A New Project Management Regime

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SESSION: C1: Integration of theory and practice in the learning and teaching process

CONTEXT Throughout 2015 and 2016, the Faculty of Engineering and the Built Environment at the University of Newcastle re-envisaged the suite of engineering programs on offer to meet the future needs of students and society. One of the key areas addressed in the changes was the formation of a strong backbone of professional practice courses running vertically through the programs. One of these professional practice courses was a complete revision of the dedicated Project Management course. This paper describes the transformation we have commenced, the pitfalls and successes.

PURPOSE The purpose the new course (ENGG3500: Managing Engineering Projects) was not to make our students "Project Managers" *per se*, but rather, to give all of the Faculty's 230 engineering students a clear understanding of the broader philosophy and expectations that underpin the project-based reality of almost all engineering-related workplaces.

APPROACH The course centred on the themes presented within the Project Management Body of Knowledge (PMBOK). The students worked in flipped-mode, with pre-reading material and presentations made available. The first part of a weekly "lecture" summarised key elements of that week's Project Management (PM) theme, which was followed by a senior-industry person giving a presentation that highlighted their own PM experiences, highlights and pitfalls. Tutorial sessions provided opportunities for the students to explore elements of that week's theme, with assessment items conducted within tutorial; additionally, current practitioners facilitated all tutorial sessions. Students had to work in project-teams throughout the semester, and deliver assessment items based on a project of their own choice. Their Major assessment item was a full Project Management Plan (PMP) that required multiple presentations, as well as a formal document. At the end of the course, an industry-panel of current PM practitioners received PMP presentations from 4 student-teams.

RESULTS The students assimilated PM information prior to each week's "lecture", which helped them fully appreciate the PM "life-lessons", as given within that week's Case-Study. Indeed, this engagement with Senior PM's was a great success, with both industry and students feeling that the transfer of information, and, mentoring, was one of the highlights of the course. Students were able to see and appreciate the benefit of each week's Case-Study. All Case-Study presentations were Pro-bono. Industry engagement (within tutorial sessions) was, again, extremely well received by the students, as any tutorial/assessment questions were answered, on the spot, by people currently working as PMs. Future course-development will focus on "sharpening" the assessment items, with a view to achieve the same outcomes but with less assessment items. Other development will improve how student's peer-assess each other for their work within their own PM-team environment.

CONCLUSIONS The students received a clear understanding of the (broad) processes, philosophies and language of the current Australian and international PM workplace. Finally, the weekly Case-Studies by senior industry PM practitioners was extremely well received by the students, as it gave them an immediate and tangible perspective on the reality of PM requirements, and across all facets of leading and managing engineering projects (as defined within the PMBOK).

KEYWORDS Engineering project management, industrial engagement

Introduction

Throughout 2015 and 2016, the Faculty of Engineering and the Built Environment at The University of Newcastle re-envisaged the suite of engineering programs on offer to meet the future needs of students and society. One of the key areas addressed in the changes was the formation of a strong backbone of professional practice courses running vertically through the programs. One of these professional practice courses was a completely new implementation for a dedicated Project Management (PM) course. This paper describes the development and first deployment of this new course, highlighting the pitfalls, successes and lessons learnt.

The purpose the new course (ENGG3500) was not to make our students "Project Managers" *per se*, but rather, to give all of the Faculty's engineering students – enrolled across 28 different programs – a clear understanding of the broader philosophy, language and expectations that underpin the project-based reality of almost all engineering-related workplaces. The new course fits in different places within various programs, some students are in their 3rd year, whilst some in their 4th year. In either case, all of the students have an opportunity to use the PM skills learnt in the remaining semester(s) of their program.

Approach

The course centred on the 12 related themes as-presented within the Project Management Body of Knowledge (PMBOK, 2013):

- Organizational Influences and Project Life Cycle
- Project Management Processes
- Project Integration Management
- Project Scope Management
- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resource management
- Project Communications Management
- Project Risk Management
- Project Procurement Management, and
- Project Stakeholder Management

Indeed, one course (within just one semester) is clearly not enough time to make any undergraduate student (nor a masters-level student) a fully-fledged project manager, so that is not what was attempted. Rather, the intent was to have the students engage with the PMBOK's themes, and, ultimately, have them work individually - and in teams - in their production of a formal Project Management Plan (PMP).

The actual course content for ENGG3500, across the semester, is given within Table 1.

