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Chapter XX

Reinventing a Level 7 Programme in Electrical Engineering and Greatly Improving upon Student Retention

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Following the successful implementation over a number of decades of a three-year Diploma in Electrical and Control Engineering at Dublin Institute of Technology, the programme entered a period of extreme difficulty and uncertainty in the late nineteen nineties and early years of the new millennium. As with many such engineering programmes, student numbers seeking to enter began to diminish. Furthermore, engagement and retention of students who had enrolled on the programme became evermore challenging, necessitating some radical moves in the formation and operation of the programme and in putting additional student support mechanisms in place. The situation hit rock bottom between the 2000 and 2002 academic years when the programme appeared to be in terminal decline. Following a major effort by the programme committee in redefining the programme, and upon receiving a annual recurrent retention grant from the Higher Education Authority of Ireland, the declining situation was reversed and the new programme is now on a healthy footing. This paper will outline the steps taken in achieving this goal. Whilst the situation has been reversed, there is little room for complacency and the difficult questions facing educators today continue to challenge.

INTRODUCTION

The School of Control Systems and Electrical Engineering is one of five schools within the Faculty of Engineering at Dublin Institute of Technology (DIT). There are three Departments within the School: Electrical Engineering, Control Engineering, and Electrical Services Engineering. In line with both the Institute and Faculty of Engineering strategic mission statements, the School offers programmes ranging from and inclusive of Phase 4 and Phase 6 National Electrical Craft Apprenticeship, Certificate, Diploma, Ordinary Degree, Honours Degree, Master of Engineering by taught modules and minor dissertation, Master of Engineering (MPhil) and Doctor of Philosophy (PhD) by research. The School currently has four post-doctoral researchers and has a significant body of research active members. The School has in excess of 800 students.

In addition to a long standing four-year honours degree in Electrical and Electronic engineering, accredited by Engineers Ireland and recognised under the Washington Accord, the School also offered a three-year Diploma in Electrical and Control Engineering (Programme Code: DT231) over a number of decades. By the 1990s, in addition to the subject areas of power electronics, control systems and automation, information technology, industrial computing and networks, and programme logic controllers and automation had become central and essential modules in programme delivery.

In spite of adequate achievement in the Irish Secondary School Leaving Certificate examinations by incoming students, the programme suffered from both high drop-out and low completion rates. Of the first-year enrolment (excluding repeat students), on average up to 20% did not present for end-of-year examinations, and the average pass rate of the remaining group was as low as 40%. The situation had reached critical proportions at the turn of the millennium and the existence/continuation of the programme was in doubt.

Success and Progression Rates for First Year Students of DT231 in the 2001/2, and 2002/3 Academic Years

29 students entered year one of the DT231 programme in 2001. Upon completion of both the summer and supplemental examinations in August 2002, only 45% or 13 students had passed and were allowed progress to year 2 of the programme. 21 students joined the programme in 2002 and from this cohort only 8 students (38%) were permitted to progress to year 2.

These retention figures had reached an all-time low and the programme would not have survived unless a serious effort was made to redress the critical issues which had resulted in (i) low student numbers entering the programme, (ii) low moral amongst students, (iii) low moral amongst staff teaching on the programme, and (iv) high student drop out rates.

Concern at poor retention rates on DT231 and other programmes in the Institute led to the appointment of a Student Retention Officer in 2001. As a priority action the Retention Officer focused on first-year attrition rates, particularly in Science and Engineering

programmes. In a report delivered a key finding indicated that specific action skills gaps, principally in the areas of Mathematics and Physics, led to a lack of confidence in first-year students, often resulting in withdrawal from the examination process and the programme. The study noted that 85% of students who withdrew did so in their first year of study [1]. To address this situation the Student Retention Officer identified three key areas requiring immediate attention:

- (1) Need for improved pre-entry information, induction and learning support
- (2) The introduction of both staff and peer mentoring
- (3) An enhanced attendance requirement

On the advice of the Retention Officer, the Head of School and the DT231 Programme Committee made a decision to seek funding to appoint a dedicated Tutor for the programme. It was upon this basis that the application was made under Measure 3 of the Higher Education Authority of Ireland – HEA Information Technology Investment Fund 2001-2006.

