174 INTRODUCTION OF STUDENT INITIATED AND THEMED MULTI-STUDENT PROJECTS

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ABSTRACT

We present the background to a change in the delivery and supervision of third year projects for students majoring in electrical and electronic engineering at Manchester University and an evaluation of our experience with this new system. One of the recent changes in the delivery of projects has been to task a smaller number of staff dedicated to the supervision of third year projects. Balancing the increased demand on staff supervising third year individual projects with increasing the quality of supervision has prompted us to change the delivery mode of third year projects. One of the main initiatives is to group individual projects under a 'theme' that will offer places for approximately six to ten students working under supervision of an academic member of staff usually with assistance of a research group member. Although students still perform an individual piece of work they benefit from joint training on (for example) software tools, the use of equipment, key techniques and higher levels of peer support.

We will reflect on the organization of the themed projects, project allocation, their delivery, supervision and support structures that we have put in place. An evaluation of demands on staff time, student experience and preparation overhead will also be presented.

Keywords: Individual project, project supervision, practical work.

I   INTRODUCTION

The final year of the B.Eng. Honours degree in engineering in the United Kingdom requires students to complete and pass an individual project that carries 30 credits out of a total of 120 [1,2]. The third year project is the only course module in which students perform a substantial, individual piece of work and allows them to 'shine their light' [3]. Traditionally, the delivery of this part of the curriculum is through allocation of a small set of students to an

academic supervisor. The allocation process is initiated by publishing a list of project topics that supervisors offer and students are requested to select several topics to aid the allocation process. Once allocated students would nominally work for 300 hours on their project spread over two semesters with a final project report due before the summer exam period.

Delivery of this specific part of the undergraduate degree is particularly demanding in terms of supervision and second examiner duties when compared to a regular module. In the past most academic staff of the School were involved in the delivery of individual projects but this was no longer deemed an effective use of staff time. At School level it was decided to task a smaller subset of academic staff with the delivery of individual project whilst at the same time introducing methods of efficient delivery of this particular part of the curriculum. The introduction of themed projects was inspired by the realisation that the largest demand on the staff time was related by weekly supervision duties and introduction into the topic of research. Thus through joint introduction, training and project progress meetings significant savings would be possible. To aid with day-to-day support, research associates or students are available to help familiarise students with equipment and techniques.

Here we report on experiences with this new scheme that were collected by running three themed projects with about twenty students during academic year 2011/12. This new type of project ran alongside the standard projects and student initiated projects using exactly the same deliverables and marking schemes. To give an overview of the way projects are run, we start by describing the organisation of individual projects in terms of deliverables that students have to provide throughout their third year and how they are assessed. We will then discuss in detail how themed projects and student-initiated or 'bespoke' projects differ from the supervision of standard projects. We will conclude by summarising our experience and future plans.

2 PROJECT ORGANIZATION/DELIVERABLES

Figure 1 shows a flow diagram of the six deliverables that students have to provide. These deliverables are deliberately spread over both semesters to encourage students to work on their project continuously but also to include further elements of professional development (time scheduling, poster design, report writing, presentation skills). Four of these deliverables are marked; the final project report carries the largest weighting factor of 70% whereas the other three have an equal weighting of 10%. Apart from the presentation and question & answer session, all deliverables are electronically submitted to Blackboard, the university's web based e-learning tool. Two academic members of staff, the project supervisor and an independent examiner, mark four key deliverables using spreadsheet templates.
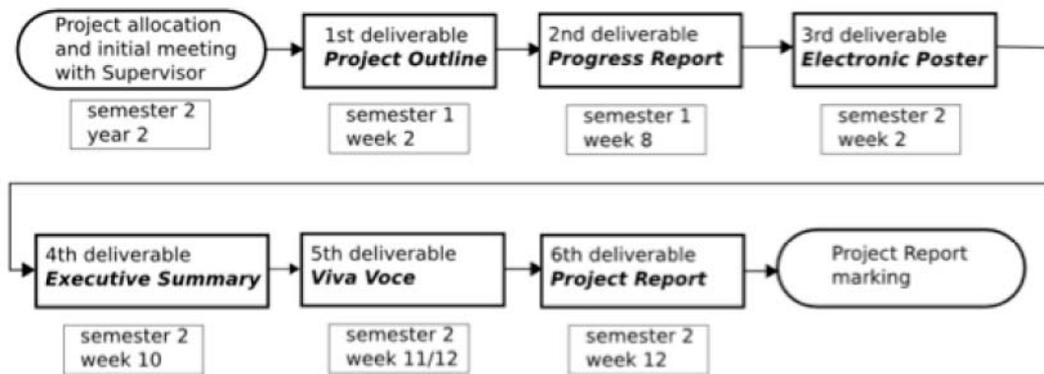
FIGURE 1. *Flow diagram of project deliverables.*

The templates organise the various items of assessment that feature textboxes for formative feedback and numeric marks (0-100%). Completed mark sheets with marks and comments are returned to students through Blackboard. The templates are made available to students as part of the project handbook. Before each deliverable, a briefing session is organised for the whole year to explain the specific requirements, give examples and to answer questions. Supporting documents and examples are disseminated through the Blackboard system.

