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<Technical Explanation>

Some Experiences of Students Final Year Projects in Mechanical Engineering Degree Courses in Britain*

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1. Introduction

First I must apologise for not giving this talk in your own language. I have found Korean people very tolerant of foreigners who do not know Korean. Please extend this tolerance to me now.

Secondly I should like to say that I feel honoured at being asked to speak to the Korean Society of Mechanical Engineers on this occasion. It has been a pleasure to work with Korean colleagues in the Profession of Mechanical Engineering and it is a privilege to address their Professional Society. In Britain, our Professional body is the Institution of Mechanical Engineers which was founded in 1847 by George Stephenson, inventor of the steam locomotive, "Rocket". (It is reported that he started the Institution of Mechanical Engineers because the Institution of Civil Engineers would not admit his membership!) However the Mechanicals and Civils are now quite friendly and are both senior members of the CEI (Chartered Engineering Institutions), who safeguard standards in the Engineering Profession as whole. Since Stephenson's day, the Institution of Mechanical Engineers has developed important functions as a Learned Society and also as a Qualifying Body. Over the years it has become the natural meeting ground for Academics and Industrialists who have tried to ensure that adequate standards of Education and Training are maintained for members entering the Profession. (see Ref.) I know that members of the Korean Society of Mechanical Engineers have the same concern about the standards and numbers (i.e. quality as well as quantity) of entry to the Profession, so I hope that I do not have to apologise to Industrialists among you for talking on a subject that, at first, might seem to be purely Educational. I think you will find that Industry is very much involved and I hope you will find it interesting.

2. Choice of Topic.

The reason why I have chosen this Particular topic is that the Korean Ministry of Education have recently decreed that a final year project, reported in a thesis, which must be assessed and must reach a certain standard before the student is permitted to graduate, should become an essential part of the Bachelors Degree Course. I know that many Universities and Colleges in Korea already operate their degree courses this way, but I understand that it is by no means standard procedure and the emphasis

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given to Projects varies from place to place. I thought, therefore, that it may be interesting for you to hear of the experiences that some British Universities and Polytechnics have had with final year student projects. These projects have been an important part of the Bachelors Degree programmes in almost all Mechanical Engineering Courses in Britain for many years.

3. Sources of Information

In order to give information from a reasonable sample of Courses in Britain, I have obtained information from five departments with which I have been associated in some way. Former Colleagues and teachers have been kind enough to complete and return a questionnaire (Appendix 1.) which I sent to them last month, and their numerical answers have been presented in the tables 2, 3 and 4. Their comments, which are in many ways more revealing than the bare statistics, are summarised in table 5 and in appropriate sections of the paper. Cynics might say that a cleverly drafted questionnaire will always give the answers required by the questioner. This may be so, because I have certainly been successful in obtaining the answers I expected. This may mean that I am clever, or that my own experience in Britain with project students, six years ago, was not untypical. In any event, the answers have encouraged me to give you my own views as well as those of my distinguished British Correspondents.

4. Departments and Courses an Explanation

You will notice from Table 1, that my

Table 1. Department and Courses.

University or Polytechnic	Sheffield University		Leeds University		Loughborough University		Leeds Polytechnic		Newcastle Polytechnic	
Department	Mechanical Engineering		Mechanical Engineering		*Engineering Production		*Mech. and Prod. Engineering		*Mechanical Engineering	
Course	M.E.	M.E.	M.E.	M.E.	Prod. Eng. and Management		Production Eng.		M.E.	M.E.
	Honours	Ordinary	Honours	Ordinary	Honours	Ordinary	Honours	Ordinary	Honours	Ordinary
Award	B. Eng (Hons)	B. Eng.	B. Sc. (Hons)	B. Sc	B. Tech (Hons)	B. Tech	B. Sc (Hons)	B. Sc	B. Sc (Hons)	B. Sc.

Note: The Loughborough University course also included three students studying Metallurgical Engineering and Managment.
*="Sandwich" Course.

answers have come from three Universities and two Polytechnics. A different grouping shows three Departments of Mechanical Engineering and two of Production Engineering (or Engineering Production-Loughborough). Yet another grouping gives two conventional and three "Sandwich" courses. A brief explanation of these groups may be appropriate here as also may be a word about the difference between Honours and Ordinary Courses.

