work, they designed the application and my job was to do implementation. Student R had programming experience but he want me to improve my skills so I was doing development on my own, Whenever I needed help Student R was there to help me to solve the problems. As I was doing almost all development on my own I had very good experience in problem solving.

Student R:

The main thing I learned from the CCV Project was that I have limited mental resources, and need to marshal them better if I want to achieve my aims in life. The project started out quite well, with predictable team teething problems being resolved. However, we failed to produce a Functional Deliverable on time, and never really recovered. From my point of view, this was attributable to a combination of excess work commitments (which I am used to, but had not anticipated in this instance), and illness (which I am not used to.)

Assessors:

I hope they learnt that every client is different, and that some clients seem to be a lot more difficult than others.

3.5   Summary and discussion

The numerical feedback from the stakeholders is represented on Figure 2 and discussed below.

All participants considered the product of the project as low value (note: with exception of the differing perceptions of the students, the sub group variation was nil).

The industry assessors placed the project as low product value with medium process value and low quality. These recollections align with both the original grade and the feedback at the time of assessment.
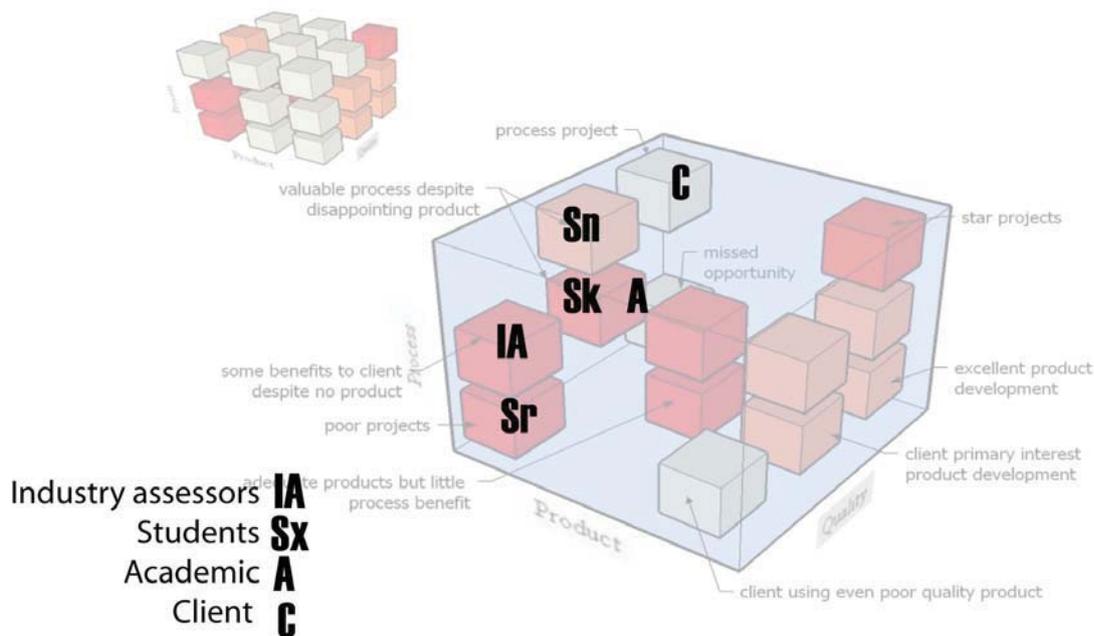
Figure 2: Perceptions of the project according to the value proposition model

Mann and Smith (2006) described these projects as "valuable process despite no product…. These are project for which no product was produced but there were still some benefits to the client. Some have made a business pathway clear, sometimes that this is in an area worth investing in, in others, an area or technical approach they wish to avoid". They go on to give reasons why the poor product use might have happened: a poor understanding of experimental design; a macho approach to tools, and tardy development. None of these, though, apply to the CCV project, there was a product, it just wasn't used.

The client placed the group in low product use but high process value and high quality.

In summary, the primary result was that the CCV Project was successful – the final presentation was really important, the senior management were impressed, and they wanted to investigate further. Furthermore, the concept of going through the process of a system development was important; it is necessary to get down to the nuts and bolts of the costs involved. Such things are often overlooked, or left out in ISS budgeting.

Mann and Smith (2006) described such projects as "valuable process despite disappointing product".

One of the students rated the project lower than the industry assessors, not seeing redeeming factors in quality or process.

The other two students and the academics were between the extremes of the critical student/assessors and the positive client. One student went as far as to describe a high value process.

We have, then, stakeholders with widely differing perceptions on the value of the process: a client who achieved his goals of a product to inspire his development team (and was therefore pleased) and assessors focussed on deployment who saw an partially incomplete product remaining unused.

In a slight twist, the authors realised a sense of *deja vu* when writing this paper. Mann and Smith (2006) described a single project in the "process project" cell: "although the project originally intended a development stage, the analysis became the focus of the project. It is perhaps not surprising that with an emphasis on implementation and deployment in assessment, this is the only 'process project'. This was the same client. Looking back, the project had almost identical outcomes for the client despite the lower quality of the CCV project.

