
Closing the Gap between the Stakeholders Involved in ICT Capstone Projects

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Abstract

This paper describes the capstone project course delivered over the past few years at AIS St Helens and the potential mismatch between the three parties, stakeholders, involved in the course. The supervisor's primary concern is that the software engineering process is followed and the learning outcomes are achieved. The client's main concern is either product or a working prototype is delivered. The students, usually foreign to the country, wish to demonstrate that they have the skills to obtain a job in the IT industry. Students often find projects that provide real-world problems such as changing requirements for which they are not prepared. They are also expected to learn new skills not taught in the preparatory papers. Many are unprepared to undertake the lifelong learning required by the industry. Thus, conflicts exist between the process and the product. The timeframe is often too short to meet the course objectives or the project scope (product functionality or quality). The capstone project process is assessed to resolve the sometimes conflicting priorities of the three parties involved.

Keywords

Capstone project, Information technology, International students, IT project.

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1. Introduction

According to the Project Management Institute PMI (2008) a project is a temporary attempt undertaken to create a unique product, service or result, the project end when all project's objectives have been achieved or when it is terminated because its objectives cannot be met. Project management is the process of applying knowledge, skills, tools, and techniques to project activities to meet the project requirements (Project Management Institute, 2008) However, inconsistencies always occur between the project manager and stakeholder or between the project manager and team members, and effort is required to manage stakeholders' expectations. Similar issues often appear in our Graduate Diploma in Information Technology (GDIT) capstone project management process, there are always gaps between the students, clients and supervisors need.

Thus, the purpose of this paper is to study the potential mismatches between the supervisors, clients and students expectations while contributing to capstone project activities in the GDIT (one year) program. The paper highlights these issues and considers how such gaps can be addressed.

Other work done by Mann and Smith (2006) introduce the value proposition model which evaluate student industry projects in terms of benefit of product, value of process and quality of work, the model rate by high, low and medium each of the three factors, Goodwin and Mann (2007) use these measures to evaluate a particular capstone project after completion and highlight substantial differences in earned values considering all stakeholders opinion. The paper outlines

that overall project value may improved, if the different perceptions identified earlier.

Our institution has offered the Graduate Diploma in Information Technology since 2004. An external organisation acts as client in the capstone project course within this qualification. Isomottonen (2008) outlines why the effect of such collaboration in learning is extremely valuable. Burge and Gannod (2009) argue that the capstone project has a number of benefits, such as supervisors select projects that are of personal interest, students may propose a potential project or select from a range of options and industrial involvement can be encouraged. However, it is important that the capstone project provides a sufficient level of realism to equip students with real experience of jobs after graduation. Thus the students want to be able to demonstrate that they have the skills to get a job. The supervisors (and academic standards) require that the correct processes being followed and the learning outcomes are achieved. The client wishes to obtain a functional product (or a prototype that can be further developed). Therefore, the three groups are seeking potentially different outcomes, united in wanting a successful project and product, this paper discusses the potential mismatch between the aims and aspirations of the three groups.

The remainder of this paper is concerned with the potential mismatches and considers how such gaps can be addressed. Section 2 outlines how the capstone project is run at our institution. Section 3 considers the methods used to conduct the research. Section 4 analyses and discusses the information obtained from the surveys and observations made by those involved.

Section 5 concludes the paper and addresses future research.

2. Background

2.1 The GDIT Structure

The GDIT course is offered over one academic year, delivered across three semesters for full-time students. The programme is targeted for international students, mostly from India and China. The major course they undertake is System Development Integration, which is offered over the first two semesters. In the first semester students study the System Development Life Cycle SDLC (Project management, Planning and Analysis) and in the second semester the remaining topics of Design, Implementation, Testing and Maintenance. In parallel they study database, networks and a programming/web development language. They also study some fundamental papers in the first semester of their enrolment. The systems development integration course conducted uses a case study to implement all SDLC stages and prepare students for the documentation and more abstract parts of the course. The programming, database and network papers prepare them for the implementation aspects.

This study examines the viewpoints of the three parties to see if there are discontinuities in the outcomes, and if so, if the gap between them can be resolved.