Sheffield University(my alma mater) and Leeds University are examples of Civic Universities, founded at about the beginning of this century. Their Departments of Engineering grew out of Colleges that had close relations with Industry in the area, but as national, rather than local Institutions, they attracted students from all over the Country and developed Degree Courses of the traditional University type-three years Fulltime. Loughborough University of Technology is a unique case. Founded as a residential Technical College, having very close links with Industry, it claims to have developed the first Sandwich Courses before World War Ⅱ and before the name "Sandwich" was invented. As its name implies the majority of Departments are Technology and Science and the Courses offered are predominantly of the Sandwich type. (UIT has a link with LUT and one of the UIT academic staff is there now, working on a Masters course.)

Newcastle and Leeds Polytechnics have a background of constituent Technical, Commercial, Education (Teacher Training) and Art Colleges, the Technical College offering part time courses to Technicians and courses leading to non-graduate Professional Qualifications. The Polytechnics have shared in the recent expansion of Higher Education to First degree level but the part time tradition of maintaining close contact with Industry now manifests itself in Degree Courses of the "Sandwich" type, validated by CNAA (Council for National Academic Awards) and some Technician Engineer courses of the HNC and HND type. (Junior College courses are about the nearest Korean equivalent to HNC and HND.)

I believe that the inclusion of two Production Engineering courses in a paper on Mechanical Engineering projects is justified because in Korea, I understand that Production Engineers (or those who in Britain we would regard as Production Engineers) find their interests best served within KSME. In Britain, they have their own Professional body, the Institution of Production Engineers. Though many Engineers belong to both IMechE and IProdE(the Heads of Department and some of the staff of both Loughborough University and Leeds Polytechnic are examples) there is obviously a place in Britain for two Institutions. In order to show that, in Korea, it is valid to consider them as "honorary" Mechanical Engineers, I have listed the student project topics from Loughborough University Production Engineering and Management Course, for 1975-6. (see Appendix Ⅱ). I am sure that a large number of Korean Mechanical Engineers would be quite familiar with many of the fields represented on this list. (A list of Mechanical Engineering project topics from Newcastle Polytechnic Honours Course from 1976-8, though now rather dated, is given for comparison in Appendix Ⅲ).

Many Engineers in Korea are now familiar with "Sandwich" Courses or the Korean adaptation of this system, whereby the student spends parts of his Course in industry on a planned Programme, and gains course credits while so doing. Appendix Ⅳ gives typical course structures and awards on both three-year full time and four-year sandwich Courses.

5. Reasons for a Project

When deciding on a curriculum for a University Course, the end product should be kept in mind. In our Course, this is the Graduate Mechanical Engineer who will later join the Profession and who should possess the ability to successfully carry out his professional duties. The question to ask therefore is, "how much does the experience of a final year project contribute to the development of this ability?" A good starting point is to ask another question. What are these duties, or what exactly is a Professional Engineer? A definition adopted by the Engineering Societies of Western Europe and U. S. A. is given in Appendix V. Of particular relevance in the context we are considering are the sections which state… "His work… requires the exercise of original thought and judgement…" and later… "His education will have been such as to make him capable of closely and continuously following such progress in his branch of engineering science by consulting newly published work on a world-wide basis, assimilating such information and applying it independently". In Britain, the length of an Engineering Bachelors Degree Course is three years fulltime or four years Sandwich Course. There are those who consider this to be too short-it corresponds, more or less, with the Korean system, except that the basic Science and Mathematics, studied in the Korean 1st Year, are completed in Britain at "A" Level in the final high school year-but it is unlikely that Courses will be lengthened in the forseeable future. The questions arise, can the time be spared for a project, and whose responsibility is it to make sure that the budding Professional Engineer emerges with these required abilities? Employers of new graduates will naturally wish to give them some initial training, relevant to their own requirements as a manufacturer of particular products or supplier of particular services. (In the case of a Sandwich Course student who remains with his sponsoring or training employer, this training may be virtually complete by graduation time.) The boundary, if there is one, between "Training" and "Education" has always been difficult to define but the responsibility for early development and encouragement of "original thought and judgment" has been decisively taken by British Educators as coming within their purview. Their concensus view seems to have been that the final year project, properly selected, supervised and assessed, is an important element in the discharging of this responsibility. This view is found not only among my correspondents (From Questionnaire returns) but the Mechanical Engineering Profession, as represented by the recent Academics/Industrialists Working Party, in their report, (Ref. page 23(i)) suggest a Mechanical Engineering curriculum which includes "an individual or group project (5 hours/week)" thus taking up 25% of the allocated course time. I am anticipating,

Table 2. Type of Projects.