Mann and Smith (2006) argued that "We have tried in recent years to avoid projects that might be seen as failed developments such as

these, rather we have recast them in early stages of development as having a product: that being an intentional prototype (or series of prototypes) to answer specific questions".

Clearly, in this case, we have not managed to get this product:process distinction articulated early, in other words: a "proposed value proposition" (Perry *et al.* 2004). Nor have we successfully managed the project with this in mind. Despite not really ever wanting a deployed system, the client still ranked the project as a "low product use" (along with everyone else). This could have been avoided if the project product was clearly defined as software to be used in promotion of the TIMS approach.

4   Conclusion

Mann and Smith (2006) suggested several benefits of the value proposition model: early in a project, as a management tool, in promoting reflection, and in assessment.

The earned value model has been of use in exploring factors affecting the success of a particular project. Different perceptions of the outcomes in terms of product, process, and quality, along with educational benefits can be seen to reflect different understandings of the purpose of the project and its outcomes. Had these contrasting perceptions been identified earlier, the overall value of the project may have been higher.

Further research should explore the explicit use of the value proposition model early in the project cycle with the hope that this positioning will provide a common understanding of the benefits of the proposed development.

5   Acknowledgements

6   References

Boehm, B. (2003). "Value-based software engineering." SIGSOFT Softw. Eng. Notes **28**(2): 4.

Bruhn, R. E. and J. Camp (2004). "Capstone course creates useful business products and corporate-ready students." SIGCSE Bull. **36**(2): 87-92.

Chamillard, A. T. and K. A. Braun (2002). The Software Engineering Capstone: Structure and Tradeoffs. Proceedings of the 33rd SIGCSE technical symposium on computer science education, Cincinati, Kentucky.227-231

Clear, T., F. H. Young, M. Goldweber, P. M. Leidig and K. Scott (2001). "Resources for instructors of capstone courses in computing." ACM SIGCSE Bulletin 33(4): 93-113.

Cockton, G. (2004). From quality in use to value in the world. CHI '04 extended abstracts on Human factors in computing systems. Vienna, Austria, ACM Press**:** 1287-1290.

Copeland, T., T. Koller and J. Murrin (2000). Valuation: measuring and managing the value of companies, John Wiley.512

Erdogmus, H. (2002). "Value of learning options in software development under private and market risk." Engineering Economist **47**(3): 308-353.

Fincher, S., M. Petre and M. Clark, Eds. (2001). Computer Science Project Work: Principles and Pragmatics. London, Springer.

Fox, A.-M., L. Takau, S. Yuan, P. Haden and S. Mann (2004). Fish n Clicks. Proceedings of the 17th NACCQ, Christchurch, NACCQ.492

Garrett, P., D. Youngman, J. McCormack, C. Rosescu and S. Mann (2003). Characteristics of success - virtually there. Proceedings of the 16th Annual NACCQ.269-272

Goodsir, K., A. Douglas, S. Holo, A. Mann, A. Sewell, L. Smith and S. Mann (2005). SciCards. 18th Annual Conference of the NACCQ, Tauranga, NACCQ.352

Higgins, R., P. Hartley, et al. (2002). "The conscientious consumer: Reconsidering the role of assessment feedback in student learning." Studies in Higher Education **27**(1): 53.

Huang, L. and B. Boehm (2005). Determining how much software assurance is enough?: a value-based approach. Proceedings of the seventh international workshop on Economics-driven software engineering research, St. Louis, Missouri, ACM Press.1-5
http://doi.acm.org/10.1145/1083091.1083095

Jugdev, K. and R. Müller (2005). "A retrospective look at our evolving understanding of project success." Project Management Journal **36**(4): 19.

Mann, S. and L. Smith (2004). <u>Role of the development methodology and prototyping within capstone projects</u>. Proceedings of the 17th NACCQ, Christchurch, NACCQ. 119-128

Mann, S. and L. G. Smith (2005). A+, Guaranteed: Insisting on best of practice within capstone projects. <u>Proceedings 18th Annual NACCQ, Tauranga.,</u> Proceedings 18th Annual NACCQ.243-248

Mann, S. and L. G. Smith (2005). Exhibiting reality: collaboration in practice. Proceedings 18th Annual NACCQ, Tauranga., <u>Proceedings 18th Annual NACCQ</u>.65-74

Mann, S. and L. Smith (2006). <u>A value proposition model for capstone projects</u>. *19th Annual Conference of the National Advisory Committee on Computing Qualifications*, 175-182,Wellington, New Zealand, NACCQ in cooperation with ACM SIGCSE, www.naccq.ac.nz

Perrey, R., A. Johnston, et al. (2004). "Value propositions: a new conceptualisation for integration." <u>Journal of Enterprise Information Management</u> **17**(2): 142.

Tidd, J., J. Bessant and K. Pavit (2001). <u>Managing Innovation: Integrating technological, market and organisational change</u>. Chichester, John Wiley.338

Whetton, S. (2005). "Successes and failures: what are we measuring?" <u>Journal of Telemedicine and Telecare</u> 11 Supplement 2: 98.