A Win-Win Situation:
Benefits of industry-based group projects

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Abstract: Many tertiary institutions use group project courses as capstones for their engineering, software engineering, computer science and informatics degree programs. These courses give students the opportunity to put together the jigsaw that is their learning from the apparently disparate pieces they have collected throughout their degree program and to gain some experience dealing with team issues. Benefits to students from participating in such courses are well documented. Not so well documented, however, are the benefits flowing to industry from participating in such programs. This paper describes the benefits one local company has derived from its participation in our third and fourth year software engineering group project course. We also draw conclusions about the model that has enabled benefits to flow to all involved – students, industrial partner and educational institution.

Introduction

Increasingly tertiary institutions are turning to group projects and group work more generally to provide students with experience that will help them develop important 'work-ready' skills. Benefits to students from participating in such courses are well documented (e.g. Beasley, 2003; Dutson et al, 1997; Oakley et al, 2004; Reichlmayr, 2006; Todd et al, 2005). Students participating in industry-based group projects gain a richer set of experiences through "dealing with real problems rather than simple, or even complicated, academic exercises" (Chamillard, 2002) that "stimulate student interest and provide additional motivation to complete the project" (Gorka et al, 2007).

Since 1999 we have been running software engineering group project courses. These projects have been academic 'canned' projects as well as those with industry partners as clients. In 2004 we combined our third and fourth year software engineering group project courses into a single course, and now all students undertake a two-semester (26 week) real-world project with industry partners. Teams are comprised of one or two fourth year students who fill the role of team managers and three or four third year students as team members. In addition, all teams have an industry experienced mentor assigned to meet with them at least fortnightly. Mentors provide formative feedback on processes and artefacts. Each year we run between 12 and 15 unique projects, depending on numbers of students enrolled. Greater detail about the design of this course can be found in Johns-Boast & Flint's paper (2009).

Industry partners do not play a formal role in student assessment. When we first began offering industry-based group projects, clients provided an assessment of the team's performance based mainly upon the final product's ability to meet their needs. This assessment contributed 10% of student marks. However, this assessment was widely varying between clients. Also as the projects themselves were often vastly different, it was very hard to moderate client assessment. Since 2008, we have introduced project reviews as part of our assessment scheme. While clients attend these reviews and

participate fully in them they do not formally provide a ranking or grading of the team's performance. Having clients participate in the reviews ensures that teams do not attempt to present their project in a more favourable light than reality. In this instance, the client usually wastes no time in asking questions which expose the student team's fanciful presentation of the state of play. Equally, they are usually more than willing to ensure that course academics are made aware of team successes. Additionally, involving clients in formally awarding marks to student teams raises the potential for conflict of interest, as many industry partners employ students from the group project teams either during or after completion of the project. Johns-Boast (2010) provides a more detailed description of the assessment approach used with this course.

This paper presents, as a case study, the benefits one of our industry partners gains through their participation in our course. We use this case study to highlight the benefits we believe can and should flow to industry through participation in such industry based project courses. In presenting our model, we make some recommendations on how to maximise the benefits to be gained from industry-based group projects.

Case study

Background to the company

The industrial partner described in this study is a local Australian SME specialising in the design, development and manufacture of advanced radar and communications solutions for civil and military applications. The company's product range includes wideband antenna systems, scalable active phased array radar for surveillance and missile fire control applications, maritime integrated communications systems and harbour and coastal surveillance systems. The company exports radar and communications systems to several countries and remains at the forefront of innovation.

Development of the software systems required to control these products takes place in-house. Most software developed by the company is embedded within these large electronic systems, so software development is typically treated as a sub-project within a larger project. Within its software development arm, the company has three levels of engineers: levels 1, 2 and senior engineer. Level 2 or senior engineers are responsible for taking the technical team lead role within the software development team. These staff also have a role in mentoring and developing more junior software engineers within the company.

The company's Technical Director is keen to participate with the university as he has a strong sense of needing to give back to the community and to help develop the next generation of Australian engineers. The majority of the company's software engineering staff has gained their degrees at our institution and this helps to foster the strong link that exists between the company and our institution.