In parallel with the application to HEA, in line with the internal Dublin Institute of Technology 5-year Quality Assurance programme review requirement, the School of Control Systems and Electrical Engineering was undergoing a major review of the DT231 three-year Diploma programme. This review coincided with the directives of the National Qualifications Authority of Ireland (NQAI) in introducing Award Level classifications (6 to 10) and in replacing level 7 Diploma awards with new Bachelor of Engineering Technology level 7 awards.¹

The Programme Committee developed a new two-stream programme with title Bachelor of Engineering Technology in Control and Automation Systems *and* Bachelor of Engineering Technology in Electrical Energy Systems, to replace the DT231 Diploma in Electrical and Control Engineering.

The decision to replace the diploma programme with one leading to a Level 7 ordinary degree was driven by several factors. Firstly, the development was, in part, a response to the Bologna Declaration and coincides closely with Engineer's Ireland's guidelines for a three-year "applied" engineering stream. A second consideration was the comment by successive external examiners on the DT231 programme that they believed that the award of an ordinary degree to successful graduates would be appropriate. A third and important factor was the recent, marked reduction in the number of applicants to the diploma; it was hoped that the new programme would prove attractive to well-qualified school-leavers and other suitable applicants.

While the origins of the proposed B Eng Tech degree were to be found in the DT231 scheme, it represented a significant advance from that programme. The Programme Committee designed a scheme which built on the principal strengths and areas of expertise of the School's staff and combined this with a range of option choices for the

¹ <http://www.nqai.ie/en/Privacystatement/> Website of the National Qualifications Authority of Ireland

student. Throughout the programme an emphasis was placed on continuous assessment in all courses, particularly those with a laboratory component.

Award by HEA of a €50K Annual Recurrent Grant in Support of the DT231 Programme

A funding application was made to HEA to facilitate the appointment of a dedicated programme tutor (at Assistant Lecturer grade) who would be trained to function as academic mentor. While the remit of the person to be appointed would principally involve the first year students on the DT231 (DT009) programme, it would also extend to maintaining contact with second and third year students. It was also intended that a scheme of peer mentoring by students would be put in place. The grant would also support purchase of dedicated software and training in WebCT, and in training and payment of peer mentors.

Following the application to the Higher Education Authority, under the Information Technology Investment Fund 2001- 2006, Measure 3 Improved Completion Rates, the Faculty of Engineering was pleased to receive a positive affirmative from HEA in December 2002 with approval for an annual recurrent grant award of €50,000.

A programme tutor, Dr Cecilia Chan, was appointed at commencement of the 2003/4 academic year. In the three years prior to her appointment, the DT231 Diploma in Electrical and Control Engineering had suffered considerably from student withdrawal. The programme in fact had the highest withdrawal rate amongst all DIT programmes during 2000, 2001, and 2002 and was in terminal decline. In the 2002/3 academic year more than 45% of the students enrolled on the programme had dropped out prior to Christmas.

Upon her appointment Dr Chan had an immediate impact in identifying and addressing some of the issues which had contributed to the high attrition rates in the programme. The ensuing success in stemming the drop out and non participation rates by first year students in the programme is largely due to her dedication, energy, creative IT support initiatives to both students and staff, and sheer hard work and commitment.

In tandem with Dr Chan's appointment, numbers entering the programme also increased significantly in the 2003/4 academic year. A total of 38 students registered in September 2003. This increase was partially the result of the move by the Faculty of Engineering in replacing the DT231 Diploma with that of the DT009 Bachelor of Engineering Technology Ordinary Degree programme. DIT was the first Institute of Technology in Ireland to make the move from Diploma to Ordinary Degree.

Students entering the programme in recent years have come from a variety of backgrounds and cultures. Amongst the entry cohort in 2003 were CAO (Central Applications Office) school leaving students, students with awards from the Irish Further

Education and Training Awards Council, FETAC², non-national students from countries including China, Africa and Iran, and mature students who had worked as electricians for a number of years and who had previously received FAS³ National Craft Electrician qualifications [2]. The breakdown in the percentage number of students per category is shown in Figure 1.

