Undergraduate Project Management and the Role of Industry

Robert T Kennedy*, Ismail Daut

School of Electrical Systems Engineering, Kolej Universiti Kejuruteraan Utara, Malaysia.
BlockA(1), Kompleks Pusat Pengajian (KUKUM), Jalan Kangar-Arau, 02600 Jejawi, Perlis, MALAYSIA.

Abstract

University engineering education and industrial employer's expectations of new graduates are considerably apart if the adverse comments that appear in the press are to be accepted. Advancement in technology results in the need for a careful compromise between the course content that is essential and that which can be left for the future If a solution is to be found there is a need for a greater understanding by the University of Employer's needs and an equal understanding by Industry of what can be delivered. An innovative approach is required in which there is greater co-operation between the parties in both the development of programmes and courses and their implementation. An integrated role for industry is suggested such that programmes and courses will identify more with the engineering profession and increase student awareness of the real world values and skills required. The major activity area of final year undergraduate projects is where an integrated and co-operative approach can be introduced. Planning, management and assessment will all need careful consideration, not only to meet the University objectives and academic requirements but also to satisfy accreditation board's requirements. A roadmap for the development of a final year project programme that integrates and defines the role of industry in a structured manner is suggested. Some of the potential problems are outlined, and in particular assessment where the external partner involvement requires additional considerations to ensure rigor, robustness and accountability. A planned programme is suggested covering the pre project period, the role and integration of industry and the final assessment. Management and documentation templates included for reference have the flexibility to be adapted or modified as required by differing courses and institutions.

Keywords: Projects: Industrial Cooperation: Management: Assessment

1. Introduction

The revolutionary progress of Technology and the subsequent evolutionary periods in Electrical and Electronic Engineering Education have resulted in the corresponding educational process having to 'pay a price'.

The basic principles of engineering and physics have not changed and are essential components in the education of engineers such that they can adapt and survive future technology advances and developments.

Unfortunately the content available has increased out of all proportion to the time available for undergraduate education which has tended to remain more constant in duration most probably due to the financial implications of longer undergraduate study.

The education sector has to make major decisions as to the basics that should be retained and the introduction of new content. The decision making can be very subjective to a particular university and to the individual programme and course developers.

The price education pays includes two common adverse comments directed at both new graduates and Universities

- "Unemployable Graduates"
- "Graduates without skills needed by Industry"

To a point this is understandable and is not restricted to the engineering education sector. There is often a difference of opinion between the supplier of a product and the customer and in this case education provides the product (graduate engineers) and industry is the customer (employer).

* *Corresponding author. Email: robert@kukum.edu.my*

To avoid or at least minimise this situation there is a need for industry to have a better understanding of the role of academia and to accept that the subjective 'pruning' of content and the diversity of the ever increasing graduate requirements means that no single university programme will satisfy all sectors of industry.

The question industry might like to consider is *"Does industry prefer 'balanced' new graduates with a deep understanding of basics and able to progress with the future or graduates prepared only for the present and its own specialized sector"?*

There is no one single solution that will satisfy all parties hence compromise is required and the paper suggests that there is now also a need for innovative industry-university partnerships in determining the content and delivery of programmes.

The Undergraduate-University relationship is generally well established and clearly defined however the introduction of Industry into a cooperative tripartite partnership requires a planned and carefully managed integrated role for industry in the process.

Traditional industry involvement has been in three key areas having differing degrees of merit

- specialist lectures
- course and programme structure advisory panel membership
- industrial placement / training

Specialist lectures offer some exposure to specialized topics but are of limited use to the present problem.

Advisory panels by nature tend to be small hence input is usually subjective towards the needs of the industrial advisor's needs and not the global industry that the university serves to satisfy.

Industrial placement, essential when accredited engineering degrees are offered, although well established in many universities and a good example of integrating industry has not provided the ideal solution.

A general solution satisfying all is not considered to be a realistic goal. A move towards improvement however can be obtained based on the two key words, compromise and partnership.