2.2 The capstone project process

The academic staff responsible for teaching the project paper approach organisations for projects before the start of the semester. Potential clients are invited to prepare a short brief (typically half a page) about the project and to present their projects to students. Students can form their own groups to 'compete' for

projects. The coordinator then matches clients and their projects to the student groups (depending on their ranking of preferences) and a supervisor from the wider teaching staff is assigned to each project. The matching of student groups also takes into account the mix of courses the students have completed (e.g. the programming language used) and the skills of the students against the difficulty of the projects.

Then, supervisors contact the client and arrange for the initial client site visit to conduct requirements gathering and to assign individual roles to each team member. Over the next two to three weeks, the student teams prepare the project proposal. When completed to the stakeholder's satisfaction it is signed by the client, the team and the supervisor. It acts as the initial requirements agreement between the three parties. Other learning agreement elements highlighted in Clear (2010) such as relating theory to practice and academic discipline related goal and outcome are covered by providing students with templates to fill as part of project documentation.

There is a weekly meeting where all the students and supervisors are present. The first meetings are taken up with course administration, group formation and client presentations. Thereafter, the sessions are designed around the deliverables (project proposal, project plan, analysis, prototype design and so on) with guidelines and tips given to the students. Then, at subsequent sessions the students present the relevant work. In addition, the students can meet with supervisors and/or clients at a time, place and frequency mutually negotiated.

Generally, the software development methodology followed is incremental prototyping, in which the product is built through successive versions that are refined and expanded in each iteration. Students present the project functionalities completed so far to the client during client meetings, collect feedback and any new requirements; the team then incorporates client feedback, implements more requirements and presents again. This process continues until the client and supervisor are happy with the solution presented by the team. The project is then signed as completed.

3. Method and sample data collection

Chan and Paynter (2006) examine the gap between students, academics and industry in their respective positions in meeting the requirements of their respective roles. This study used a combination of surveys and interviews to obtain the perspectives of each group. Our concern in this paper was to examine how to close the gap between expectations and delivery in the final semester project. Accordingly, a survey was conducted to investigate the opinions surrounding the capstone project for GDIT students, this study explored the following:

- If our students are sufficiently skilled to conduct projects for the clients
- The effect of frequent communication between students, client and supervisor on the project outcome
- Client expectation of project deliverables
- Project complexity and duration
- The role of supervisor in the process

A small convenience sample was conducted to determine opinions of clients¹, graduate students² and supervisors³. We used both online survey and paper-based questionnaires to survey the three target groups. Each of the three related questionnaires had four to six sections.

The client questionnaire covers client involvement and expectations, project duration limitations, the clients' opinions toward supervisor involvement and student contribution. The last section, demographics, covered the client organisation's background and previous project feedback. There were 27 invitations sent out to complete the survey 14 completed survey forms were collected. And of these, 64% were from companies that undertake IT activities and 36% from companies involved in primarily non-IT core activities. 79% of these organisations had been operating for five years or more, over 35% of respondents had experience with more than one team of our GDIT project students, one had 6 teams and another had 4 teams.

The supervisor questionnaire covered project characteristics, project duration, supervisor involvement, client involvement. Eight responses were collected from nine invitations.

¹ The Client is a company representative who provides project requirements, meets with students to follow up project progress and finally accept the project. Clients are usually external to the academic department.

² The Graduate students is a graduate who successfully completes all the requirements of the GDIT study, including the final project

³ The Supervisor is an academic staff member who facilitates the final project process

The student's questionnaire included project duration, supervisor involvement, client involvement and the student's general background information. 57 individuals responded to the survey from over 150 emailed from the survey link. More males (75.4%) than females (24.6%) completed the survey. All respondents were 20 years old or above, with most falling in the 20-30 year old range (82.4%). The respondents' ethnicity was mainly Indian (68.4%) and the remaining ethnicities including Chinese (21%), Japanese and Indonesian.