University or Polytechnic	Sheffield University	Leeds University			Loughborough University		Leeds Polytechnic	Newcastle Polytechnic
Department and Course	Mech. Engineering Hons. and Ord.	Mech. Engineering Hons.		Mech. Engineering Ord.	Eng. Production Hons. and Ord.		Production Eng. Hons. and Ord.	Mech. Engineering Hons. and Ord.
(a) Literature Survey Projects	6%	—	—	—	Project No (1) combines aspects of (a), (b) and (c) 100%	—	Project combines Aspects of (a), (b) and (c) 100%	None
(b) Design Projects	12%	(i) 100%	—	100%		Project No(ii) 100%		10%
(c) Experimental Projects	67%	—	(ii) Computer/Exp 100%	—		—		60%
(d) Other Projects	15% Theoretical/ Analytical	—		—		—		30%

here, the information supplied later in table 4 (Project Scope and Assessment) and table 5 (Opinions) but I felt that it should be established early, that in Britain, Projects are considered important and are here to stay. Any debate on the subject of final year projects is about their scope, type and assessment; debate is not about whether there should be a project.

6. Type of Projects

In compiling my Questionnaire, I assumed that projects could be divided into three basic types; design, literature survey and experimental, or four, if it is accepted that certain projects will contain elements of two or all three of these. (see Appendix I, Question 3). It can be argued that ideal projects will contain elements of all three, and this would seem to be the aim and the achievement, in part, of the courses at Loughborough University and Leeds Polytechnic (See Table 2). But project supervisors must initiate realistic projects, and these may not be ideal from the point of view of (i) the way it tests the student or (ii) ease of assessment. A student's motivation is an important factor and his enthusiasm will not be fired if he knows that he is involved in an unrealistic exercise. (This can be Particularly true of design projects.) The selection and preparatory work required of teaching staff may therefore be more arduous than that required for a graduate school research project. I believe the following points are relevant.

(i) The student has limited experience and limited time. Although he should be aware already of the open-ended nature of investigations, from experimental work in previous years, a badly chosen project may be almost impossible to assess, as progress will inevitably be slow, and a student is discouraged if he sees no possibility of worthwhile achievement in the time available.

(ii) A measure of student choice in the selection of his project has been considered important. This is usually from a list prepared in the Department (internally generated projects) though the principle is difficult to apply if a sponsoring Firm insists that the Sandwich Course student attempts a project of its choice, against the student's wishes. (This can also cause problems when 70% of the students want Thermodynamics and Fluids Problems and nobody wants Applied Mechanics··· a reported situation from Newcastle!) It usually happens that some students have to be directed to a particular project, because they are slow to decide themselves.

(iii) There are difficulties involved in any arrangement where by the final year student joins a research group comprising staff and graduate students. How can his particular task be defined and his contribution assessed? I would not recommend this procedure.

Apart from the Production Engineering Courses at Loughborough University and Leeds Polytechnic, the questionnaire replies indicate a preponderance of Experimental Projects. (In the case of Leeds University, there is a computer based or experimental project in addition to the compulsory design project. Some factors influencing the choice of each of the three types of project are considered next. (They may also provide some explanation of the distibution recorded in table 3.)

(a) Literature Survey Projects: Student motivation may be a problem here, unless he has himself chosen the topic of his investigation. Not many Engineering students consider the library their natural place of work, and guidance, preferably in earlier years of the course, on the best way of using a library is the only way to make possible a good Project. (Appendix Ⅶ gives a guidance Sheet, issued to first year students on the course at Leeds Polytechnic, which may be of interest.)

(b) Design Projects: Student motivation may also be a problem if he knows that his design is unlikely ever to be made. Creativity and inventiveness are considered necessary characteristics for a good Engineer and increasing emphasis has been placed on the

Table 3. Source of Projects.

<table>
<tr><th>University or Polytechnic</th><th>Sheffield University</th><th>Leeds University</th><th>Loughborough University</th><th>Leeds Polytechnic</th><th>Newcastle Polytechnic</th></tr>
<tr><td>Department and Course</td><td>Mech. Engineering Hons. and Ord.</td><td>Mech. Engineering Hons. and Ord.</td><td>Eng. Production Hons, and Ord.</td><td>Production Eng. Hons.* and Ord.</td><td>Mech Engineering Hons. and Ord.</td></tr>
<tr><td>Projects from Supervisors Research Interests</td><td>82%</td><td>85%</td><td>60%</td><td>13%</td><td>70%</td></tr>
<tr><td>Projects from Direct Request from Industry</td><td>18%</td><td>5%</td><td>None</td><td rowspan="2">67%</td><td>20%</td></tr>
<tr><td>Projects from Industrial Training Period</td><td>1 (occasional)</td><td>5%</td><td rowspan="2">40%</td><td>None</td></tr>
<tr><td>Projects from Students own Suggestion</td><td>1 (occasional)</td><td>5%</td><td>20%</td><td>10%</td></tr>
</table>

*To start in 1977.

teaching of design in the past 15 years or so. A design project may, with advantage, include model making.