Since 2002, the company has sponsored five student projects (in 2002, 2004, 2006, 2009 and 2010). As we require that all industry projects are not critical to the organisation, there have been a couple of years when the company has been unable to sponsor projects due to a lack of suitable projects or when their staff profile has precluded participation.

Company's model for participation

Technical team leaders – i.e. level 2 or senior engineers – participate in the software engineering student group projects. Company participants volunteer to take part in the program or on occasion the software engineering manager may suggest an individual take part because they possess a skill set relevant to the project being undertaken by the students.

Originally the company designated only one individual to have responsibility for the student project. However, it was soon discovered that this caused problems, both for the students and the company, should this person be away for any reason, such as holidays or sickness. Now there are always two people designated with responsibility: a primary person and a second, fall-back person. This decision has impacted the company's ability to sponsor a project each year, but ensures that once a project is undertaken the whole process runs more smoothly and increases the likelihood of the delivery of a useful piece of software.

The company acculturates the student team into the company culture. Essentially members of the student team are treated as employees and real-world expectations are placed upon them. It is made clear to team members from the outset that this is a serious company with real products to produce and real dead-lines to meet and that, as such, failure is not an option. Student teams have not let the company down yet.

Once the student team begins to produce working code, the company works closely with the team to ensure that it meets their quality standards as well as the more general requirements of the project itself. Software is regularly included within the company's code-base and is given extensive user testing (usually by the company's software engineering development team) while it is being developed by the student team.

Company benefits

What makes the approach this partner has taken unique is that they use the student project as a training ground for their own staff. Staff working with the students may have had limited prior experience as a technical team leader and limited experience mentoring more junior staff. This is particularly so for the 'backup' staff member. Participation as the technical team lead for a student team provides staff members with the opportunity to apply the learning that they have gained on the job, or through attendance at external short-course training in management.

In effect, acting as the technical team lead for the group project provides *work-experience* for these members of staff, enabling them to learn on the job; to experiment and make mistakes without it unduly affecting their career, which mirrors the experience we are attempting to create for our students.

Experience gained through participation in the student projects is considered by the company as quite valuable, but because it is regarded as a training exercise it does not directly impact upon the staff-member's promotional prospects. It also provides staff with valuable experience that they would otherwise not get. For example, it enables participants to experience the role of a 'customer' – an experience that they do not normally get because the software engineering staff are normally suppliers rather than purchasers of products and services.

Additionally, participation in the course provides the company with the more usual benefits of:

- a framework within which to keep in touch with the university thus enabling senior management to build strong collaborative relationships with academics;

- building a good reputation with students as an employer of choice, thus ensuring that on graduation local students will seek employment with the company;

- enabling potential employees (current students) to be filtered. For example, after working with the students for eight months, it is easy to know whether they will fit within the company's culture;

- the addition of one to one and a half person years to the company's software engineering team's output through participation in the group project. This enables the software development team to produce real products that are useful and necessary for company operations but which would otherwise take longer to develop and/or may never be developed. This software can (and has been) absorbed into core company operations.

  While the successful development of the software is not key to the company's operation, as required by our rules of participation, the software that has been developed has been used by the company to aid its day-to-day operations and involvement of student teams has enabled development sooner than otherwise would have been possible. For example, participation in the group projects has enabled the company to develop software that has helped to streamline configuration management issues surrounding the development and release of complex engineering systems, while another project has contributed to the building of simulation software to help with the testing of radar arrays.

Company issues faced

The only real issue the company has faced in its eight years of participation in the group project course relates to assigning only one company representative to the project. Since the company has allocated two technical team leaders to each project there have been no real issues.

The company has not had to face the issue of failing projects, due mainly, we believe, to the model that they have put in place to handle participation. In essence, the company takes the projects very seriously, and will only engage in a student project if they can provide a suitable task, and if appropriate staff resources are available to supervise the students.

Benefits and Issues

In this paper we focus on the benefits and issues experienced by participants in industry-based group project courses.

Benefits

As Chamillard et al (2002) also identify, our model of industry-based group projects provides real benefits to each of the three stakeholders – students, industry and academic institution. However, we believe that our model provides even greater benefits to industry than might otherwise be expected.

