



**PROVOST'S REPORT TO COUNCIL ON
THE REVIEW OF THE
DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING**

1. INTRODUCTION

This report presents the outcome of a departmental review of Electronic & Electrical Engineering. An external peer review visitation was undertaken on the 28th and 29th of April, 2004 by Professor Peter Raynes, University of Oxford, and Professor Jan Biemond, Delft University of Technology, the Netherlands.

The report is based on (i) feedback from the external Reviewers received on the 6th September, 2004, (ii) a submission from the Pro-Dean of Engineering and Systems Sciences received on the 23rd September, 2004 and (iii) a submission from the Department of Electronic and Electrical Engineering received on the 18th November, 2004.

The main purpose of the departmental review is (a) to provide a structured opportunity for the Department to reflect on its activities and plans for development, while benefiting from a constructive commentary by senior colleagues external to College; (b) to ensure that quality and standards in teaching, research and administration are being maintained and enhanced; and (c) that areas of concern in this regard are identified and addressed within an eighteen month timescale. This review process ensures that each academic department in College is reviewed systematically once every five years.

2. OVERVIEW OF THE DEPARTMENT

2.1 Aims and Objectives of the Department

- To provide education in Electronic Engineering, at undergraduate and postgraduate levels, to an assured high quality level that is informed by best international practice.
- To conduct research that will inform its teaching programmes, provide a stimulating environment for student research work, and that will provide engineers trained in research to contribute to the national economic development.
- To contribute to economic and community development through (i) the promotion of engineering studies in schools, (ii) involvement in access programmes to increase the participation both of students from economically deprived backgrounds and of mature students in Electronic Engineering studies, (iii) active participation in the work of professional engineering bodies and national research and development agencies, (iv) promotion of job creation through working with College and national bodies and through appropriate direct involvement.
- To contribute to the collegiality of the University through collaboration with colleagues in policy determination, broad curriculum activities and cross-disciplinary research.

2.2 Programmes to which the Department provides teaching

Undergraduate

B.A.I. Electronic Engineering

B.A.I. Electronic and Computer Engineering (joint programme with Department of Computer Science)

B.A. Moderatorship in Physics and Chemistry of Advanced Materials.

B.A. Computer Science

Postgraduate

Postgraduate Diploma / M. Phil. in Music & Media Technologies
 M. Sc. in Integrated Systems Design.
 M.Sc. in Physical Sciences and Medicine

2.3 Research

The Department is involved in research in the following areas:

- *Electronic Engineering Materials and Technology*

In the area of Advanced Electronic materials, the focus has recently been on the study of the dielectric materials (low k, polymers and glasses) for applications in electrical insulation; liquid crystal devices for applications in photonics and ferromagnetic fluids. Theoretical studies on stochastic processes and non-equilibrium dynamics are ongoing.

- *Electronic Circuit Design*

Design activities extend from mapping DSP algorithms onto architectures and subsequently onto libraries of standard cells, through to full-custom circuit design in CMOS and BiCMOS technologies with an emphasis on low-power dissipation. Specific work includes adaptive signal processing ASICs, power-speed figure-of-merit studies and the implementation of medical instrumentation applications in discrete and integrated form.

- *Communications Engineering and Systems Processing*

There are several strands of activity in this area including Land Mobile Radio Communication and Propagation, Future Generation Communication Systems Networks, and Signal Processing.

2.4 Summary Statistical Profile of the Department for the Academic Year 2003 - 2004¹

Staff FTE	Undergraduate FTE	Postgraduate FTE	Department Staff:Student Ratio	Faculty Staff:Student Ratio
19.19	103.63	63.5	9	16

¹ Figures from Senior Lecturer’s Annual Report approved by Council at its meeting on 1st December 2004.

2.5 Accommodation and Facilities (Physical Resources)

The Department is located within the TCD campus at three sites. The space in Áras and Phiarsaigh is allocated to research in integrated-circuit design, the postgraduate programme in Music and Media Technology and to some of the research work in Digital Signal Processing and Telecommunications Networks. The space in the Sami Nasr Institute for Advanced Materials is allocated to the Department’s teaching and research in Microelectronics Technology and Advanced Electronic Engineering Materials. There has been significant refurbishment of the laboratories in the Printing House where research into Digital Signal Processing and Magnetic Fluid Analysis takes place.