(c) Experimental Projects: The difficulties of running successful experimental projects largely involve the extent to which departmental resources of instrumentation, manufacturing equipment and technician manpower are tied up for the duration of the Project. Delays in the manufacture of experimental rigs can prove to be disastrous for student morale and subsequently for project assessment. However in a department that is reasonably well equipped, once a programme of Projects has been started, some experimental projects can be self generating in that modifications (sometimes quite minor) give viable projects in following years.

Table 4. Scope and Assessment of Projects.

University or Polytechnic	Sheffield University	Leeds University		Loughborough University	Leeds Polytechnic	Newcastie Polytechnic
Department and Course	Mech. Engineering Hons. and Ord.	Mech. Engineering		Eng. Production Hons. and Ord.	Production Eng. Hons. and Ord.	Mech. Engineering Hons. and Ord.
		Hons.	Ord.			
Number of Projects by Each Student.	1	2 (1) Design (Compulsory) (ii) Computer or Experiment	1 (Design)	2 (i) "Bachelors" Project. (ii) Design Project	1	1
Group or Individual Project	Individual	(i) Individual (ii) *Pairs	Individual	Individual	Individual	Individual
**Student time Allocation: hrs/wk	10	12½	N. A.	7	6	6
**Student time Allocation: Total weeks	20	20	N. A.	20	24	26
Time when the student selects (or is directed to) his project.	12 Months before final exam.	N. A.		12 Months before finals. (May be started in industry training period)	12 Months before final exam.	12 Momths before final exam. (Ideal)
Time when the student must present report.	5-6 weeks before final exam.	Before final exams.		5-6 Weeks before final exam.	Few weeks before final exam.	4 Weeks after final exam.
Project(s): Percentage of Final Assessment	20%	25—30%	N. A.	Hons. 33% (i) 22% (ii) 11%; Ord 43% (i) 29% (ii) 14%	15%	15% (Hons) 12% (Ord)
Project(s): Assessed by	Supervisor and two others.	Supervisor and one other		Supervisor and one other	Supervisor and Dept. Head or nominees	Supervisor and Small Group.

*one report but individual assessment.

**This is the minimum allocated time. Students are expected to spend more time than this and use judgement on how best to allocate the time available between the project and other subjects.

Note. N. A. Information not available.

7. Source of Projects

Question 4 on the questionnaire (answered in table 3) is perhaps the worst drafted of the questions that I asked. Academic staff teaching in Engineering Degree courses have close contact with industry and their own research interests are certain to be connected in some way with the needs of industry. In addition, any requests direct from industry are certain to fall within the area of interest of at least one member of the staff. In the case of Sandwich Course there may be overlap between the second, third and fourth answers that are given. (i.e. A student, during his industrial training period, may find a topic, which, with the approval of the firm concerned, he suggests to his Department as a suitable project. I must admit, therefore, that the way this rather ambiguous question was answered, depends on how it was interpreted. Navertheless, I believe that it is significant that the vast majority of projects have been reported as being within the supervisors' research interests, suggestion competent and conscientious supervision and assessment. It is also clear that there is a considerable contribution from industry, both direct and indirect. This influence is more direct in the case of Sandwich courses than in full time courses. The project topic suggestions from students are rare, but I believe that it is important not to discourage this source.

In the particular circumstances of Korea now, I consider that the current development of final year projects provides another area in which Industrial/Academic cooperation can flourish. But British experience has shown that it does not mean less work for the professor and it does not mean an immediate, correct solution for the industrialist. Topic selection and arrangements for cooperation should be made carefully.

8. Scope and Assessment of Projects.

Table 4 gives answers received to question 2 in the questionnaire but also gives additional information which was supplied by my correspondents and which I believe add greatly to the value of the overall picture presented.

(i) Number of Projects: Most Courses have one final year project. Those which have two projects, include a design Project.