1.1 Compromise

Industry needs to consider that

(i) universities educate many undergraduates from the same cohort for a wide range of engineering specialisms and a diverse group of industries and do not normally have programmes customised for a particular future employer.
(ii) the time constraints available for programme delivery means that new graduates will only have completed the initial stage of the learning process and that the next 'training' phase rests with the employing industry.

Universities on the other hand must also take a more responsive role by

(i) providing a robust and fundamentals based education plus some varied specialist knowledge that can be adopted in a diverse engineering environment or adapted in the future.
(ii) reviewing the procedures involved and needed to develop programmes and courses more suited to a wide employer base.

1.2 Partnership

Universities and Industry need to review the best way forward as a co-operative venture by perhaps fine tuning the existing three areas and considering a new approach to minimize and ideally solve the problem.

2. Final Year Projects

The rationale for the already existent individual final year undergraduate project as a common integral part of engineering education programmes has been primarily to satisfy accreditation and conform to international norms.

The objectives are usually an individual student centred independent investigation by which the student can demonstrate the analytic, measurement and testing, design and communication skills obtained during their three or four year period of degree study.

This paper suggests that final year undergraduate projects with industry having a key role is one approach that may help develop new graduates with capabilities more related to the needs of industry rather than with purely academic knowledge.

3. Industry Role

The suggested role for industry is to expand on the student centred approach and enhance what already exists by identifying with the engineering profession and increasing the awareness of the real world values and skills required.

Assuming that there are already in place clearly defined roles and goals a good starting point is during the industrial placement period which usually precedes the final year.

The role of industry is crucial to the success of the exercise and input may include project suggestions, provision of materials, student sponsorship and most importantly co-supervision of the project.

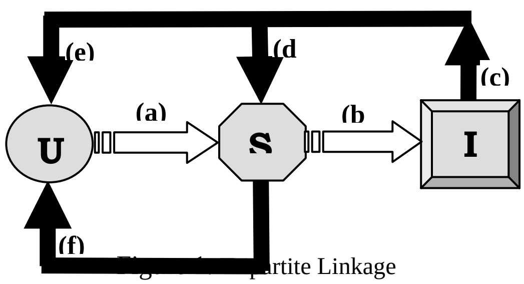

Figure 1. Tripartite Linkage

Figure 1 demonstrates the interactive feedback nature and role of the three partners in the process

- (a) university (U) input to students (S)
- (b) student (S) provides a long interview
- (c) industry (I) feedback
- (d) industry (I) input to the student (S) (including project suggestions)
- (e) industry (I) input to the university (U)
- (f) students (S) return to university more mature, with greater knowledge and project ideas

The ideally essential co-supervision of the project will however place an extra burden on industry as time will be required of the industrial supervisor for regular meetings with the student and the academic supervisor. A planned agreed schedule of meetings is therefore a prerequisite that industry may well find difficult to keep. This will however be a good indicator of the industrial commitment to the process.

Universities with large student numbers may encounter additional problems including finding industry partners for all students, however this should not be mandatory to considering and running the scheme.

4. Project Objectives

The general desire of academia is as shown in Figure 2 to provide a quality learning experience via the medium of a quality project that meets the academic requirements of the programme. The interaction of industry is intended to add the extra dimension of projects that introduce tasks that industry would normally expect new graduates to complete.

Choice of industry interactive projects however needs to be carefully managed and introduced as the requirements of industry and academia are often at opposite ends of the spectrum. Academia merely requires that the project satisfy the programme academic standard whereas industry may be looking for a final product. The latter can impose an abnormal time requirement on the student so again understanding the partnership objectives is essential.