3. EXTERNAL PEER REVIEW REPORT

SUMMARY OF REPORT

TEACHING

The Reviewers begin their report by outlining the teaching responsibilities of the Department at undergraduate level. They note that the majority of the Department’s teaching is in the four year professional engineering degree programme (B.A.I.) and that “*the Department is responsible for teaching courses in Electrical Engineering Science that are both a foundation for students who wish to pursue studies in Electronic Engineering in their Sophister or Senior Years, and also an introduction to the principles of Electrical Engineering as a core competence for students who proceed to studies in Civil or Mechanical Engineering*”. The Reviewers suggest that a drop in the numbers of students taking the Computer Engineering and the Electronic and Computer Engineering tracks in the Sophister years is “*partly due to the cyclic behaviour of the ICT sector and the bad publicity about future job possibilities in Ireland*”.

The Reviewers feel that the distribution of the teaching load in the Department has been “*reasonably fair*”. In the meetings with academic staff of the Department of Computer Science and the Department of Electronic and Electrical Engineering, they encountered differing views on the taught courses. It is felt by

some staff that in the Sophister years *“it is very difficult to introduce new courses to replace older ones, or to introduce more project work”* and that this is due in part to *“the lack of adequate collective mechanisms for changing teaching involving four departments ... but also in part to a conservative reaction by some senior academic staff to such innovations”*. While the Department’s students show excellent performance in their degree exams, the Reviewers notice that there are some concerns with the mathematical abilities of the Freshmen students. They note the concerns of staff that *“some of the mathematics in the BAI programme... is pure mathematics and too far away from engineering mathematics”*.

The Reviewers met with sixteen undergraduate students (four from each year) during their visit and found that the students were generally happy with the teaching facilities and with the lecturers, and students felt that the *“broad bachelor degree with two initial common years is a nice way to get a feel of engineering.”* The Reviewers note that every undergraduate of the College has a personal academic tutor. With respect to staff:student liaison, the undergraduate students they met expressed a wish for more regular feedback during the year and would like to have more examinations at term breaks, especially in the Junior Freshman year.

The Department is involved in two postgraduate courses: the M. Phil. in Music and Media Technologies (M.M.T.) and the M.Sc. in Integrated Systems Design (I.S.D.). The M. Phil in M.M.T. was introduced in 1996 and is a joint course with the School of Music. It is a two-year course with the option of a Postgraduate Diploma at the end of the first year. According to the Reviewers, the course *“offers a balanced approach to musical and technological topics, with particular reference to the role of Music in emerging New Media Markets”* and it *“has a strong international reputation with high appraisal by the different external reviewers over the years”*. The Reviewers found that the students on this course were extremely well motivated and, despite their diverse backgrounds, well integrated. Although graduates of the course were employed in a wide range of domains, the Reviewers observe that *“due to the downturn of the economy, especially in the IT sector, there are temporarily not enough jobs in Ireland”*.

The M.Sc. in Integrated Systems Design (I.S.D.) was initiated by the department in response to requests from the electronic design industries for an advanced part-time programme of two-year duration suitable for experienced engineers and had its first intake in October 2000. The Reviewers note the comment from the course’s external examiners that the course *“... is at a high level, very relevant to industry”* and that students who have completed the course *“have taken on an increased leadership role in their companies”*. The Reviewers report that the course is currently (2004/2005) suspended *“as the difficult industrial climate has resulted in few engineers being released or sponsored for part-time studies”*.

RESEARCH

The Reviewers outline the Department’s main research areas as follows:

- *Electronic Engineering Materials and Microelectronic Technology*

This is the study of advanced materials and there are four academics involved in this area of research. The Reviewers report that *“there is a well-established laboratory...with a range of sophisticated electronic and optical instruments”* and that *“the research can be described as very successful and of high quality, partly due to the involvement in the College’s Institute of Advanced Materials”*.

- *Electronic Circuit Design*

This involves mapping Digital Signal Processing algorithms and biomedical applications onto architectures in CMOS and BiCMOS technologies. The Reviewers note that research progress in this area *“has been hampered by lack of staff and funding for projects”*.

- *Communications Engineering and Signal Processing*

Work in communications is broadly directed towards Land Mobile Radio Communications and Propagation, Future Generation Communication Systems Networks and Signal Processing. The research *“can be seen as of high quality and highly successful”*.

While the Reviewers feel that the overall research performance of the Department compared to that of other Departments of equivalent standing is *‘reasonably good’*, they observe *“large variations in performance of the 14 academics ranging from excellent to rather weak...with an unequal spread of funding over the academics”* which they feel *“may in part be caused by the change of focus of the major funding institutions (E.U., Science Foundation Ireland) from small project funding to the funding of very large projects, Centres of Excellence, Networks of Excellence and large Fellowship grants”*. They emphasise the importance of

encouraging all staff to “*promote or be associated with grant applications*” especially if the Department wishes to realise its aspiration to increase research funding. The Reviewers suggest that by publishing more International journal papers, it may be possible to achieve “*a higher research ranking both in Ireland and Europe*”. They also suggest that “*cooperation of academic staff and the formation of larger teams is also a good means of cross fertilization, and a way to anticipate the changing funding style towards bigger projects*”. The Reviewers report a suggestion from junior academic staff that the appointment of a ‘mentor’ would be useful to guide new appointments towards obtaining funding and setting up of projects. In general, they feel that the Department’s research would benefit from an improvement in the physical infrastructure and layout of the Department.