The delivery of the third year project already starts in semester 2 of the second year of undergraduate studies when a presentation is made to students regarding project arrangements, type of projects and call for bespoke projects. A list of all standard and themed project titles and description is issued with a deadline at the end of semester 2 for returning a ranked ordered list to the project coordinator. To reduce staff overhead a web-based form is used where students enter their selections (see figure 2). Usually around 80% of students can be allocated their first choice and a small number of students enter into a second round of project selections because they cannot be allocated to any of their selections. If possible, the project coordinator will give students that opted for multiple type projects a choice before issuing the project allocation.

FIGURE 2. *Web based student project selection system.*

The first deliverable is the project outline (no more than 200 words) which is due two weeks into the first semester. The project outline is not marked. Instead it is used to inform the project coordinator that students have met their supervisor and that a project has been agreed upon. The topic of the project generally is the same as that allocated but can differ as long as supervisor and student agree on the new topic. The project coordinator also uses the project outline to allocate an independent examiner that is knowledgeable of the specific project area.

Eight weeks into the first semester the progress report is due. This report is intended to show that the student understands their project, that they can plan its execution, have considered their options (e.g. design routes, methods) and can provide a critical appraisal. The report (10 pages) will also contain (as an appendix) a health and safety risk assessment, a Gantt chart and project risk analysis/mitigation.

The third deliverable is a project poster that is submitted early in the second semester. The project poster is aimed at a 'non-specialist' audience and allows students to develop skills to communicate project impact, project aims, approach taken and progress to date using graphical design. The poster is marked with the largest contribution of the mark related to the visual appearance and quality of the poster in terms of explaining the project with a small contribution to the mark in terms of technical achievement. For many students it is the first time that they have engaged in making a professional poster and the School provides a briefing session showing examples of good practice.

At the end of the project we ask that students prepare an executive summary of their project in preparation of the viva voce. During the viva voce the student presents the project work to both supervisor and independent examiner and answers their questions. This fifth deliverable is jointly marked by the two members of staff and feedback is given to the student. The feedback includes suggestions of improvement to the executive summary. The student will revise the summary and use it as the abstract of the final project report, which is the sixth and final deliverable. The viva voce is a great opportunity for markers to acquaint themselves with the project outcomes in preparation for marking of the final report.

The final report is due at the end of the second semester and is limited to 50 pages. The marking of the final report consists of two different mark sheets, one for the supervisor and another one for the independent examiner. The only overlap of the two mark sheets are the sections of technical achievement and testing, analysis and conclusion. The independent examiner judges the quality of the report in terms of English, use of figures, clarity etc. whereas the supervisor is asked to mark project management, and ability to progress independently.

3   THEMED PROJECTS

During the academic year 2011/12 we started by offering three themed projects. Initially the number of students per theme was limited to seven in order not to load the supervisors with a larger number of students than their colleagues running 'standard' projects. The topics of the three themes were selected to align with the current research themes of the School: eAgri, Autonomous systems and Smart grids. The themed projects were advertised to the students

using a briefing meeting with a short description of each topic of research and their impact. For the Smart grid theme, for example, the following description was used.

"In September / October 2011, a monitoring system will be installed in 11 substations of the University power system. The monitoring system that is deployed will measure the voltage and current passing into 16 low voltage distribution systems supplying University buildings. The availability of this unique power systems monitoring system provides extensive opportunities for smart grid projects. The monitoring system is based on the compact RIO system that can both measure data in real time but which can also provide real time control opportunities that could assist the University electrical engineers in the day-to-day management of the power system. Opportunities exist for theoretical analysis along with hardware and software development. An ideal outcome of a project running in this area would be something that further developed the capability of the campus monitoring system or something that saw the system be able to interact with building users to try and incentivise a reduction in power demand throughout the whole day or at specific times.