(ii) Individual: It can be argued that the ability to work as a team member is necessary characteristic and it is a pity to have no experience of this. However, the question of priorities, in allocation of the time available, will always arise and it is probably more important to ensure that the student is given the opportunity to show what he can do individually.

(iii) Student time allocation: These figures do not give a very good impression of the additional time spent by the student on his project. The effort that he feels is required, is left for him to decide, in the light of the knowledge he has of the importance attached to it by the Department, which is reflected in the project weighting in the total degree assessment.

(iv) Selection of project: All departments prefer, and some insist that the project topic is selected 12 months before the final exams. In the case of experimented topics in particular, this ensures that delays in the design (if necessary) and manufacture of rigs are

Table 5. Summary of Opinions and Future Proposals

University or Polytechic	Student Opinion	Staff Opinion	Future Changes proposed (If any)
Sheffield University	Generally enthusiastic	Extremely valuable. Students synthesising (not analysing) for first time.	No changes envisaged.
Leeds University	Considered very worthwhile part of the course.	Hard Work. Design important-compulsory	No changes proposed. (Resent reduction from 3 projects to 2) but overall time increased)
Loughborough University	Many students start project early-in industrial training period.	Not known, but probably significant that Loughborough gives highest % assessment.	None. Known.
Leeds Polytechnic	Enthusiastic but sometimes feel "over whelmed"	Popular with most staff.	Plans are to increase weighting of project from 15% to 18%
Newcastle Polytechnic	Prefer experimental projects. (Dislike literature surveys.)	Project is the major item on degree course. Affects degree class.	No definite plans but possible upgrading of percentage assessment considered.

avoided, and assessment are minimised. Students usually prefer to the problems of fair get started as soon as possible and early selection is popular with them

(v) Presentation of Report: Only Newcastle Polytechnic permits presentation of the report after completion of the Final Exams. On all other courses, projects must be presented a few weeks before the exams. There is something to be said for the Newcastle system, if the academic calendar permits, as the student is thus deterred from neglecting his other subject just before exam time. Insistence on report presention to a deadline 4 weeks after the exams ensures that the project itself is not neglected.

(vi) Percentage of Final Degree Assessment: This varies between 12% and 43%. The lowest figure, underestimates the significance attached to the project, as degree classification in the case of "border line" students is more affected by performance in the project than performance in other subjects.

(vii) Project Assessment: It is the process whereby fair and standardised assessments are made of the projects submitted by a class of students, that can cause the greatest difficulty when organising final year Projects. It may be thought that the easiest way out is to assess the project on a Pass/Fail basis and leave it at that. This is less than satisfactory for at least two reasons. The student has no incentive to do more than the minimum required and there is a danger of substandard superivision resulting. Comparison between lecture course and project assessment highlights the difficulties.

(a) Lecture Course: All students on the course take the same exam. They therefore answer the some questions -(of equal difficulty for all), have the same time allowance and the same teacher assesses the work of all the students.

(b) Project: Students have different project. Their tasks are therefore of unequal difficulty, they spend as much time as they choose and they have different supervisors.

Despite these difficulties, I believe satisfactory assessment can be made, and the answers to my questionnaire provide some of the solutions to this problem. More staff can be involved by spreading the load at final assessment time. A verbal presentation by the student, in a colloquiam of staff and students also assists in this regard. (The experence is, in any case, of great benefit to the student.) You may find interesting a project grading scheme intiated in Newcastle Polytechinic about 10 years ago given in Appendix Ⅶ. Young and inexperienced staff were greatly assisted by this scheme, devised by a Senior member. It is interesting that after 10 years, their weighting for section B has increased from 44% to 50% (This estimate is made before the report is read, and is the supervisors assessment of the students work throughout the year.) Continuous assment of the project is at least as important as the assessment of the final report.

9. Opinions and Future Proposals

Table 5 summarises answers to the additional questions at the bottom of the questionnaire. These answers were full and forthright, most of them contained in letters which accompanied the returned questionnaires. As you can see there is a large measure of agreement about the value of projects, You may consider this surprising, bearing in mind the differences historically in the development of polytechnics and Universities, and the differences between the stucture and nomenclature of the courses that I have considered. The only explanation is that, on this topic at least, all the British Educators concerned are agreed that their experience over the years shows them that projects are an essential and worthwhile part of a student's education in Mechanical (and Production) Engineering. The profession, represented by the industrialists on the Working Party who produced the Institutions document "The Development of Mechanical Engineers", would also seem to agree.

10. Conclusions

Ⅰ.

