

VICI: Experiences in Introducing Student run Software Companies into the Curriculum

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Abstract.

This paper discusses a novel course run at the University of Sheffield entitled: "Setting up and Running your own I.T. Company." The course is taken by all 4th year students on the M.Eng. in Software Engineering and M.Comp. in Computer Science. The course involves the students organising themselves into companies and trading with a variety of clients. It introduces some of the issues in identifying market opportunities, formulating proposals, negotiating contracts with clients, capturing the requirements, managing the satisfactory construction and delivery of the product, quality assurance, keeping accounts and many issues that relate to the way a real company needs to operate. The paper reports on the current status of the project and on some of the experiences of the staff and the students involved in it. Some conclusions are drawn and recommendations made for those wishing to develop a similar course.

Introduction.

Many comments have been made about the inadequate preparation that many of our graduates appear to have for life in the modern business and industrial world. Engineering employers, particularly, are very vociferous on this point. The recent Dearing Report [1] and much of what underlies the Engineering Council's SARTOR Report [2] focuses on this issue.

It is not just about developing communication and teamwork skills or about having attended modules in business studies or accountancy, it is much more fundamental than that. The belief is that *graduates do not understand the context, the processes and the constraints that apply to business these days*. As such they are poorly prepared for the challenges that the dynamic world of work will pose.

One way in which this can be approached is through the use of industrial placements and sandwich degrees whereby students spend from 3 to 12 months working in a company, either as part of their course or during vacations. This can be very valuable if the placements and vacation experience is of a suitable nature. There are, however, a number of problems with placements of this type. Firstly, the student's experience on a placement is quite hard to monitor in order to assure ourselves and other interested parties that it is *valuable, challenging and relevant*. Secondly, a negative experience on a placement could be very damaging to the student's self-esteem, to their understanding of the world of work or to their continuing studies. Furthermore, there is no reason, *per se*, that a placement will help a student to develop the entrepreneurial skills and understandings that are being demanded by the business community.

In [3] a number of comments are made such as: “Universities *seem to be teaching the inappropriate technical and business skills for our industry.*” Ian Taylor, CMG.; “Some *older Universities, in particular, do not even see their role as preparing people for work.*” Gordon Ewan IT-NTO. These comments reflect widespread attitudes amongst many business people, not always based on reliable information and in many cases anecdotal. It is clear, however, that, even if we think that our graduates are fit for a career in business, some of their prospective employers don't. It may just be a myth, of course, and certainly the demand for our graduates is far in excess of supply (last summer nearly all of the graduates from this department were offered several jobs at salaries significantly higher than a young University lecturer could hope for!). However it is time that we tried to address this perception and to see if we can provide a more realistic type of educational provision that was *real, enterprise-oriented and enjoyable.*

2. “Setting up and running your own IT company.”

This year (1997/8) we have introduced a new module with this title specifically for our 4th year MEng and MComp students. These are our prestige degrees, with high entry requirements and a hurdle at the end of the 2nd year that must be satisfied, of an average mark of at least a good 2-2 standard and no failed component. It is also the main route that we perceive to CEng accreditation following the requirements of SARTOR [2]. So the class is fairly small, talented and enthusiastic. When we first started exploring the idea of setting up such a course we talked to the students - then in their 3rd year. Their response was very enthusiastic and throughout the planning period we worked with them and obtained their support for the basic structure and curriculum details. This was important because the assessment was going to be difficult to define precisely in advance and a spirit of trust was needed between staff and students if it was going to work.

The module is of 20 credits (one sixth of the total load), which runs over the full academic year. The basic description is as follows (taken, primarily, from the University's Module Directory):

COM401/2 Setting up and running your own IT company. (20 Credits)

Pre-requisites: COM301, 302, 303, 304, 306.

[Remarks. The module runs over two semesters. The pre-requisites are the core third year modules and are intended to ensure that the participants have a good grounding in most aspects of a modern computing curriculum (and to restrict entry to an appropriate student cohort).]

Aims/Description. This half module involves students forming and running companies that offer IT consultancy and software development services to outside organisations. The emphasis of the work will be on learning how small IT companies are created and managed, the legal and financial frameworks with which such companies operate, the practical management of the companies and their successful trading. Students will involve themselves in the following activities:

- researching market opportunities for software products;
- carrying out IT audits on behalf of local organisations and preparing appropriate IT strategies;
- acting as software/computing consultants to local organisations;
- developing software for clients;
- maintaining software for clients;

During the course of the module students will keep company records, prepare company reports as well as developing analysis and design reports and other consultancy reports for clients.

Teaching Methods: Lectures, seminars, practical design work, client presentations.