Table 1: Weekly course content for ENGG3500

Week 1	Introduction to course, Defining a project, Defining project management
Week 2	Project management roles, Belbin's team roles
Week 3	Initiating a project, Gaining project approval, The project charter, Project scope
Week 4	Project management methodologies and approaches, Stakeholder management
Week 5	Developing a project schedule, Software applications to develop a schedule
Week 6	Risk management, Controlling risk
Week 7	Human resource management, Communication management
Week 8	Cost management
Week 9	Project ethics
Week 10	Quality management, Procurement management – what is procurement?
Week 11	Closing the project
Week 12	Presentation of Project Management Plans to an Industry Panel. NOTE: only Four Student-Teams presented on this day, with the selection of Student-Teams based on every team's Presentation-performance during Week 11's Tutorial session.

For semester weeks 1-11 the students worked within the following regime:

Flipped coursework material. The students were given access to a variety of "pre-reading" documents, short videos and lecture slides; all provided via the University's learning management system.

- The intent was that students would come to the weekly "lecture" with a reasonable understanding of that week's PMBOK theme, with a view that they would be better situated to receive, and understand, that week's industry presented Case-study.
- It was expected that these weekly "pre-reading" packs would typically require 1-2 hours engagement. For example, prior to Week 9's Project-Ethics case-study, the students were expected to locate the following documents (working web links were given) with the expectation that they would access, download and read this information:
    - Nelson, L & Netherton, M.D. (2017) Project Ethics, *Week 9 summary notes for ENGG3500*.
    - Bazerman, MH and Tenbrunsel, AE (2011) *Ethical breakdowns.*
    - Hart, M (2011) *The ethical lessons of Deepwater*.
    - McFarland, M (2012) *Occidental Engineering Case Study*: Part 1 – An ethics case study and commentary, and Part 2 – A tutorial on ethical decision making.

Senior Industry presenters. The first part of each weeks "lecture" was a quick summary of the key elements of that week's Project Management theme – as given by the Course's Coordinator. This was immediately followed by a case-study, presented by an industry-based guest speaker.

- All of the people giving these case-studies were very experienced, senior Industry people. Their brief was to give a presentation highlighting their own (and very personal) PM experiences, highlights and pitfalls, and as they related to that week's PMBOK theme (as detailed earlier in the Approach section of this paper).
- Indeed, the University was extremely fortunate to have case studies delivered by Senior Industry people, as listed at Table 2. Further, each of these presenters were extremely gracious in giving their valuable time - and experiences - pro-bono.

Industry Tutors. Later each week, a single 2-hour tutorial session provided students the opportunity to discuss and explore elements of that week's PM theme, with some minor assessment items (listed later in this paper) conducted within the tutorial sessions.

- Each tutorial session was facilitated by industry-sourced tutors, where each tutor was a current PM practitioner. Table 3 lists the numbers of various Industry Tutors and highlights the diversity of PM practitioners who facilitated and advised the student's tutorial sessions.

Table 2: Senior Industry people who presented PM Case-Studies for ENGG3500

Week:	Weekly PM Theme:	Senior Industry Person:	Organisation:
2	PM roles	Bill Sidwell	Alstom ECS
3	Initiating a project	Andrew Vild	Project Everest
4	PM methodologies	Clint Bruin	ResTech Pty Ltd
5	PM scheduling	Tim de Grauw	APD Power Engineering
6	Risk	Peter Carson	NSW Roads and Maritime
7	HR management	Pierre Gouhier	RPC Technologies
8	Cost management	James Kennedy	Laing O'Rourke
9	Ethics	Jim Bentley	Hunter Water
10	Quality & Procurement	Tim Nancarrow	AMP Control
11	Closing the project	Gavin Lewis	BAE Systems

Table 3: Variety of PM practitioners who facilitated Tutorial Sessions for ENGG3500

Numbers of PM Practitioners:	Type of PM Organisation:
12	Private companies
4	Government agencies

Method of assessment

Throughout the semester, students worked in project-teams (of six people), and delivered assessment items based on a project of their own choice. A number of generic projects were offered to every team (as listed in Table 4); however, since the course was intended to be applicable for students across a range of degree-programs, teams were also given the flexibility to choose a project that they felt worked well within the particular skill-sets of their team. A sample of some of the alternate project chose by different project teams is also listed within Table 4. Whatever project was chosen by each team, that project then remained with them for the remainder of the course. If any team did wish to make-up a project of their own, they were assisted and guided in their selection by their tutor.

In the end, the choice of project was not that important, as it was not the actual project that mattered so much, rather, the goal was to allow students to develop and demonstrate their PM skills through the "*management*" of their chosen project - whatever that may be.