The inclusion of, Mechanical Engineering and Production Engineering courses in the the questionnaire is justified on the grounds that both are catered for within the Korean Society of Mechanical Engineers. The inclusion of both 3 year full time and "Sandwich" Course 4 year Courses from Universities and Polytechnics gives a wider sample of British experience in this field.

Ⅱ. Types of Project:

(i) Projects in Production Engineering Courses are intended to cover all aspects of literature survey, design and experiment.

(ii) A separate design project is required in two courses. (one M.E. and one P.E.)

(iii) Experimental projects are most numerous, in the two Mech. Eng. courses where a clear breakdown of available information was supplied.

(iv) Literature survey projects are least numerous.

(v) A compater project was an option on one course.

Ⅲ. Source of Projects:

Most projects are generated within the Department and arise out of staff members' own interests. The figures for projects direct from industry and as a result of the student's industrial training period are higher in the case of "Sandwich" than in full time courses. Projects suggested by students themselves are rare but not discouraged.

Ⅳ. Sccpe and Assessment of Projects:

(i) Number of projects. Most courses have one final year project. These which have two projects, include a design project.

(ii) Individual projects are preferred.

(iii) Time Allocation: Time spent on projects is considered to be a matter of judgement by the student. The minimum recommended varies between 6 hours and $12\frac{1}{2}$ hours per week.

(iv) Selection of project: On all courses it is preferable for the student to have selected (or been directed to) his Project, twelve months before his final exams.

(v) Presentation of report: In all Courses but one, the Project has to be presented a few weeks before the final exams. The exception (Newcastle Polytechnic) requires the report 4 weeks after the exams finish.

(vi) Project weighting in degree assessment varies between 12% and 43%. Even in case of the lower figure there is a greater influence than the figure suggests, since degree class is affected more by project assessment than other examined subjects.

(vii) Project is assessed by at least two staff members. Care is always taken to ensure uniformity of assessment standards. Oral Presentation (Colloquium) by the student, before staff and fellow students, is recommended.

Ⅴ. Opinions (including my own) and Future Proposals:

The concensus among teachers, students and industry is that final year student projects are an essential part of a Bachelors Degree Course in Mechanical (and Production) Engineering. Projects, when selected, supervised and assessed with care, can make a significant contribution to the development of the budding Professional Engineer. Finally, I trust that you may find some of this British experience of interest. I extend best wishes to those Korean Professers who are developing their own schemes for student projects. And to Industrialists, I commend the scheme as another area in which they can benefit from Academic/Industrial co-operation.

Acknowledgements

Before I finish I must express thanks to a number of people. First my colleagues and friends in Britain who returned my questionnaires and provided other information as well, deserve my gratitute. They are Professor J. K. Royle of Sheffield University, Professor R. J. Sury from Loughborough University of Technology, Mr. J. Pidduck and Dr. R. Taylor from Leeds Polytechnic, Dr. R. Baul from Leeds University and Dr. C. Armstrong and Mr. F. Weeks from Newcastle Polytechnic. I would also like to thank Mr. K. H. Platt, Secretary of the Institution of Mechanical Engineers, who sent me some very useful and relevant Institution literature on Education and

Training topics. Next I would like to thank Dr. Lee, Kwan, President of UIT and Dr. Kim, Ki Hyun, Head of Mechanical Engineering and his colleagues for assistance and encouragement in the preparation of this paper. Finally to the President of KSME and to you the members, thank you for hearing me so sympathetically.

Reference

"The Development of Mechanical Engineers (Meeting the Needs of Industry)". Academics/Industrialists Working Party. I. Mech. E. Sept. 1975.

APPENDIX I

FINAL YEAR STUDENT PROJECTS

1. Course Description.
   (i) Subject ··
   (ii) Award ··
2. Scope of project.
   (i) Student time allocation
   (hrs/week and total weeks)···············
   (ii) Project; percentage of final assessment
   (iii) Group or individual project ························
   (If group project, is report and assessment group, or individual·········)
3. Type or project.
   (i) Number of design projects ···························
   (ii) Number of literature survey projects············
   (iii) Number of experimental projects ···············
   (iv) Number of combination of (i), (ii) and/or (iii), or other type·········
4. Source of project.
   (i) Number aring out of supervisor's own research interests ··
   (ii) Number coming as direct request from industry············
   (may be after approach by Department)·········
   (iii) Number coming from industrial training···
   (iv) Number coming as individual student suggestions··
5. (i) Total number of students ··························
   (ii) Total number of projects ···························

Details for the previous academic year will be suitable, unless for some reason they are not typical.