Assessment: Coursework.

The basic background to the module is that in the 2nd year the students have taken part in the Software Hut project [4] which exposed them to the experience of working in teams with a real client trying to construct a suitable solution to the client's business problem. This was used as a vehicle to consider business process modelling, requirements capture and all of the processes involved in the engineering of a piece of high quality software for their client. These skills were then extended with more technical knowledge from their 3rd year programme and their experiences with their 3rd year major individual project and dissertation. Also as part of their third year work they attended a seminar course on software engineering. In the course of this they studied, in some depth, 50 papers from the current software engineering journals (see [5]) and this provided a considerable insight into the *state of the art* in areas as diverse as requirements capture, project management, quality control, testing, design methods and tools etc.

The intention was that the students set up a number of companies and trade with real clients. The companies are to be run as professionally as possible and standard accounting, planning, management and quality control methods used throughout.

As part of the initial training for the exercise the students took part in a series of seminars organised by the Sheffield Training and Enterprise Centre in conjunction with the National Westminster Bank. These were evening sessions aimed at the general public wishing to set up their own companies. They were given by experienced consultants and covered areas such as: financial and business planning, marketing, company law and other related topics. The students reacted enthusiastically to most of these sessions which took place in the first few weeks of term.

To provide a focus and a basic infrastructure for the student companies the Department arranged for a small room to be allocated for their exclusive use which was furnished with 4 PCs and other basic equipment such as phone, kettle etc.

We had identified a number of potential clients prior to the course starting and arranged for these clients to visit the group to discuss possible projects.

The students had to negotiate with clients - find out what the client's problem was, whether they thought that they could provide a quality solution, discuss the costs of doing this and trying to agree a contract.

This was the starting point. One client was obtained from some research contacts we had, the other initial client was a company who had previously been involved in a 4 month summer MSc project and wanted the system built by the MSc student extended. It was a fairly small task and thus unsuitable for another MSc project. (In other words the student companies could carry out maintenance for former student projects, something that was not always possible in the past.)

3. The basic structure of the module.

This course is assessed by coursework, and we had to negotiate what form this will take. The module is highly experimental and everyone involved had to be consulted and involved in order to make it succeed.

in the first year there are 6 students on the course. Next year there will be 16 and so some thought has to be given to ways of making it manageable for larger class sizes. For this current year we envisaged 3 companies or divisions which would operate concurrently:

- A. Software development.
- B. Software consultancy.
- C. Software training.

The proposed company structure:

The students decided on a name for the company - VICI or rather 3 names: VICI Development, VICI Consultants, VICI Training.

Each company will have two “officers” a chairman and a finance director.

This year, then, each class member is an officer for one company. Everyone will be an “ordinary” member of the other two companies, so each company has 6 personnel. We change roles round in Semester 2 to give everyone experience as chairman and as finance director once. Someone (the finance director) of each company will install and use the Sage package for keeping the accounts. A number of management planning systems had to be set up by the students so that there were methods of identifying the work involved, the way it is to be shared out and some form of monitoring system. The students also had to think about quality control methods, should they use inspections, some formal mechanism (Fagan eg. or use some of Gilb's ideas.) or what? They must also think about some way of costing activities, some of this will be with real money, other clients will not be charging so there is a need to estimate the cost and account for it in a “virtual” way in the company accounts

Deliverables for assessment purposes.

It was agreed that there should be monthly documentation to be submitted, along with other agreed output, for assessment and planning purposes.

3.1. Monthly real accounts.

3.2. Monthly virtual accounts (which will include notional labour costs based on the number of hours work carried out on the projects and management activities and costed at an appropriate level, for the sake of argument we could cost an hour at something like £10 per hour per person). In some projects include a notional charge to the client based on an estimate of the time required to complete the project.

3.3. Monthly report identifying what was done in the previous month, targets/milestones reached, problems/delays experienced, together with an updated plan for the next month.

3.4. Any deliverables completed in the previous month, requirements documents, design documents, implementations, quality control material, user manuals etc.

Later on a business plan will be prepared in conjunction with the evening course, this will be assessed by the Bank who can provide a professional perspective on the viability of a business plan if some students wished to continue with their company.

A possible structure for assessment.

(i). Customer satisfaction - on the basis of questionnaires given to clients on delivery of the product/course.

(ii). Administrative procedures - based on monthly reports, planning documents, business plans etc.

(iii). Quality control - evidence of a review process, use of software engineering methods in specification, design and validation (testing).

(iv). Profitability - based on the annual virtual accounts - would we have survived financially if the money had been "for real", also the business plans would be assessed under this heading.