Table 4: Projects undertaken by some of the different project-teams

Generic projects available to all teams:	Design and build a community garden space
	Design and develop an on-campus work-placement software package
	Design and develop a land-regeneration management project for a local space
Specific projects developed by some teams:	A power-supply distribution network
	A community water-playground
	An integrated IT distribution network across The University of Newcastle
	A wall between USA and Mexico
	Development of a racing car

Assessments

ENGG3500 had a variety of assessment items: minor and major, as listed in Table 5. There was a mix of individual, group and peer marks available, with group-work marks capped at 50% of the total, and peer-assessed marks capped at 10% for any one assessment item; as per broader University policy. Finally, of the 6 minor assessment items worth 3.75%, only their top-4 were included in their final grade; the intent was to give students an opportunity to "*have-a-go*", and not be penalised for any early mistakes.

One of the goals for the assessment schedule was to provide a number of minor assessment items with a view to provide feedback on components of work that would, ultimately, end up within their final PMP. Teams were also given multiple opportunity to physically present to their tutor groups during the semester, with the intent of giving them regular feedback and thus improving their final, major, PMP presentation. The assessment schedule for the course is given in Table 5.

Each of the minor assessment items were items that would eventually, "plug-in" to the final PMP. Thus students had the opportunity to receive weekly feedback on (components of) their final PMP. Further, a 30% Major assessment was required half way through the semester. This major assessment was, in effect, 'Part A' of the final PMP, and again gave students the opportunity to submit work at the level required in their final PMP. The marking of the first part of the PMP, as an early assessment item, gave students another opportunity to receive early feedback on what was required for their final written PMP.

The final PMP assessment required a group-presentation component, worth 10% of the overall course mark. To allow students an opportunity to develop their team's presentation skills, a number early presentations were delivered by each team (within tutorial sessions) where minor marks and feedback were given immediately. The final lecture-session of the course involved the top four project-teams re-delivering their PMP, to the whole class plus an Industry panel. The industry panel consisted of the senior industry people who had given case-studies throughout the semester and the Industry sourced tutors. These four teams were awarded bonus marks, with the "Winning Team" (as determined by the Industry Panel) awarded further bonus marks to incentivise the activity.

The majority of marks were allocated to MAJOR assessment items. Indeed, 80% of the total marks were possible from 3 of the 10 assessment Items, with each of the minor items designed to be components of the Major assessment items, and where the students had time to integrate feedback from the Minor items into their Major items.

Table 5: Assessment items for ENGG3500

Assessment Item:	Type of assessment:	Involvement:	Weighting:
Minor Assessment 1	Individual submission	Individual Mark:	3.75 %
Minor Assessment 2	Group Submission	*Group mark:*	*3.375 %*
		Peer mark:	*0.375 %*
		TOTAL:	3.75 %
Minor Assessment 3	Group Presentation	*Group mark:*	*3.375 %*
		Peer mark:	*0.375 %*
		TOTAL:	3.75 %
Minor Assessment 4	Group Submission	*Group mark:*	*3.375 %*
		Peer mark:	*0.375 %*
		TOTAL:	3.75 %
MAJOR Assessment (Part A)	Written Submission	*Individual mark:*	*20.25 %*
		Group mark:	*6.75 %*
		Peer mark:	*3.00 %*
		TOTAL:	**30.00 %**
Minor Assessment 5	Group Submission	*Group mark:*	*3.375 %*
		Peer mark:	*0.375 %*
		TOTAL:	3.75 %
Minor Assessment 6	Group Presentation	*Group mark:*	*3.375 %*
		Peer mark:	*0.375 %*
		TOTAL:	3.75 %
Minor Assessment 7	Individual submission	Individual Mark:	5.00 %
MAJOR Assessment (Final PMP)	Group Presentation	*Group mark:*	*9.0 %*
		Peer mark:	*1.0 %*
		TOTAL:	**10.00 %**
	Written Report	*Individual mark:*	*25.25 %*
		Group mark:	*10.75 %*
		Peer mark:	*4.00 %*
		TOTAL:	**40.00 %**

Group work and Peer assessments.

One of the key outcomes of ENGG3500 was for students to come together in diverse teams and – collectively - produce their final PMP. Of course, bringing together a number of students from different programs (and at different levels within their programs) and requiring them to work collaboratively was challenging. Indeed, for many students, this was the first time they had worked with students from every program within the Faculty; this, by definition, created a challenging team-based environment – and not dissimilar to industry teams that are assembled from a number of different specialisations for a new project. To counter any perceived or actual concerns that "Group projects aren't fair" the course used the Self & Peer Assessment Resources Kit (Spark^{PLUS}) developed by Willey (2014). Spark^{PLUS} was used to facilitate feedback to each member of each team, as given by other members of that team.