Benefits to Students

- From their third year of study, students participate in the full software development lifecycle. As part of their assessment they are required to reflect upon the process of software development, thus enabling them to begin developing skills that will lead to life-long learning.

- All fourth year students gain experience managing a team of their peers. This gives them the opportunity to put into practice the various technical and management theories to which they have been introduced during their degree program. Reflection encourages them to experiment and to discover what approaches work in different situations.

- Working with industry partners on real-world projects, provides students with what amounts to a 'work integrated learning' experience, but one where we are able to control for many of the problems encountered through sandwich courses and internships (Orrell 2004).

- Opportunity to gain work-experience within industry while still studying full-time.

- Experience on which to draw when applying for positions on graduation.

Benefits to Industry

- Provides industry with an opportunity to deliver a community service; to help develop the next generation of software engineers.

- Provides work-experience for junior and mid-level staff. This experience equates in many ways to that experienced by the students.

- Enables industry to develop and maintain close relations with the academic institution.

- Provides additional development capacity at a much lower cost than would otherwise be the case.

- Provides industry with an opportunity to vet potential employees to ascertain their suitability.

- Provides industry with an opportunity to present themselves to students as an employer of choice.

Benefits to Educational institution

- Enables academics to offer more engaging projects than otherwise would be possible.

- Enables academics to develop meaningful relationships with industry.

- Enables academics to more readily understand issues faced by industry.

Issues

The issues we have encountered since 2004 have not, in our view, been significant. They have, however, included:

- Industry partners who put forward projects and then have not provided the level of support necessary to ensure any sort of success.

- Industry partners who have put forward projects that are in reality unsuited for student projects.

Reflections

This paper has used a case study to highlight the benefits that we believe can and should flow to industry partners through their participation in tertiary student group project courses.

As one would expect, we have had both successful and some less successful projects. In comparing these projects to discover whether we could discern any pattern that might help us predict student project success we noted the following:

- some clients proposed projects, the successful outcome of which would significantly benefit the company;

- some clients treated their student teams more as employees than as students undertaking an academic assignment;

- some clients invested more heavily than others in the success of the project by, for example, using their own test teams to test the software developed by the students;

- some teams had fourth year team leaders who were very committed to the successful outcome of the project and led by example.

Companies and teams exhibiting these characteristics seemed always to have successful projects regardless of the overall academic calibre of the student team.

The industry partner described in the case study believed that they had always been lucky and had teams comprised of students of high academic calibre. However, when constructing teams we do not select students based on academic performance; rather students are placed in teams based upon their expression of interest in undertaking the project. Therefore our case study industry partner had not had teams comprised predominantly of highly achieving academic students. In some cases, teams were composed of predominantly lesser performing students, yet in all cases the student teams have produced high quality, commercial grade software for our case study industry partner.

In addition, we believe that this model enables the flow of learning in both directions between the academic institution and the industry partner. It provides an opportunity for students to demonstrate to their industry client the benefits of an approach or theory to which they have been introduced at university and about which the client may have little knowledge. Conversely, it also provides an opportunity for industry to inform academics about the real-world problems that they face, of which an academic may have little experience.

Recommendations

Ensuring a successful outcome for all stakeholders – students (learning, grades, fun), industrial partner (production of quality software and intellectual assets, as well as delivering real value) and academics (student learning, confidence in assessment, development and maintenance of industry contacts and partnerships) – can be a very difficult task as stakeholders have widely divergent requirements for success. Success for one may not necessarily mean success for another.

To increase the likelihood of success for all stakeholders we make the following recommendations.

- **the industrial partner should**
  - ensure that the task presented is achievable within the constraints presented by a student project

- be prepared to make a significant time and effort commitment to the project
- approach the student project as a normal in-house or contract software development project
- expect and demand real commitment from the student team

- **the student team needs**

  - a team leader who is focussed on the outcomes of the project NOT just marks
  - is willing to be guided by the industrial partner

- **the course academics should**

  - provide mentors with real-world experience
  - encourage students, through the assessment scheme, to focus on the project and not the marks
  - encourage students to be innovative and to take calculated risks

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