The Reviewers report a strong presence of postdoctoral researchers and that this, along with the postgraduate students registered in the Department, is a vital mechanism in maintaining a good research standing. They met with a group of twelve postgraduate and postdoctoral research students during their visit. The students reported that “*office and laboratory space was rather crowded*” and that student interaction was restricted because of the spread of the Department across three locations. The students felt that there was a productive atmosphere within the research groups with “*enough feedback for self improvement*”. However, they would have welcomed more lectures at the start of their Ph.D. study on “*time management, research methods and how to write a paper*”.

The Reviewers suggest that “*consideration should be given (in some cases) to replacing the time-consuming writing of a Ph.D. thesis at the end of the fourth year by a thesis consisting of a collection of high-quality international conference and journal papers*”. They feel that this would “*focus the student from the beginning on writing research papers and is also beneficial for the Department’s research portfolio*” as international journal papers are seen as an important indicator of performance and consequently a major tool for resource allocation. A short compulsory taught component as part of the Ph.D. course may increase the Ph.D. quality level as a whole.

The Reviewers also met with eight graduates from a variety of industries who had different opinions about the future of Electronic Engineering in Ireland. Some graduates expressed concern about the “*current limited interest in studying Electronic Engineering, the limited number of high-tech start-ups as innovation drivers (only five start-ups in Electronic Engineering last year in the whole of Ireland), the outsourcing and increasing movement off-shore of production, services and research, and the consequent exodus of the electronics and computer science industry*”. Others saw positive signs in the presence of a highly skilled work force, combined with “*an improving economy (Intel building a new factory) etc.*” The graduates suggest that “*relevant research areas for the coming 5 years are biomedical devices, automotive electronics, wireless communications and digital signal processing (DSP) applications*”. Their general feeling is that Trinity College served them well, and that the most important skills they learned were “*problem solving ability, mathematical background, system thinking, planning and interpersonal.*” They also noted the life advantages of the “*(hidden) benefit of meeting and mixing with people from so many different disciplines and cultures*”.

RESOURCES

Commenting on the physical resources of the Department, the Reviewers say that “*the spread of a moderate sized department over three different and geographically very spread buildings was not ideal and clearly inhibited interactions between the research programmes and researchers involved with them*”. They note that the Department has up-to-date equipment and experimental facilities through state grants, research contracts and donations, but add that “*the high cost of maintenance of complex equipment and the absence of any realistic equipment insurance are major challenges for the Department*”. Both the Sami Nasr Institute for Advanced Materials and Áras an Phiarsaigh have benefited from external funding and as a result have excellent, up-to-date facilities.

MANAGEMENT AND ORGANISATION

The Reviewers highlight the fact that in addition to the restructuring of College Departments and Faculties, the Electronic and Electrical Engineering Department is facing a number of other challenges. They note that “*management of the Department is by democratic consensus, traditionally by a meeting of the full-time academic staff and representatives of the full-time non-academic staff*”. They feel that the Head of Department should have more power in this Departmental Committee and suggest that “*an even better way (of managing) seems to be to operate through a small Management Team with representatives of the three*

research themes”. They report that the Head of Department prefers an open style of leadership with frequent meetings but that he “would like to have more time for strategy and vision development and people management, especially for the needs of the junior academic staff”. The Reviewers note that “the Department is facing a substantial change in its staff composition due to retirements, resignations and the expiry of contracts” and advise that “the Department must urgently address how to manage continuity in its teaching (and consequently its research) and how to use the opportunity presented by the retirements to evolve the specialisms within the Department”.