4. Survey results and discussion

4.1 Students Skill and aptitude

Since the majority of our students come from different backgrounds and they only undertake two semesters, each of 14 weeks IT study before conducting the capstone project, we thought it necessary to investigate clients, students and supervisor's opinions surrounding student's skill and aptitude in IT. 85% of clients agree that "students are sufficiently skilled to conduct a small project for their company", clients comment that students lack "*conceptual thinking*". This might be due to weak communication skills or cultural background. 75% of supervisors agree that "the theoretical study provided in the first two semesters was sufficient to prepare students for the final project".

Only 50% of students answered "Yes" to the question "The theoretical study provided in the first two semesters was sufficient to prepare me for the final project".

Since all our clients required application development, some of students' comments, "*networking was*

completely waste of time". and" I feel it help as basics .. not up to real industry's point of view".

Few students believe they need more in depth programming and database skills, few students comment that they need to study different technologies, as their project involved technologies that had not been taught in the earlier classes. Davenport and Prusak (2000) define knowledge as, "a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information.". As the students focus on the intricacies of the tools, they typically do not realise the theory behind it that provide the necessary framework to transfer their knowledge to a different environment.

The results above suggest that students lack of confidence; they need to learn "how to learn", as this is an essential skill for students and practitioners in the IT area, as it the field constantly evolves. That is, "knowledge is inherently recursive" (Armour, 2000)

4.2 Expected deliverables

Due to the nature of the qualification, we expect our students are more likely to produce a prototype or a component that can be integrated into an existing application than a ready to launch solution. Fig 1 outlines survey questions and client expectations of project deliverables. 64% of client respondents agree or strongly agree to never assign mission critical projects to students, 100% of supervisors agree to this question. In terms of deliverable expectation, 50% of the clients expected a complete solution and 57% expected a prototype that could be taken to the next stage (by another project group or an external or internal IT group), over 35% of clients expect students

to deliver both. Clients from companies that undertake IT activities were more likely to favor a prototype as an outcome, while clients from non-IT organisations preferred a complete working solution. All client respondents agree or strongly agree that the client should verify the deliverable before acceptance (100%).

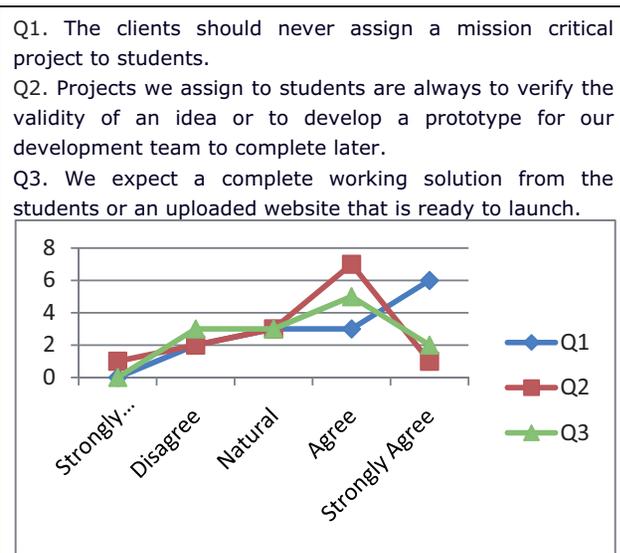


Fig 1 project deliverable, client's opinion

4.3 Project Characteristics and Process

The nature of a valid project for academic purposes to achieve the requirements of the GDIT is problematic. In general, all projects surveyed in this study involve software development, mainly web development, and students worked in teams. Every team member had to record in their individual journal twice a week to reflect

on the project experience. Each team conducts an oral presentation every second week to the entire project group. This typically consists of PowerPoint slides and at later stages of the project may include documentation and the prototype or working system. We often find one team member fails to contribute as expected. It is impractical to closely monitor the individual student's contribution. In the competency-based approach of the project, the students pass or fail as team depending on the outcome of the project. Hence the stronger students tend to have to do more of the work. However, some students must rework their individual deliverables; a set of documents based on the unit standards. This study also investigated the possibility of enforcing a workplace environment in the campus lab for teams who could not get a client's offer to work in their office.