Student Categories	No. of Students	Student %
Disability/ Elderly Student	1	3%
VEC Student	3	8%
Student who dropped out / failed from other college courses	5	13%
Foreign Student - (3-Chinese, 2-African, 1-Iranian)	6	16%
Mature Student - Electrician	6	16%
Leaving Certificate Student	17	44%
Total Number of Students Registered in September	38	100%

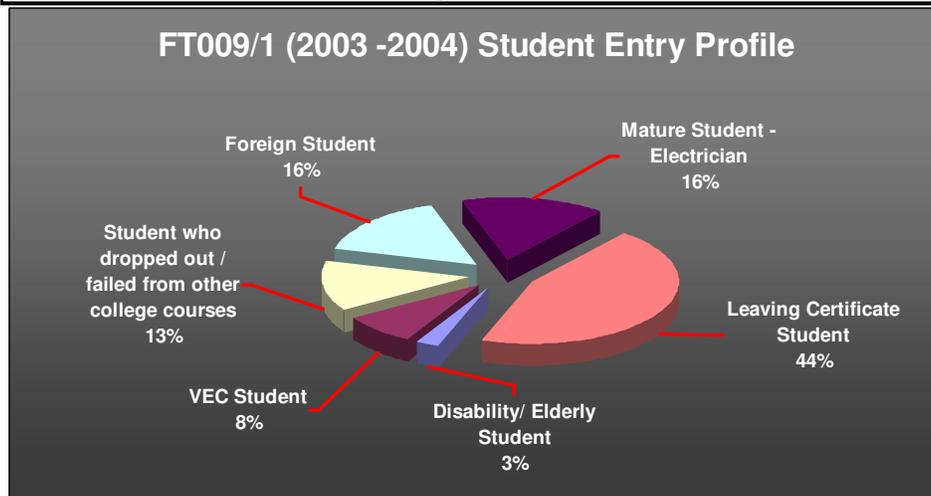


FIGURE 1

Academic Year 2003/4 - First Year Student Entry Profile to the DT009 Programme - Bachelor of Engineering Technology in Control and Automation *and* in Electrical Energy Systems

A significant effort was made when designing the new DT009 programme document in the two years prior to its introduction in September 2003, to ensure that the programme would fall into line with modern trends in education delivery [3]. Significant modifications were made to the assessment methodologies applied in the earlier (DT231) programme, with emphasis on end-of-year examinations reduced and greater emphasis placed on continuous assessment elements throughout the duration of the programme. Continuous assessment in each module was assigned at least a 50% weighting, with some modules (Engineering Computing and Engineering Practice) configured for 100% assessment and with no end-of-year examination component. It is widely accepted today

² <http://www.fetac.ie/> - Webpage of the national awarding body for Further Education and Training in Ireland

³ <http://www.fas.ie/> - Webpage for FAS, Ireland's National Training and Employment Authority

that by actively engaging students throughout the semester and rewarding effort accordingly, the learning experience is greatly enhanced and students are more likely to succeed on the programme.

Success and Progression Rates for First Year Students of DT009 in the 2003/4, 2004/5 and 2005/6 Academic Years

From a cohort of 38 students entering first year of the programme in the 2003/04 academic year, 32 students completed the three academic semesters and presented for the May end-of-year examinations. Of the 6 students who did not engage, one student deferred his place on the programme for one year, two students departed to enter alternative programmes and one student left the programme owing to ill health. Two additional students engaged in the programme and registered for the examinations, however they did not sit the examinations. Excluding the student who deferred early on in the programme, from a cohort of 37 students, 28 passed year 1 (20 students passed all elements at the summer examination sitting, with a further 8 students passing the repeat supplemental examinations). This amounted to a 74% success rate and progression to year 2 of the programme. (An additional 2 repeat (DT231.1) students also passed and progressed to year 2 of the DT009 programme.)