RECOMMENDATIONS

The Reviewers recommend the following – all recommendations are in quotation:

Teaching

- (i) *The broad Bachelor with two common years seems very much appreciated by both undergraduates and graduates, though there may be some merit in considering a reduction to one common year.*
- (ii) *Promotion of Electrical and Electronic Engineering should be invigorated at the Freshman level, through international student exchange.*
- (iii) *The use of course appraisals is still in an introductory stage and is a voluntary process. The nature of the questionnaire, and in particular the questions asked should be reduced in number and be more focussed on specific aspects of the course, and the feedback to students and the follow-up actions should be formalized.*
- (iv) *The ambition to restructure the content of the M.Sc. course in Integrated Systems Design (ISD) as a one year fulltime M.Sc. degree course with a modular structure to facilitate students from industry is a very good option and deserves full attention.*
- (v) *An industrial placement of students as a concluding part of their BAI should be considered*
- (vi) *The feedback system to undergraduates should be improved and made more frequent.*

Research

- (vii) *There should be more focus on junior academic staff, they feel time-impooverished; their ambition as researchers is undermined by obligations as teachers and corresponding administrative tasks. There is a need for a mentor in the guidance of building an own group.*
- (viii) *Better ways of flexibility in the system to increase excellence, for example a formal sabbatical system should be in place to boost research; currently procedures are missing to implement a formal leave of absence.*
- (ix) *Course review and renewal should be changed from an individual initiative to a more structured departmental activity.*

Resources/facilities

- (x) *The research would generally benefit from an improvement in the infrastructure provided. For example the research space is crowded and not always ideal for the work being undertaken. The spread of a moderate sized department over three different and geographically very spread buildings is not ideal and clearly inhibits interactions between the research programmes and researchers involved with them.*
- (xi) *The unequal spread of funding could be improved by better collaboration, larger group sizes to anticipate the current funding situation (which has changed recently from small project funding to the funding of much larger projects).*

Management/organisation

- (xii) *Funding of the University is not yet related to quality. To become a top research university a new output-based resource allocation model should be in place.*
- (xiii) *Department management should be modernized; from democratic consensus driven meetings by the full-time staff to a more modern goal-oriented management style through for example, a small Management Team headed by the Department Head.*

4. RESPONSES FROM THE DEPARTMENT AND THE PRO-DEAN OF ENGINEERING

The Pro-Dean of Engineering feels that the Reviewers’ report contains “a balanced and comprehensive assessment of the Department, drawing attention to its strengths and weaknesses” and the Department is pleased with “the overall positive tone of the report”. The Pro-Dean notes that the Reviewers refer to the “high quality of the undergraduate degree and the success of the postgraduate programmes” and that they find the overall research performance of the Department to be “reasonably good...though rather uneven in

quality". He also refers to the Reviewers' recommendation that consideration should be given to "*reducing the common curriculum to one year*" and to their view that there would be some merit in amalgamating the four Departments within the Faculty into one Department of Engineering. He notes that the Reviewers advert to "*a certain degree of tension between senior and junior members of the Department*". In conclusion, he states that "*the Head of Department is addressing these concerns and (the Pro-Dean) is confident that he will do so effectively*".

The Department concurs with the majority of the recommendations arising from the Reviewers' report and states that the Department has already started to address many of the issues highlighted. He welcomes the Reviewers' positive response to restructuring the M.Sc. in Integrated Systems Design, but notes that it would be impossible to achieve at present due to "*restrictions on hiring replacement academic staff*". With regard to the concerns about the standard of mathematics being taught on the BAI programme, the Department states that the agreed philosophy of Freshman engineering mathematics is that "*courses provided by the School of Mathematics should focus strongly on core mathematical skills, such as calculus, linear algebra*" and that "*mathematical applications and problem solving skills are the key objectives of the companion course titled Engineering Science*". Regarding the issue of student feedback, the Head of Department believes that "*the issue of feedback should be seen as more inclusive, and in particular, attention should be drawn to course work and assignment feedback*". Regarding the Reviewers' suggestion concerning the Department's management structure, the Department "*does not favour or support a management team approach*", as suggested by the Reviewers.

5. RECOMMENDATIONS TO COUNCIL

In addition to the Department of Electronic and Electrical Engineering addressing the detailed recommendations outlined in the review report, the following recommendations are made to Council in light of the review report and the responses from the Pro-Dean of Engineering and Systems Science and the Department:

- (a) that in the context of the proposed new structures in engineering the Department should:
 - 1 Undertake a broadly based review of curricula at undergraduate and postgraduate levels involving all members of staff and student representatives.
 - 2 Develop a strategy for research and publication for the next five years that addresses the issues raised by the Reviewers, the opportunities presented by new structures, and that includes a planned approach to research funding.
- (b) that the Faculty should:
 - 3 Support the department in responding to the recommendations for development, especially by facilitating coordination at teaching and research levels within and between such new schools as are formed, and by supporting a more structured and broadly based approach to curriculum review.
- (c) that College should:
 - 4 Consider any appropriate proposals for spatial re-organisation among the departments in any new school structures.
 - 5 In the context of any such new school structure, pay particular attention to innovative plans for curriculum, teaching and research development that might be supported through a College-wide change fund.

John Hegarty
Provost