Fig 2 summarises the supervisors' opinions on project complexity and other issues surrounding project learning environment. All supervisors believe that students work better in campus, and they must provide a quality product before final presentation

Most supervisors believe students should learn new skills while undertaking the capstone project. However, supervisors added: *"The new skills and technologies should not be more than 30% in the project upon the student current skills"* and *"The most suitable projects, not too easy or too hard"*

- Q1. Students should learn new skills and technologies, not only gain extra experience on existing skills Clear(2001).
- Q2. Project complexity must be extensively beyond the students' existing knowledge and experience clear (2001).
- Q3. Students must provide a quality product at completion before the final presentation and grading.
- Q4. To reflect real world environment and to achieve better product quality and learning outcomes, students should be required to work on campus for at least 32 hours a week and the roll must be recorded.

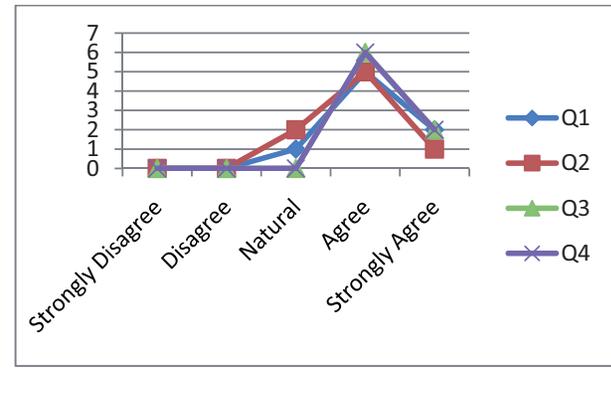


Fig 2 Valid capstone project, supervisor's opinion

4.4 The effect of project duration on its final outcome

Supervisors often obtain feedback from students that the project duration is very short. This is often manifested in gaps in the final product, especially in the area of validation of user input. Often students cannot deliver all client requirements within the 14 weeks. At the proposal stage, these requirements are classified as out of scope.

We investigate clients, students and supervisors opinions on this area; all categories of survey participants were asked to respond with a "Yes" or "No" to the question "The team would deliver a better solution to the client if the project duration was longer", 83% of the clients, 75% of students and 75% of supervisors responded by "Yes" to the question. 44% of the clients, 69% of students and 80% of the supervisors believe that increasing the project duration by one month should be sufficient for students to deliver a better solution. It is not surprising that the students, supervisor and client struggle to agree on the specific project requirements, as this is usually the hardest part of the SDLC even for a single coherent experienced team, let alone groups brought together possibly for the first time. All projects have the triple constraints of scope, time and cost and all involve uncertainty Schwalbe (2008). Hence, if this balance is not carefully made from the beginning the quality of the final product suffers.

This study also investigated the possibility of dividing the project scope to complete the project over two semesters by two teams. 13 clients responded to the question "If the project duration is insufficient, the scope of the project can be divided into two stages. Having an additional team from the following intake to continue the work would lead to a successful process", 84% of clients and 100% of supervisors agree that this would be successful process, assuming that project could be supervised by the same supervisor over the two semesters.

4.5 regular communications between students and client

Students were asked the following questions to investigate the effect of regular communication on the

project final outcome. Then results were filtered by both questions

- 1- "How often did you meet with the client" , respondents may select once a week, fortnightly or as required
- 2- "When did you complete or expected to complete the final project?" respondents may select before the end of semester of enrolment, at the end of semester of enrolment, before the beginning of the next semester, during next semester.

The percentage of students who finished the project within the expected time frame is then calculated for each different meeting period. Table 1 presents the results.

While Table 1 does not reflect any impact of regular meetings with clients on the outcome of the project, 93% of client respondents express interest in regular student progress reports to the client once a week or fortnightly. In contrast, supervisors reactions were more mixed, with two supporting "once a week", three "fortnightly" and three "as required".

Some client's commented that; regular meeting with clients ensure delivering client expectation, weekly meetings with email in between were the best.

Students who fail to deliver on time (students who complete the project during the next semester), provide the following comments, "if clients keep on changing the requirements then ultimately it affects the time schedule".