I should also be grateful for any comments you may wish to make about the attitude of staff and/or students to

(i) the projects and (ii) the preference for either internally generated projects or these suggested by industry.

Do you anticipate any change in your current policy on project?

APPENDIX II

LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF ENGINEERING PRODUCTION
PART C PROJECTS—1975-76

Student's Co.	Topic
(Lucas)	Closed-loop Stepper Motor
	Influence of Cutting Fluids in Surface Grinding
(Foden)	Group Technology in Gear Box Manufacture
(Sankey)	Flame Hardening Head Design
	Optimisation by Gas Flow Visualisation Techniques
(Sankey)	Development of Production System for Kegmatic Barrel Washing Plant

Student's Co.	Topic
(Mass. Fer)	Numerically Controlled Positioning System
(Preci-Spark)	Tube Expansion
(C. A. V.)	Dimensional Changes in Sintering
(I. M. I.)	Deep Drawing around Convex Dies
(Ford)	Ironing of Square Bar to Round
(G. Fisher)	Devise, Build and Test Automatic Assembly Machine for a Coupling
(C. A. V.)	X-Y Plotter Interface for Interdata Computer
(Lucas)	Adhesives Selection Procedures
(R. H. P.)	Develop Mechanism for Feeding Bearing Races to De-magnetis
(Drallin Controls)	Evolutionary Operation of N. C. Turning Machine
(I. M. I.)	Adhesive Bonding with particular reference to Copper Bonding
(Wellworthy)	Surface Area Measurement of Castings
(Preci-Spark)	Reinforcement of Polyeurthenes
(Raleigh)	Friction Welding Fe-C-Cu Sintered Metal Compacts
(B. S. C.)	Feasibility of Hot Machining in Parting Steel Rings
(Sankey)	Devise, Build and Test Attachment to Automatically Unload Wheel Hubs from a Press
(Sankey)	Ejection Forces in Extrusion
(I. M. I.)	Numerical Control for Electron Beam Welder
(R. H. P.)	Development of Quality Control Programme
(Reed International)	Investigation of Labour Turn-over at Key Terrain Ltd.
(Mass. Fer)	Materials Flow System Analysis
(Dunlop)	Quality Control Criteria in Manufacture of Bonded Impact Mountings
(Eston Axles)	Evaluation of Cutting Fluids in Turning
(Mass. Fer)	Low Friction Load Transporter
(Thorn)	Analogue to Digital Conversion
(Ford)	The Role of Production Foremen at Fords
(Normalairgarrett)	Bearing Area Characteristics in E. D. M.

APPENDIX Ⅲ

B. Sc. (Hons.) in Mechanical Engineering
NEWCASTLE POLYTECHNIC
PROJECTS

Fourth Year

A sample of the Fourth year Honours Degree projects is given below. These have been taken from the list of projects undertaken by students in the Academic Sessions 1966-1967 and 1967-1968.

1. Vertical steering of coal winning machines on remotely operated longwall faces.
2. Application of fibre-reinforced plastics for axial flow pump blading.
3. A design study on a device for the production of cathode ray tube connector pins.
4. An investigation of the response of a two degree of freedom torsional system.

5. An investigation into the use of streamlined boiler tubes to reduce gas side pressure drops.
6. Elastic stability of glass reinforced resin cylinders under compressive axial load.
7. Friction factors for fluid flow in helically coiled pipes.
8. Heat transfer studies on an experimental rotating tube heat exchanger.
9. The design and construction of a two dimensional cavitation rig.
10. Transient response of a heat exchanger to step changes in temperature.
11. A photoelastic study of loading stresses in a built-up high pressure cylinder for an extrusion press.
12. Design and construction of a monotube variable inclination steam condenser.
13. The development of analogue systems for the study of transient heat conduction.
14. Design and manufacture of a torsion meter suitable for autographic recording.

APPENDIX Ⅳ

TYPICAL COURSE STRUCTURES AND AWARDS

1. Three Year Full Time Course.
   Ⅰ. Examination at end of 1st year. Pass in all subjects compulsory may be at second attempt before 2nd year start.
   Ⅱ. Examination at end of 2nd year: Selection examination for Honours (Good students), Ordinary (Others). (But Ordinary students must also pass in all subjects.)
   Ⅲ. Final Examination for Ordinary Course- Final Examination for Honours Course.
2. Four Year Sandwich Course.
   (a) Thin Sandwich (4 College Periods, 3 Industrial Periods.). Examinations at end of all college periods. Selection for Honours/Ordinary at end of 2nd or 3rd period.
   (b) Thick Sandwich (3 College Periods, 1 Industrial Period). Examinaions at end of all college periods. Selection for Honours/Ordinary at end of 2nd period.