Results

The change in teaching practice has impacted in these ways: the students were able to access and assimilate PM information prior to each week's "lecture", which then helped them fully understand and appreciate the PM "life-lessons", as given within that week's Case-Study presentation. Indeed, this engagement with Senior PM's was a great success, with both industry and students feeling that the transfer of information, and, effectively, mentoring by some very senior people, was one of the highlights of the course. Students were able to immediately see and appreciate the benefit of each week's Case-Study. All Case-Study presentations were Pro-bono; however, all industry-based tutors were paid for their time, either individually or via cost recovery to their firms. This aspect of industry engagement (within tutorial sessions) was, again, extremely well received by the students, as any – and all – of their tutorial/assessment questions were answered, on the spot, by people currently working as PMs.

The tangible deliverable for each student was their team's formal PMP. Direct feedback from members of the Industry Panel (who received the presentations from the final four project teams) was that the PMPs were of a very-high standard, particularly for students only learning the broad context of Project Management. Indeed, one senior industry person stated that she had to remind herself that the projects, as presented, were not real, and had been "made-up" by the students, such was the comprehensiveness of the plans delivered.

Challenges and Opportunities

Whilst the new course was viewed as a success, as with any new venture there is room for improvement, and ENGG3500 was no exception. A summary of key issues and their proposed solution(s) are:

- Getting industry people linked into the University's systems much earlier. Whilst industry people are, of course, already involved in many aspects of the Faculty's different programs, this was the first time that such a large course had 100% of tutor support drawn from industry. Ordinarily, such a large number of tutors would be drawn from post-graduate and post-doctoral groups, meaning that the majority of people would be already "on-board" when it comes to their access to the University's IT systems. However, the inevitable delays as so many external people were integrated meant that the Course-Coordinator's workload increased dramatically.
- The assessment-workload was logistically ambitious at the start of the course, particularly given the delay in system access for every industry tutor. This delay meant that (each week) hundreds of assessment items had to be individually retrieved, disseminated, and retrieved between the Course-Coordinator and each tutor. This workload-reality meant that the assessment system quickly became overloaded, and timely feedback to all students - in the first part of the course -

suffered. The students were scathing of this problem, and, quite rightly, saw it as a very bad example of project management.

- Future course-development will alter the assessment items, with a view to achieve the same outcomes but with less (minor) assessment items - this will reduce tutor and course coordination workload.
- The student peer-review system, whilst extremely valid, did not properly work. Not through any fault with the Spark^{PLUS} method, rather, though logistics challenges experienced as part of Course Coordination of a new course. The implementation of Spark^{PLUS} via a new IT system, which, when combined with the overloaded assessment feedback problem, meant that peer-reviews were, effectively, abandoned for some assessment items. Where peer-review didn't work, students were given full marks for the peer-review component of that assessment item. Future development will improve the peer-assessment methodology via improved IT system delivery.
- With such a diverse group of students drawn from so many programs, when any one student dropped the course the workload for the remaining members of their project team increased. It was not possible to simply re-balance the numbers within project teams by reallocating students to alternate tutorial sessions, due to the significant number of clashes with so many other classes. The solution is that next time the course is run, all tutorial groups will be run at the same time. This will, by definition, remove the flexibility of some students to choose a tutorial session that (possibly) best suits their personal time choices; however we believe it will be better to have a layout whereby students can be readily transferred between teams, and thus re-balance the numbers within each project team, such that workload is similar – and fairer – across all students.
    - The ability to run all tutorials for ENGG3500at the same time was facilitated by the serendipitous 100% redevelopment and implementation of a new timetable across the whole of the Faculty for 2018. This meant that ENGG3500, with its diverse number of programs, could be timetabled first, rather than attempting to "fit it within the gaps" of an existing timetable.

Conclusions

A completely new PM course was designed and delivered as part of a large-scale program rewrite. This PM course featured senior engineers with substantial PM experience, providing their reflections and knowledge related to 'that weeks' PMBOK topic. This was provided pro-bono by each presenter in response to a "mail out" seeking their input. In response to our request, some 35 industrialists responded for the 12 available lectures, demonstrating a willingness from local industry to engage with the University. The input from these industry people was well received by the students, as it gave them an immediate and tangible perspective on the reality of PM requirements.

The use of industry based "junior PMs" was likewise received well by the students, as these tutors brimmed with credibility in the PM space.

The mock projects from which the students developed (and presented a PM Plan for) were of sufficient quality that external reviewers needed reminding that these were not active projects.

Students reflecting back on the course after the completion, have commented that the practice skills in presenting and reporting have made a positive impact in their studies.

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