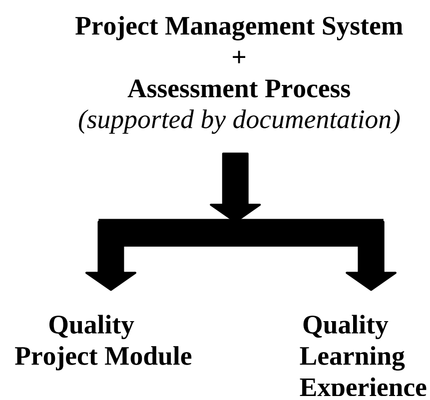

Figure 2. Project Objectives

The involvement of industry should therefore primarily be to provide interactive guidance and support with the objective of aiding graduating engineers to have employable skills rather than having an extra short term member of staff working to tight deadlines.

5. Project Management

The abbreviated individual parts of the proposed management plan shown in Figure 3 will become self evident when the sections are discussed. Unnamed blocks are awards and approval panels.

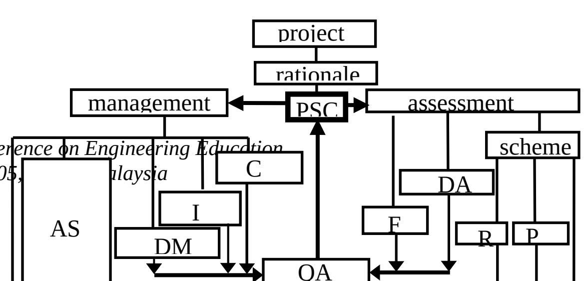

Figure 3. Management Plan

5.1 Induction Programme

Induction (I) as shown in Figure 4 is a programme of activities within project management provided by the university. The pre final year induction programme is to inform students of the project requirements and procedures prior to the period of industrial placement, and could include seminars on the use of log books and literature search. The programme is also intended to prepare students for discussions re possible industrial co-operation. The final year induction programme should recap the previous work and add project management and report writing seminars.

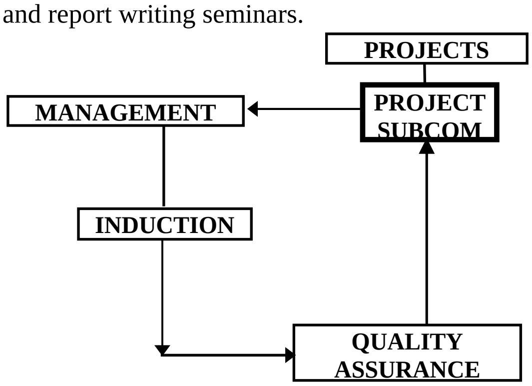

Figure 4. Induction

5.2 Project Allocation and Specification

Project allocation and specification (AS) as shown in Figure 5 is a most important initial stage to ensure all projects are of a suitable and equitable standard, have been adequately researched and are implementable. This would normally involve all parties involved prior to submission for pre project approval.

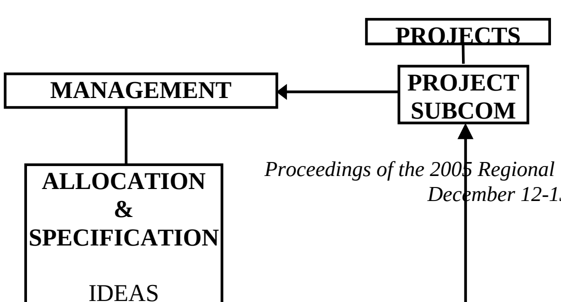

Figure. 5 Allocation and Specification

5.3 Management Documentation

Project management documentation (DM) shown in Figure 6 is prepared by the university. Documentation would include project registration, the project proposal and possibly a descriptor as shown in Table 1. The descriptor not only shows what is intended in the project but aids the pre project approval panel. Columns P and A indicate the proposed activity and achieved results. The handbook would normally cover laboratory procedures and safety regulations.