In the 2004/05 academic year, there was an unprecedented 100% success in progression with 28 students in total passing following summer and supplemental examinations, and 2 students being allowed to carry one subject into year 2 of the programme.

In the 2005/06 academic year, 26 from an entry of 30 progressed to year 2 of the programme. These results of progression from year 1 to year 2 over a three period are shown in Figure 2.

It is also of interest to map the progression of students who commenced the programme in 2003/04, and who have subsequently completed years 2 (2004/5) and 3 (2005/6). Of the students who progressed to year 2 of the programme (academic year 2004/5), 26 presented for the end-of-year examinations with 23 successfully passing all elements and progressing to year 3. This amounted to an 88% progression rate. (An additional 4 repeat students (DT231.2) also passed and progressed to year 3 of DT009).

32 students presented for end-of-year examinations in year 3 of the programme (academic year 2005/6); of these 26 completed the requirements (equivalent to 81%) and were the first graduates of the programme. The results are shown in Figure 3.

	2003 -04	2004 -05	2005 -06
No. of Students Registered	38	30	32
No. Students Passed	27	28	26
Students Carrying 1 subject	1	2	0
% Progressing into year 2	74%	100%	81%

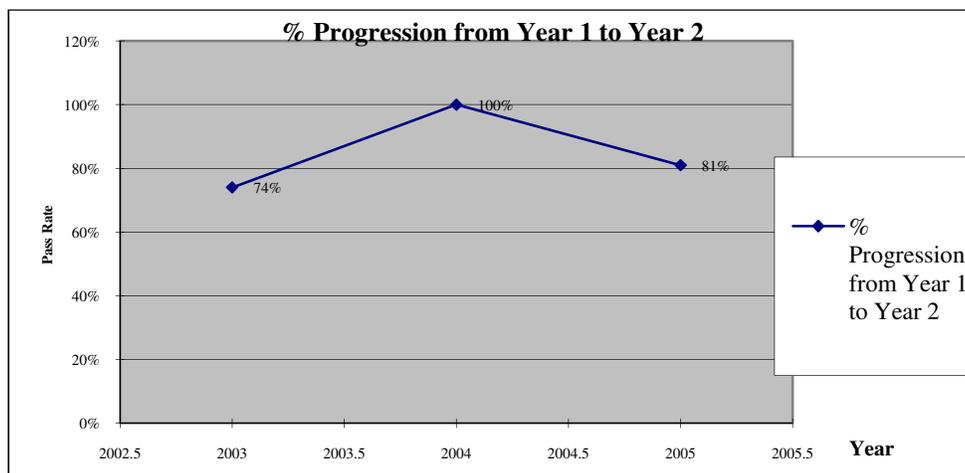


FIGURE 2
First Year Student Numbers and Progression Rates for 2003, 2004, and 2005

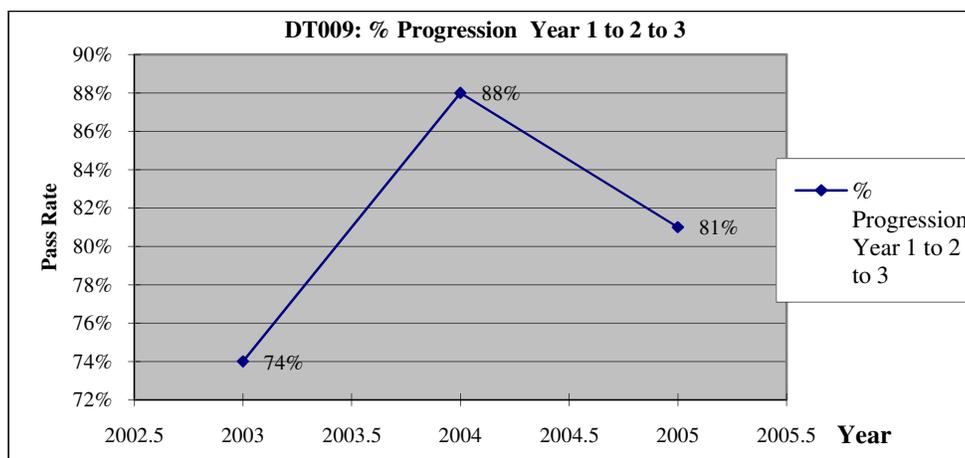


FIGURE 3
Progression and Overall Pass Rates from Years 1 to 3 of Students who entered the DT009 Programme in the 2003/04 Academic Year

81% of students who commenced the DT009 programme have successfully graduated in 2006. While this is a very good result, there is more to be done and it is the intention that this trend will move upwards towards 90% in the coming years.