We need to apportion the assessment between these (and possibly other) headings. Within these headings we will need to come to some more detailed division. These decisions are still to be agreed. It may seem unsatisfactory that the detailed assessment has not yet been defined. We still do not know the precise nature of the activities during the year. However, the four headings above will form the basis of the assessment.

4. The programme of work.

The first two jobs were:

4.1. To construct a web based database for a major London hospital that would enable consultants in a medical specialty to consult and submit details of medical cases and the associated treatments on an on-going basis. The task also involved setting up, a suitable web database server to be located in London and the emphasis had to be on security, reliability and usability. The client was a Professor from London who visited the Department on a number of occasions to discuss requirements and examine prototypes. E-mail was also used to communicate with this client. There was a fee agreed beforehand by the client.

4.2. To develop an existing sales/stock control system for a philately company in North Wales. This system had been developed by an MSc student as their summer project a year earlier. This client wanted to extend the functionality of the system. A full (formal) specification of the existing system was available and this was very useful. The client visited a couple of times to discuss requirements.

The students were able to make a good start on 4.1 and produced a feasibility study and a rapid prototype for the client. The client then took some time to respond.

The second job has been allocated a lower priority.

4.3. A client from a local teaching hospital proposed 3 database/web projects similar in style to 4.1 and visited the company to discuss the proposals. These are now also under development.

4.4. A consultancy was negotiated with a local technology transfer organisation and is currently on going.

4.5. The students are also keen to provide training courses and have negotiated with two clients. One client is a local organisation which is introducing e-mail and WWW facilities. they want a simple training package to be developed so that their workforce will be able to use e-mail effectively, attaching and retrieving files, undertake simple internet browsing etc. Initially there will be 17 people to train but ultimately there are several hundreds who would use the training materials over the internet in the organisation. Another client wishes to have a training course developed to teach the use of Access database packages within their organisation. In these types of contract the hard part is identifying accurately what the client wants and then developing a training package targeted at the right level and using the right medium and educational approach.

4.6. The company is to install a video conferencing system to enable remote communication with future clients to take place using this technology, where appropriate.

4.7. Other consultancy and training opportunities are under discussion.

4.8. As part of their market analysis strategy the group prepared a company brochure and a questionnaire to send out to local organisations and companies. This will provide a valuable resource for the future.

The department also runs an MSc in Advanced Software Engineering and, as is usual in these courses, requires students to undertake a project in the summer. As part of that students also prepare for the project by taking a thesis preparation module in Semester 2. One of the projects offered was participation in the student company scheme and this was chosen by 2 students. So they have been brought into the company and will be carrying out projects of their own within the company. These are outlined below:

4.8. Another medical web based database for an European medical society.

4.9 The development of an oracle database for a major UK charity. This is, as yet, still in the initial stages of negotiation.

5. Some experiences and reflections.

The initial worry was whether we could find enough work of an appropriate type for the students to do. That has not been a problem. In fact, there is, if anything more than enough and was one of the reasons for introducing it into the MSc project system.

In future years there will be more MEng and MComp students taking these modules and this could cause us some management problems. However, if one analyses the amount of effort required to run this module compared with that of an advanced undergraduate module of similar weighting it is probably significantly smaller. There is no lecture preparation required, no laboratory practical preparation. What we have to do is to help

the students to make contact with clients, and as the word spreads about the course external clients are beginning to contact us. The lecturers have to monitor the progress through weekly meetings with the company, helping with the planning of the work, ensuring that all the students are contributing suitably, reading the monthly reports and meeting the occasional client.

What have the students learnt?

The experiences gained are many and varied.

It has given the students an insight into the responsibilities of business in a way that working for a company could never do. They now realise that satisfying the client is down to them. There is no one else to blame if it goes wrong, the buck stops with the company management. This simple realisation has dramatically changed their attitudes to the way they organise themselves, to the need to attend to what might seem to be trivial (but necessary) detail.

The mechanisms for managing projects, reviewing the quality of their output and delivering on time have been given a new dimension now since it is they who are seeking client satisfaction now. The clients are *their* clients.

Some of the procedures that were adopted to ensure that the project management and the quality control were suitable are worthy of further comment. Our attitude was to talk to the group regularly about these issues but not to prescribe in detail what they should do. It was interesting how they changed their attitudes as they progressed and saw that they needed to formalise procedures if they were going to achieve all that they wanted to do.