Table 1: Project completion met deadline vs. frequency of meeting with client.

Q2 \ Q1	before the end of semester of enrolment	at the end of semester of enrolment	before the beginning of the next semester	during semester next	Total respondent	Percentage of the 1 st and 2 nd column (finish in time)
Once week	1	7	3	3	14	57%
Fortnightly	6	6	2	1	15	80%
As required	8	8	4	2	22	72%

4.6 Regular communications between students and supervisor

In the same manner, the effect of regular reporting to the supervisor was studied. The results were filtered by two questions

- 1- "On average how often did your team meet with the supervisor", respondents may select any option from column 1 of table2.
- 2- Same as question 2 in section 4.4

The percentage of students who finished the project within the expected time frame is then calculated for each different meeting period. Table 2 presents the results.

From table 2 it is obvious that regularly meeting with the supervisor led to a successful project outcome, 87.5% of supervisors believe that they need to meet with students at least once a week.

Table 2: project completion met deadline vs. frequency of meeting with supervisor.

	Students select one of these	before the end of semester of enrolment	at the end of semester of enrolment	before the beginning of the next semester	during next semester	Total respondent	Percentage of the 1 st and 2 nd column
Twice a week	12	13	4	1	30	83%	
Once a week	2	5	1	5	11	54.5%	
Fortnightly	0	0	1	0	1	0%	
As required	2	3	3	0	8	62.5%	

4.7 Supervisor Role

The supervisor's role in the capstone project often varies according to the students' needs and the nature of the project. It also varies during the project's progress. In general, we noticed that students need more guidelines in the early stage of the project than later, as they build on clear requirements, understanding and establish their ideas and schedule. Clear (2001) outlines that the "instructor's role includes, but is not limited to structuring, monitoring, managing, and assessing students work".

This study investigated clients and supervisors expectation of the supervisor involvement in the capstone project. Table 3 outlines the survey questions along with client, and supervisor responses. The responses indicate the percentage of respondents who agree or strongly agree with the question surveyed.

Table 3: Supervisor role in the capstone project

Questions	Clients Respond	Supervisors Respond
A supervisor's role is to act as a mentor, to provide suitable skills and strategies customised for each project case, and to maximise the potential teaching environment	92%	88%
A supervisor's role is to act as a technical consultant, and to suggest techniques and technologies students may overlook if left on their own.	75%	100%
A supervisor's role is to act as a project manager, to monitor project progress and to offer students general guidelines, as students will make detailed decisions themselves.	The question not presented to client	50%

5. Conclusion

As described in this paper it is difficult to balance the often conflicting concerns of the parties involved. The students want to obtain (the skills necessary for) jobs, the supervisors wish to see a correct process is performed throughout the project lifecycle and the clients seek a completed product or working prototype. These conflicts and lack of congruency in the desired outcomes can affect the product and process of delivering the deliverables and / or delay the project.

In this paper we investigated the opinion of the three parties involved in the capstone project process and delivery. Considering the results presented in the previous section, although supervisors require a quality product to be delivered, clients from IT companies are

satisfied with a prototype as a deliverable. We believe that a suitable capstone project will be a non mission critical project, which requires a working prototype that addresses all functional requirements, or a component to be integrated to an existing system as a deliverable. This is due to the short time frame constraint as well as lack of industrial experience by the students, a complete working product could be achieved by other teams using the prototype as a starting point. Projects should provide students with the opportunity to extend their skill and knowledge, not only to reinforce existing skills.

It is also found that clients are interested in weekly or fortnightly progress report, and supervisors who meet with their students twice a week were able to keep students on track and achieve a considerably higher project completion rate within the limited time frame. Supervisors provide suitable skills and strategies, suggest techniques and technologies tailored for each project case. However, project management activities should be left to the team leader, and the three way communication over the whole capstone project duration will be an advantage, especially at the early stage of the project.

We will continue to evolve the course learning for each semester, in order to achieve better results necessary for a satisfactory outcome. We will also try some alternative models for the course as an opportunity to see how varying some of the parameters may provide a better solution to meet respective needs.

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