What Have Been the Key Drivers in Turning the Tide on Retention Trends in Level 7 Degree Programmes within the School of Control Systems and Electrical Engineering?

There is an ongoing debate across technological education sectors at both national and international level on the necessity of adapting and changing institutional and individual outlook in respect of methodology in delivery of education – from a *teaching* to a *learning* centred environment, whilst maintaining or indeed improving upon standards and producing highly qualified and motivated graduates. Coupled with this debate is the perception that a much higher percentage of students entering third level education today appear to have a less solid grounding in science and mathematics than was the case a decade ago. DIT has taken several steps to address these issues, not least the appointment of the Student Retention Officer in 2001 and the creation of a Maths Learning Centre in 2004. This latter ‘drop-in’ centre has provided support to more than one thousand five hundred students across the Institute in the interim period. Support is provided by one-to-one tuition via drop-in sessions, and with e-learning resources on WebCT and the support centre website [4].

As with many educational institutions, DIT is at a point of change and is gradually moving from an institution with a somewhat traditional and conservative approach to delivery in education, to a more student centred, project based learning environment wherein the student is encouraged to take on a more research active and design based approach from commencement of study.

With support from the HEA Information Technology and Investment fund and from the Teaching and Learning Centre at DIT, Cecilia Chan has been very creative in actively engaging and supporting students entering the Faculty of Engineering, from induction upon entry into year one of the DT231/DT009 programme, right through to graduation upon completion of their year three term of study.

One initiative which has been very popular with first year students has involved individual and group project work whereby creativity in design is encouraged in an unrestrictive and non formal environment. Upon being supplied with a tool box containing an array of items including recycled electrical and mechanical components, a rule set and an invitation to design a product based on a guideline theme, students have enthusiastically participated and have often produced clever and innovative working design models. Some of the inventions have been displayed by the students at DIT open and recruitment day events. Peer mentoring by second and third year students has also been implemented, whereby selected students provide support and advice to first year students. These mentors are encouraged to participate at the Faculty of Engineering Open Day events and they receive a small stipend for these and other contributory activities [5].

It is widely accepted today that in imparting scientific and engineering education, *transferable* ‘key’ or ‘soft’ skills should be imbedded in programme curricula and delivery. Communication skills and professional development modules have become increasingly important in programme design. To further supplement and enhance these

modules, a one-day workshop was delivered by the Career Placement office at DIT in February 2005 and again in 2006, with emphasis on CV writing, presentation skills and guidelines to good interview practice. All students attending the workshop received a certificate and the workshop has been assigned a 1 ECTS (European Credit Transfer System) module credit. Students have expressed considerable satisfaction with the programme.

In a further initiative, a one-day “Career Speed Dating “ event has been organised and was held in April 2005 and March 2006. A business lunch was held in a city centre hotel with invited recruitment personnel from several leading technical companies from the greater Dublin region. The event was organised in a manner which enabled students to meet with and have short informal rotational interviews with many of the invited company representatives. This event has been extremely positive to both employers and students and it has resulted in many placements of students upon graduation.

Both Dr Chan and staff colleague, Leslie Shoemaker, who has also made significant contributions in addressing retention in a sister programme to DT009, DT010 in Electrical Services Engineering, have made considerable contributions in recent years in improving the First Year Induction experience of students registering for our programmes in engineering. Improved information packs and organised social events have added to both the effectiveness and enjoyment of the event which is staged in mid September, in the first week of term. Leslie Shoemaker has researched the role and activities of student mentoring across the Institute and at Universities external to DIT and has gained significant insight into the issues facing young people entering third level education from a range of backgrounds [6]. Leslie is a qualified psychologist and councillor.