Example projects that could be offered as part of this theme would be as follows (although it should be noted that students are encouraged to carry out their own research before the initial project meeting to allow them to identify any other areas in which they would like to work):

- Development of sensors to place within the substation and monitor parameters such as partial discharge
- Use of voltage and current data from the monitoring system to develop a dynamic rating scheme to allow equipment to be overloaded
- An assessment of the ability of the University power system to accept the introduction of local generation schemes (such as wind / photo voltaics)
- Production of live link displays that highlight building energy use to users to assess the impact this has on energy use
- Prediction of future energy demand based on historic data
- Development of phasor measurement units based on GPS techno-logy to allow coordinated cross-campus power flow measurements

- Development of a local security scheme to alert the University engineers of unauthorised substation access
- Analysis of control algorithms for network reconfiguration for minimisation of losses / control of voltage levels

Students opting for this project theme will be supervised by Professor Ian Cotton and will be expected to work closely with a number of PhD students who are engaged in work relating to smart grid systems. At the initial meeting of the students engaged in this project area, a discussion would be held between all students to determine the areas they wish to work."

Unlike the standard projects, no details regarding the specific work that was required for each student nor a listing of pre-requisite knowledge was given. In fact, within the topic students were encouraged to actively engage and come up with research areas themselves that would then be discussed during the first meetings with the supervisor.

Similar to the standard projects students would select themed projects provided entries were given regarding the type of activity they preferred (software, hardware, digital/analogue electronics, etc.).

More recently a template for a themed project was developed and generally consists of three elements:

- A structured learning (instructional) phase, in which the students will learn to use design, analysis or simulation tools, software and hardware. Technical literature study may be required and class sessions may be held. This phase may last for around two weeks.
- A design phase. Projects will be individual from this point, each student having a design hypothesis to prove. This phase will use the expertise and knowledge gained in the first two weeks to solve an engineering problem, which might involve design and fabrication/hardware construction, simulation, programming or other work using the facilities provided.
- The final phase will generally concentrate on testing of the student's design or hypothesis and further development.

4   JOINT PROJECT DELIVERY 2011/12

During the 2011/12 academic year the delivery of standard, themed and student initiated individual projects was first implemented for the full cohort of 136 students. Of these, 12 students performed self initiated projects and 20 students were allocated to one of the three themed projects. The themed projects were very popular with over 40 students selecting one of the three themes. Selection of the students admitted to the themes was dictated by their average performance during their second year of studies.

Student initiated projects where judged on their scope and deliverables, taking into account the projected costs; suitable supervisors were allocated if the project was deemed suitable. As always the majority of effort in project allocation was in finding a suitable project for students that could not be allocated a suitable standard project.

All supervisors are required to meet weekly with their students to check on progress and help with any issues that the students have. Typically supervisors would meet students individually to discuss their project taking a significant amount of their time. In contrast, supervisors of themed projects met with all students in a single common sitting. This approach has several benefits to both the supervisor and students and is appropriate for interlinked projects that are part of the themed project. The plenary weekly meetings would generally discuss how students are tackling the particular phase of their projects. For the most part the discussion would be very similar for each student, e.g. literature review, understanding what their project is, planning delivery, studying suitable methods, etc.

The collective meetings with the supervisor would initiate and support a team spirit that would continue outside the meetings themselves. Meetings with supervisors generally were lively with students discussing topics amongst themselves. This team 'spirit' creates peer pressure, which spurs on the weaker students in particular usually without intervention of the supervisor.

Supervisors should, however, monitor any alienation of students that could occur due to this peer pressure. The trials showed significant levels of student cooperation and sharing of facilities and help with debugging hard- and software problems.

Day-to-day technical and experimental support for the students through research assistants was important to further relieve supervisors. Particularly in aspects of training in software tools or handling of experimental equipment, research assistants are more suitable than supervisors since they generally have more experience with practical aspects of the work.

Because each student is expected to perform an individual project it is important to define the unique contribution to the themed project by outlining the project clearly at the onset. Due to the spread of deliverables throughout the year any tendency to 'diffuse' project contributions is counteracted and we have not witnessed any issues in this respect. The final project report holds copies of previous deliverables (project outline and progress report) as appendices so that markers can gauge project outcomes against project outline and original project planning.

Supervisors used one of two methods for conducting one-to-one supervision or surgery: as part of the weekly meeting or ad-hoc (if and when required). When part of the weekly meeting the one-to-one meetings would be conducted after the plenary part of the meeting and take between 10-15 minutes for each student. Typically a weekly meeting would take between 60-90 minutes for 6-7 students, which compares to a similar amount for the same supervisor for standard project per student in previous years.

5   CONCLUSION

The experience gained during the first year of running themed and student-initiated projects has been excellent and the School will expand the number of themes and retain the option for students to perform their own projects in the next academic year. The themed projects specifically do not merely present a very efficient way for staff to deliver the individual projects. Students performing themed projects have reacted enthusiastically and benefit from peer support and interaction.

We don't foresee changing delivery of third year project to make it completely themed based. The mix of the three types of projects is considered to be important because not all type of projects can be run as themes.

References

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