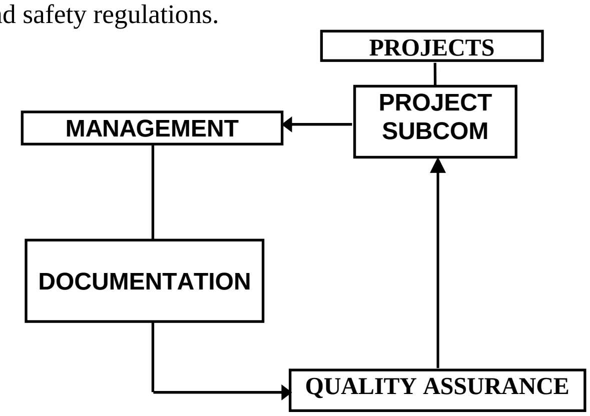

Figure. 6 Management documentation

Table 1. Sample Descriptor

		P ✓	A ✓
DESIGN	HARDWARE		
	SOFTWARE		
	EMC COMPLIANCE		
SIMULATION	COMMERCIAL		
	DEVELOPED		
PROGRAMMING	TYPE		
POWER SOURCE	BENCH SUPPLY		
	OEM		
	DESIGNED		
THERMAL MANAGEMENT			
TESTING	GENERAL		
	EMC COMPLIANCE		
	SAFETY		
LITERATURE SURVEY			
OTHER			

6. PROJECT ASSESSMENT

The university 'value' of final year projects can vary considerably and in some cases can be a major contributor to the final degree classification.

Robust objective assessment, the final act in the process, is therefore extremely important and needs even more careful consideration if assessment by the external industrial partner is involved. Accountability and transparency are also becoming essential in countries having 'data protection acts' due to the rights of students to access all information related to their study.

The format of projects in which a cohort of students is supervised by numerous supervisors tends to introduce more subjectivity than the normal taught course where all students are assessed by the same examiner. Assessment does not come naturally, there is very little training in the education sector and the new initiative suggested (if operational) is likely to result in the involvement of experienced practicing engineers whose only experience of academia is their own student days.

A secondary factor that can significantly affect assessment is that industrial partners may range from the multi-national company (with higher expectations) to the very small with few experienced engineers.

A planned and well defined role for the industrial partner in the assessment process is therefore an essential component that needs to be incorporated into the project management plan.

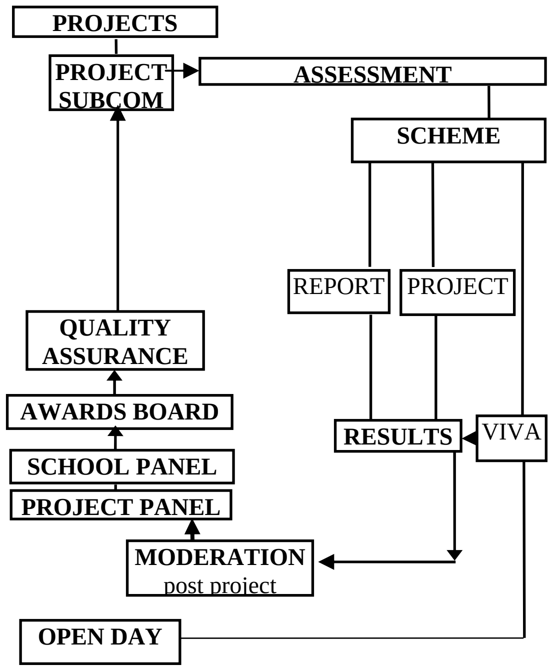

Figure. 7 Project Assessment

Project assessment as shown in Figure 7 involves assessing the project, the final report and a viva. Input to all parts would be expected from both the university supervisor and the industrial partner.

