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ENHANCING EDUCATIONAL PROGRAMMES FOR GEOMATICS IN IRELAND

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ABSTRACT

The growing spatial information needs of society, the rapid development of new surveying technologies, and the global demand for appropriately qualified surveyors, have triggered a radical re-evaluation of Geomatics education in Europe. Although significant enhancements to DIT's educational programmes have been made during the last decade, the provision of new opportunities for learners and innovative changes to existing paradigms of training and education are required. This paper addresses some of the issues confronting educators in DIT, and presents some of the strategies for their enhancement and implementation.

Szybko postępujący rozwój nowych technologii pomiarów gruntów wspólnie z silnym zapotrzebowaniem na odpowiednio wykształconych geodetów zarówno w kraju jak i za granicą, zapoczątkowały radykalną ewaluację edukacji geodezyjnej w Europie. Pomimo znaczącej poprawy programów edukacyjnych, która nastąpiła w DIT w przeciągu ostatnich 10 lat, wciąż potrzebne jest dostarczanie nowych możliwości dla osób uczących się i innowatorskich zmian w obecnych paradygmatach edukacyjnych. Ten artykuł prezentuje niektóre zagadnienia, z którymi spotykają się wykładowcy w DIT, a także omawia poszczególne strategie rozwinięte w celu poprawy edukacji i sposoby ich wdrażania w życie.

1. Geomatics Graduates in a Changing Society

1.1 Introduction

Graduates in Geomatics must be skilled in the implementation of a wide range of spatial data processes and be adaptive to continuing technological change. This necessitates the development and provision of relevant undergraduate and postgraduate programmes, and flexible learning products. Education and training institutions must therefore respond to the developing needs of the information society as reflected by the mainstream use of spatial information systems, the on-going development of national spatial data infra-structures, and the technological

reform of existing land administration systems. At the Dublin Institute of Technology (DIT), these requirements and aspirations are captured in our mission statement which states:

The mission of the Department of Spatial Information Sciences, responsive to the spatial information needs of society, is to promote and deliver flexible learning resources, facilitate and undertake applied and fundamental research, and actively engage with the spatial information community at national and international level.

1.2 Geomatics in an Irish context

When discussing the existing or future demand for graduates and professionals by niche market sectors, the influence of the current and predicted economic environment into which they will be absorbed is a significant factor. A summary (and relevant) analysis of the employment and population statistics for Ireland (pers. comm. B.Hughes) shows that:

- there was minimal growth in employment in the period 1926-1992 and it remained static at 1.15 million \pm 0.1m;
- from 1991 to date (2006 Census), job growth has risen by one million to c. 2.15 m;
- the increase in population for the same period was +0.7 m to give a current total population for Ireland¹ of c. 4.2 m, representing an increase of c. +18% in 15 years;
- a significant proportion of that increase is attributed to inward migration from within the new accession states of the EU;
- current predictions estimate that by 2021 (the next 15 years), the growth in population will be +80 K per annum, i.e., an increase of +1.2 m over the period to a total of 5.4 m and
- the consequential job growth over the same period will be +0.8 m (this will meet the so-called 'Lisbon Target' set by the OECD for Europe in 2003).

The above indicators predict sustained growth driven by the continuing need for key skills in all sectors of an economy (Figure 1) that has radically changed from a largely agrarian and rural manufacturing base, to one based on hi-technology and software production, ITC expertise and internationally traded services (source: http://www.esri.ie/irish_economy/).

¹ Ireland is the official name of the State, covers 83.3% of the island's total land area (c. 84 400 km²), and has a population of c. 4.2 million. Northern Ireland lies on the northeast of the island and is a constituent country of the United Kingdom. It occupies 16.7% of the total area and with a population of c. 1.7 million, has double the population density of Ireland.



Fig.1. Irish economic profile & unemployment trends

These economical and social issues are attributable, among other factors, to Ireland's EU membership, access to the Single Market, our low corporation tax rate, a large multinational presence, a high proportion of the population of working age, increased participation in the labour market especially by females, a reversal of the trend of emigration toward immigration, a more stable public finance position, and co-ordinated social partnership agreements between Government and trade unions. Significantly however, this transformation towards a 'knowledge economy' was underpinned by sustained investment in education and training by the State over the last 15 years. The spatial information components of that economy (Figure 2) are now an intrinsic part of the Irish success story to date and the demand for skilled graduates into the future, nationally (and globally), is predicted to continue.



Fig. 2. Components of the Irish spatial information industry

In this context, the challenge of planning for an uncertain future can be assisted through the implementation of 'futures' methods and techniques. This process partly involves:

- identifying relevant strategic question(s);
- considering differing and alternative futures or 'scenarios';
- developing a final 'preferred' vision of the future;
- agreement and development of a strategic plan;
- realising this with measurable key performance indicators (KPIs).