Cecilia Chan is also participating on the DIT Masters in Third Level Learning and Teaching programme, with expected graduation from the programme in 2007. To date she has graduated with a postgraduate diploma and she has taken modules in key skills, career management and psychology in education. Being of Chinese nationality, Cecilia is also interested in multi-cultural studies and she has written a research proposal on the *Comparative study between Chinese and Irish students in terms of cultural, social, economic, political, and psychological values from an educational perspective across the three major disciplines – Engineering, Computer Science and Business Studies, in Ireland* [7].

Cecilia is also taking a lead role in the promotion of Women in Engineering at DIT, and the group is committed to actively encouraging more young women to take up careers in science and engineering [8].

Where to From Here?

Much has been achieved, however there is still much to be done. In the past there was perhaps not sufficient concern or attention paid to student failure and drop out rates on

many engineering programmes. Indeed, it could be argued that the standing of a programme was sometimes gauged by the percentage of students who did not pass and progress within the programme. This is no longer seen as a satisfactory approach to third level education. Having achieved the entrance requirements and being accepted into a programme, it is reasonable to expect that the vast majority of committed students will progress and graduate from that programme. It is unlikely that 100% success will be achievable for most engineering programmes; however the aim should be to achieve up to and in excess of 90% successful completion rates.

ACKNOWLEDGEMENTS

The Faculty of Engineering wishes to acknowledge the support of the Higher Education Authority of Ireland, Information Technology Investment Fund 2001- 2006, Measure 3 Improved Completion Rates. Helpful support was also received from the Teaching and Learning Centre, the Maths Learning Centre, and the Student Retention Officer, at Dublin Institute of Technology.

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Eugene Coyle received his B.E. degree in Electrical Engineering, Master of Engineering Science degree in Power Electronics and PhD degree in Engineering Rehabilitation, from University College Dublin in 1977, 1988 and 1993, respectively. Following eight years working in both the private and public sectors in Ireland, he joined Dublin Institute of Technology in 1985. He was appointed Senior Lecturer teaching in 1998, Head of Department of Control Engineering in 2003, and Head of School of Control Systems and Electrical Engineering in 2004. Eugene is a Fellow of both Engineers Ireland and the Institution of Engineering and Technology.

Mike Murphy received his Higher Diploma from Dublin Institute of Technology and BSc in Electrical Engineering from Trinity College Dublin in 1980, his MEng degree in 1982 and PhD degree in 1987 (Stevens Institute of Technology). He is a Member of the Institute of Electrical and Electronics Engineers. He commenced his career in Bell Labs and later Bell Communications Research before returning to the academic sector in 2002. He is currently a Director of Dublin Institute of Technology and Dean of the Faculty of Engineering. While working in industry he was an adjunct professor teaching engineering programmes at Stevens Institute of Technology and New York University. He currently chairs the Academic Society of Engineers of Ireland (IEI). He is focussed on making engineering at DIT challenging, fun and rewarding for students and the academy.

Frank Costello graduated from University College Dublin in 1978 with a Bachelor of Civil Law degree, and he qualified as a solicitor in 1980. He also received a diploma in career guidance in 1980. He practiced as a solicitor for 15 years before returning to education, when he received both a degree psychology and a master's degree in family counselling in 1999. Frank worked with disadvantaged schools in development and delivery of learning and teaching programmes for some years before joining DIT in 2001 as Student Retention Officer. He is interested in student identity, motivation and career progression.

Cecilia Chan graduated from Trinity College Dublin in 1996 with a first class honours Bachelor of Engineering degree. She received her PhD from TCD in 2001, in digital imaging and signal processing. Cecilia joined DIT in September 2003 as assistant lecturer and student tutor to students on the three year diploma and ordinary degree programmes within the School of Control Systems and

Electrical Engineering. She received a Postgraduate Diploma in third level Learning and Teaching at DIT in 2005 and she is currently studying for a master's degree in Learning and Teaching.

Leslie Shoemaker