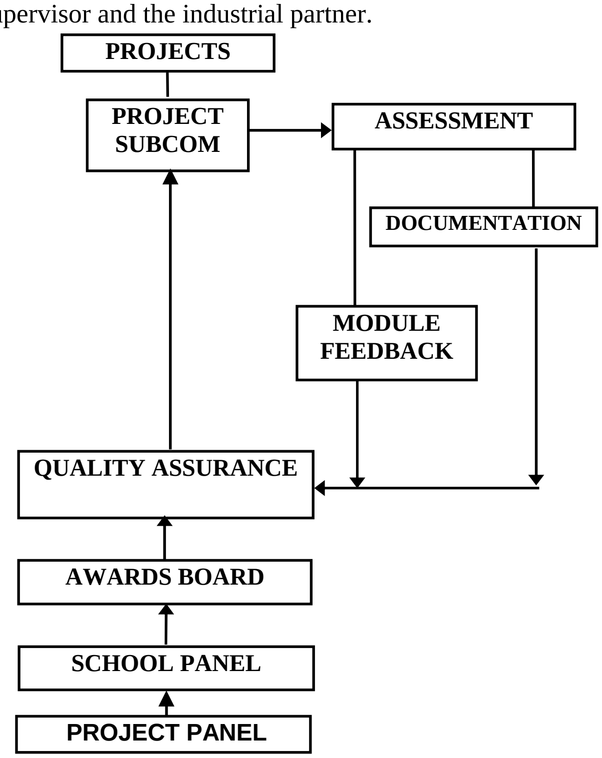

Figure 8. Project assessment documentation

It is suggested that the overall involvement of industry is more important to achieving the objectives than their involvement in the assessment process. Internal university supervisors will have more contact with the students and should therefore have greater input thereby helping to reduce potential assessment problems.

To minimise subjectivity and assist the lesser experienced assessors the assessment requirements should be clearly identified by means of assessment documentation as indicated in Figure 8.

Assessment documentation (DA) would include standard forms for project, report and viva marks as represented in Tables 2, 3, 4 together with a student module feedback questionnaire. In addition post project documentation would include results and statistics package for external examiners and accreditation.

Supervisor comments are essential inclusions for accountability, should remarking be required.

mm represents the maximum mark
M represents the achieved mark
m represents moderated mark
C marks awarded supportive comments
G general comments

Table 2. Project Marks Form

PROJECT	**sub elements**	**mm**	**M**	**C**
management	project proposal & work plan			
	interim progress statement			
	log book			
	management total			
performance	effort, initiative, assistance given			
	originality inventiveness			
	performance total			
engineering design development testing	design content use of CAD software pcb quality of hardware quality of software test & measurement			
	engineering total			
	PROJECT TOTAL			G

Table 3. Project Report Marks Form

REPORT	**sub elements**	**mm**	**M**	**m**	**C**
structure & presentation	clarity references appendices bibliography acknowledgements diagrams etc				
summary	**NOT** an abstract				
theoretical content	report objective material research knowledge topic awareness				
design & testing	concepts / design achievements results interpretation evidence of work done				
finale	discussion: conclusions: implications suggestions				
	REPORT TOTAL				G

Table 4. Viva marks form

VIVA	**sub elements**	**mm**	**M**	**C**
presentation skills	oral poster			
technical knowledge & understanding	re project re the project topic in the wider context			
	VIVA TOTAL			G

7. Conclusion

The paper has presented reasons for a new approach university-industrial partnership in the delivery of final year undergraduate projects. Some of the potential problems have been identified and the role of the industrial partner has been suggested.

The management plan is however not restricted to the involvement of an industrial partner and can be applied to university only managed projects.

The importance to new graduates and the university in avoiding the 'negative' comments referred to in the introduction is obvious. It is also equally important that employer expectations of new graduates can be realized.

The recommendation is that the industrial and the university sectors consider greater interaction in the planning and implementation of programmes and courses to maximize the potential of the next generation of engineers. A partnership in final year undergraduate projects is perhaps a small step in the right direction.

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Biographical Information

ROBERT T KENNEDY, BSc MSc CEng. FIEE. FIERE. SMIEEE. Professor Kennedy has over 40 years experience in a number of universities world wide during which time he has managed final year project programmes. Power Electronics is his main area of interest and at present he heads the Power Electronics and Electrical Machine Design Research Cluster at KUKUM.

ISMAIL DAUT, Cert. in Energy Eng. & Audit (Tenn), BAppSc (USM) MSc PhD (Cardiff Wales), AMIEE. Assoc. Prof. Dr Ismail Daut is Dean, The School of Electrical Systems Engineering, KUKUM.