The weekly business meetings that the companies held (at which no staff attended) were vital and it became apparent that detailed minutes and actions had to be recorded. The monthly reports to us were also of great value and will be part of the assessed material. These reports were structured as follows (a structure that the students refined themselves in consultation with us):

1. Quality checklist (see appendix A);
2. Preface;
3. Development projects - current status (Introduction, schedule from previous month, achievements of current month, problems and processes, schedule for further work, deliverables for this month);
4. Consultancy projects (same structure);
5. Training projects (same structure);
6. Administration (same structure);
7. Appendices (correspondence with clients,
8. Accounts (real and virtual);
9. Minute of business meetings.

Another interesting aspect of the course was that the companies had full responsibility for setting up and administering their Windows 95/NT network which included organising the backup procedures using a Jaz drive and discs. Also the installation of a video conferencing and networking system was part of the company infrastructure that needed planning and implementing. All of these activities gave the students a challenge and were

very successfully done. The fact that they were responsible for their own facilities helped to engender a much more mature and professional approach than one might have expected.

Another interesting benefit from the activities, particularly the training contracts, is in developing perspectives on aspects of work that are in marked contrast to the normal student view of life. For example, the training courses they will be providing for an industrial client have to be delivered to a high standard. The client satisfaction will be partly measured by asking the participants of the course to evaluate the quality of the teaching. They are now on the other side of the fence from when they evaluated the teaching of the university lecturers!

The assessment of the student performance on the course has not yet been completed. It is too soon to say what the outcome of this will be like. There are no established academic markers that we can use in this assessment and so we will have to experiment. Because the students have approached the activities with a great deal of enthusiasm and effort it is to be expected that this will be reflected in their overall grade for the module. This seems to be a common phenomenon with a self selected group of students doing project work.

Each month the company provides a monthly report on activities. This includes the current status of each contract, including a commentary on milestones reached, problems encountered and potential solutions. The monthly accounts are also presented in two forms - virtual accounts where their labour costs are included and real accounts which reflect real expenditure and income. For several months both of these accounts were somewhat negative since no income had come in as no contracts had been completed. This can be a little dispiriting at first but has now been accepted by the students.

Another assessment source is the documentation associated with each contract. We expect *best practice* in software development to be used, wherever possible.

6. Student feedback.

Before the start of the course we asked the students to fill in a brief questionnaire about their attitudes to the course and what they hoped to gain from it. We also asked them to supply us with a paragraph or two after they had experienced it over one complete semester. We will follow this up after the end of the course with further feedback.

Some feedback after one semester.

“The course funded by the FDTL grant (fondly known as VICI) has been of great interest to myself. The fantastic dreams we had for it at the beginning of the year may not all have been fulfilled, but this is only because the course has taught us many of the problems encountered when setting up a software company, and we now have a much more realistic approach. When I look back to the beginning, it is hard to believe that we were the same people who now have correctly structured meetings, produce monthly reports, and use a strict quality control checklist to assess all the work that we produce. It seems to me that the course is positioned quite nicely in the gap between attending lecture courses, and having time out in industry.”

Grant Bardsley, Feb. 98

References.

- [1] Report of the National Committee on Higher Education (the “Dearing Report”), 1997.
- [2] Engineering Council, Standards and routes to registration (SARTOR), 1997.
- [3] “Nice degree, shame it's irrelevant”, Interface, The Times, October 15, 1997.
- [4] Andrew Stratton, Mike Holcombe, Peter Croll, “Improving the quality of Software Engineering courses through University based Industrial projects.” Submitted to Project’98 Workshop, University of Sheffield.
- [5] M. Holcombe, “A seminar-based course that attempts to provide a more “academic” approach to Software Engineering.” to appear in IEEE Trans. Eng. Education.

Appendix. Results of initial student surveys.

Reason	%
To gain a masters	67
To allow more time to decide on a career	50
To make themselves more attractive to an employer	100
To learn more about the subject	83
Other reasons	33

Table 1: Reasons for staying on

Sector	%
Commercial	100
Industrial	85
Academic	85
Public	1000
Other	0

Table 2: Career sector interests.

Skill	Average rating out of 5 (1 very important...5 unimportant)
HTML & WWW	2.33
Java	2.75

Table 3: Technical skills wanted

Skill	Average rating out of 5 (1 very important...5 unimportant)
C++	1.66
Visual basic & 4GLs	2.1
Network management	2.1

Table 3: Technical skills wanted

Skill	Average rating out of 5 (1 very important...5 unimportant)
Customer liaison	1.5
Presentation skills	1.5
Report writing	1.66
Team working	1.2
Video-conferencing	3.2

Table 4: Communication skills

Skill	Average rating out of 5 (1 very important...5 unimportant)
Time management	1.66
Accounting	2.5
Work allocation	2
Business administration	1.88

Table 5: Business skills