Awards.

The student working on the Honours Course, will be awarded a degree classified, depending on his performance in the final year, as follows:

Class Ⅰ, Class Ⅱ Division Ⅰ, Class Ⅱ Division Ⅱ, Class Ⅲ, Pass. The student working on the Ordinary course, will be awarded, a degree classified, depending on his performance in the final year, as follows:
Pass Grade Ⅰ, Pass Grade Ⅱ.

Note.

Graduate Schools prefer to admit students who have gained at least Honours Class Ⅱ Division Ⅰ standard in their Bachelors Degree.

APPENDIX Ⅴ

THE PROFESSIONAL ENGINEER

The following definition has been adopted by the Engineering Societies of Western Europe and the U. S. A. (EUSEC).

A professional engineer is competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending, managing and in the education of the engineer. His work is predominantly intellectual and varied, and not of a routine mental or physical character. It requires the exercise of original thought and judgment and the ability to supervise the technical and administrative work of others.

His education will have been such as to make him capable of closely and continuously following progress in his branch of engineering science by consulting newly published work on a world-wide basis, assimilating such information and applying it independently. He is thus placed in a position to make contributions to the development of engineering science or its applications.

His education and training will have been such that he will have acquired a broad and general appreciation of the engineering science as well as a thorough insight into the special features of his own branch. In due time he will be able to give authoritative technical advice, and to assume responsibility for the direction of important tasks in his branch.

APPENDIX VII

DEPARTMENT OF MECHANICAL ENGINEERING
NEWCASTLE POLYTECHNIC 1976

Questionnaire and Marking Scheme for Projects

		Marks
Section A (No marks allocated but to be used for reference in final assessment)		
1. How difficult would you say the project is?	Very difficult	
	Moderately difficult	
	Straightforward	
Section B (General) (To be marked before report read)		
2. Has the student understood the problem and pursued it?	Fully	11
	Partly	6
	Not at all	0
3. To what extent has the student shown self reliance in determining the course or the work?	Greatly	11
	Slightly	6
	Not at all	3
4. Do you consider the student has done More than	(a reasonable	11
Just about	(amount	6
Less than	(of work?	3
5. What original work has the student contributed to the problem?	A considerable amount	11
	A little	6
e.g. an experimental technique, a mathematical derivation, an ingenious design	Nothing	0

		Marks
Section C (Report)		
6. To a new reader, is the short summary- (Answer both (a) and (b))	(a) Absolutely clear?	3
	Moderately clear?	2
	Not clear?	0
	(b) Adequate?	4
	Moderately comprehensive?	2
	Inadequate?	0
7. Has the problem been presented to the reader	Clearly?	7
	Moderately clearly?	3
	Not at all?	0
8. Is the survey of the literature- (Have relevant references been omitted. Is the appraisal critical enough?)	Satisfactory?	7
	Moderately good?	3
	Unsatisfactory?	0
9. Were results discussed? (In the case of literature survey, results may be replaced by contents of literature such as assumptions, leading statements, supporting experiments)	Thoroughly?	7
	A little?	3
	Not at all?	0
10. How are diagrams presented and cross referencing carried out-are references made correctly?	Well	7
	Moderately well	3
	Badly	1
	Not at all	0
11. Does report read as an integrated whole? (e.g. detailed work should be put in appendices, padding should be penalised).	Yes	7
	Partly	3
	No	0
12. Are conclusions in body or report (Answer both (a) and (b))	(a) Precise?	3
	Moderately clear?	1
	Non existent?	0
	(b) Adequate?	4
	Moderately comprehensive?	2
	Inadequate?	0
13. Is the quality of the English (sentence construction, grammar, spelling)	Good?	7
	Moderate?	3
	Bad?	0

N.B. When any of these questions is deemed inapplicable by the project supervisor, he should insert what is, in his opinion, an adequate substitute.

Section D

1. State whether, in the supervisor's opinion, the final mark resulting from this marking scheme is a reflection of the work done.
2. State any additional relevant comment not covered by the above.

APPENDIX VI

LITERATURE SURVEY PROJECT PROCEDURE LEEDS POLYTECHNIC.