2. Geomatics Education Profile

Geomatics professionals in Ireland are currently unregulated, so the profession includes practitioners with a range of surveying and engineering qualifications. This profession, more than most, has been relentlessly driven by rapid advances in surveying and computing technology during the last few decades. This has inevitably produced a very high degree of automation in the design and use of such technologies, leading some commentators to argue that learner skills in these areas should or can be downgraded accordingly. The authors strongly promote the opposite view. Geomatics professionals now require broad skills and high level knowledge to better evaluate and assess the specifications and optimal use of such advanced technologies in order to meet the stringent tolerances now demanded by most commercial contracts reliant on, or incorporating spatial data.

2.1 Background

The current 4-year undergraduate programme in Geomatics developed from the 3-year diploma programme in Geo-Surveying that was offered from the mid 1970s until its cessation in 2001². The 3-year diploma predominantly focussed on spatial data capture, and supplied approximately 500 professionals for the traditional land surveying and associated professions during its lifetime. However, there was a perception among graduates that the diploma level qualification was hindering their career progression because it was not of a bachelor honours standard (the norm required for professional appointments, especially in the public sector). A substantial number of these diploma level graduates were therefore obliged to study abroad for an extra year to obtain a bachelor level qualification in order to improve their qualifications and their career potential. This provided one of the imperatives to develop the 4-year honours degree level programme.

² The augural programme to train land surveyors at DIT (and in Ireland) commenced in 1967 as a 4-year professional diploma in Geo-Surveying. That ran successfully until the mid-1970s, after which it was discontinued (for economic and viability reasons) and replaced by the 3-year diploma in Geo-Surveying until its cessation in 2001.

Secondly, access to master's programmes in Ireland is predominantly restricted to graduates with honours bachelor degrees (4 years). Diploma graduates were therefore restricted in their academic and professional advancement.

Thirdly, the Bologna Accord (1999) promoted a significant reform of third level education in Europe by proposing a 5-year standard for a master's level degree. This has led to the widespread adoption in Europe of a 3 + 2 model comprising a three year bachelor degree followed by a two year masters' degree. However, many educational programmes in Ireland have decided to retain the 4-year honours bachelor level degree structure due to:

- the custom of restricting access to masters programmes to honours degree graduates;
- the predominance of 1-year fulltime masters degree programmes in Ireland, which satisfies the Bologna 5 year standard for masters degrees by using a 4 + 1 model;
- fees for undergraduate degrees are paid for by the Irish State but there are substantial fees levied for postgraduate programmes. Consequently, reducing the length of the bachelor degree programme to 3 years would put learners at a significant disadvantage.

It was generally appreciated that Geomatics professionals require a broad high level education to ensure they have the necessary skills and competencies to best serve the diverse needs of a changing society in the information age. There was also a belief that a significant enhancement of geomatics skills was necessary to stimulate improvement of the Irish geomatics market, so the development of a new educational model was seen as an investment in the future as well as addressing the issues outlined above.

2.2 Current Educations Models

Educational programmes that are currently delivered at DIT include undergraduate and postgraduate programmes, both of which have been recently modularised and semesterised. This permits a greater degree of flexibility in programme design. These main programmes are supported by a range of specialist short courses aimed at meeting the continuing professional development (CPD) of the participants.

2.2.1 Undergraduate Programme

The four year Bachelor of Science in Geomatics adopted the educational profile proposed by FIG and CLGE which recommended three main stands (Figure 3) including:

- the traditional land surveying discipline of measurement science;

- the production of spatial information and the management of spatial databases;
- the application of spatial information for land management (land tenure, land value, land use and land development).



Fig. 3. Educational profile of the future for surveyors recommended by FIG and CLGE [Enemark 2001]

The undergraduate bachelor degree in Geomatics is a National Qualifications Authority of Ireland (NQA) Level 8 qualification [RE1 07]. The duration is for 8 semesters (Figure 4) and it attracts 240 ECTS credits. This degree is unique on the island of Ireland, and has produced 109 graduates in its first 5 years since 2003.

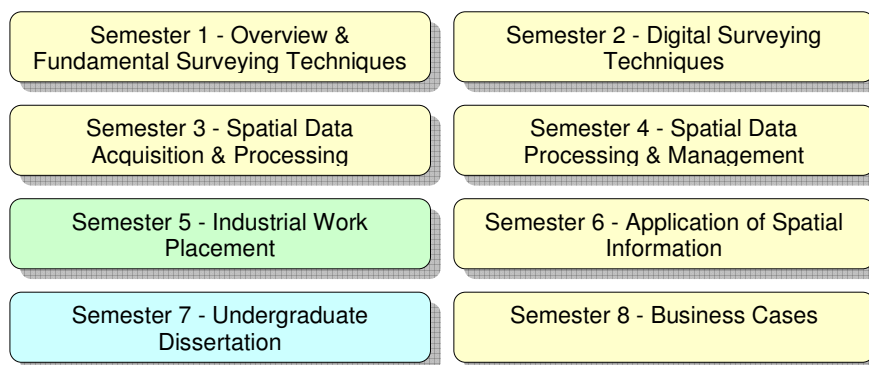


Fig. 4. BSc Geomatics programme offered by DIT

2.2.2 Postgraduate Programme

The Master of Science degree and Post Graduate diploma programmes in Spatial Information Management were launched in September 2007. These were designed to suit mid-career professionals in public and private organisations who are already working with spatial information but wish to acquire a qualification and the skills necessary to release the added value from their systems, and optimise their usage. A number of competing programmes are available in Ireland which

focus on geographic information systems and remote sensing, but the significantly different philosophy of this programme is its focus on the acquisition, management and analysis of 'spatial information' rather than merely on the 'system'.

The programme carries a NQAI Level 9 rating and attracts 90 ECTS for modules delivered on a part-time basis on one evening and one full-day per week over four semesters, to facilitate professionals in fulltime employment. Successful completion of the modules in semesters 1-4 leads to the award of a postgraduate diploma. Completion of the dissertation module in semester 5 leads to the award of a master's degree. It is also intended to allow open access to learners wishing to undertake individual modules only, as fulfilment of their CPD requirements for membership of the professional bodies (see Section 4).

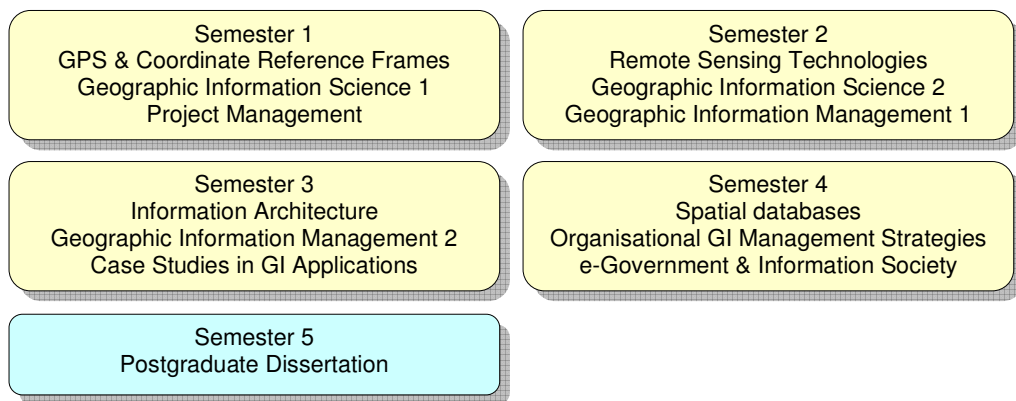


Fig. 5. MSc Spatial Information Management programme offered by DIT

2.2.3 Continuous Professional Development

A number of short programmes are also provided by DIT as specific training and as continuous professional development in:

- Coordinate Reference Systems (5 ECTS) via eLearning and awarding (DIT Code DT156);
- Geographic Information Systems, an evening course of 20 weeks duration (DT157);
- Global Navigation Satellite Systems (5 ECTS), currently under redevelopment for delivery via eLearning (DT158).

2.2.4 Corporate Training

The Department can respond to the specialist training needs of organisations and their staff, by offering customised corporate training on a part-time basis or a full-time intensive basis. Corporate training promotes interaction with private and public sector companies and professional bodies through facilitating the provision of

continuing education and training programmes to these sectors/bodies. Numerous such courses have been successfully delivered.

The academic staff are also proactively engaged in organising seminars in collaboration with the professional bodies, to debate issues and promote best practice in a range of relevant topics.

3. Future & Ongoing Developments

3.1 Academic Programmes linked to NQAI levels

As discussed in section 2, DIT is primary involved in the delivery of geomatics educational programmes at Bachelors and Masters levels, equivalent to levels 8 and 9 of the NQAI framework [NQAI 2003]. When combined with the CPD portfolio of specialised courses for practitioners as previously outlined in 2.2.3, DIT still does not currently meet all of the spatial information needs of society as identified in the Department's mission statement. Society will require more and highly skilled professionals, and opportunities have now been identified at both sub-honours degree level (certificates and diplomas) and postgraduate level (taught & research masters and professional & research doctorates).

3.1.1 Certificate & Ordinary Degree Levels

As explained in section 2.1, the geomatics honours degree offered at DIT developed as a replacement for Geo-Surveying diploma and certificate programmes. Previously, students had the opportunity of graduating with a certificate after two years or a diploma after three years, depending on their level of academic achievement and career choice. Students registered on the current honours degree, who do not complete all four years of the programmes, exit DIT without any qualification. Thus most students who leave the programme prematurely find it necessary to undertake additional education or training in order to improve their employability. This often leads to a change in career for the individuals involved, and they are permanently lost to the geomatics industry.

In order to deliver graduates at technologist or technician levels the Department of Spatial Information Sciences is currently examining flexible modes of delivery and a number of solutions to the issue of credit accumulation and premature exit from honours level bachelor degree programmes. These options are expanded upon in section 3.2.

3.1.2 Postgraduate Level

The Department of Spatial Information Sciences, as one of eight departments that make up the Faculty of the Built Environment at DIT, was involved during 2007 in the development and accreditation of a faculty-based Professional Doctorate in the Built Environment (DBEnv) which involves taught and research components, and a major research thesis [RE2 07].

This programme marks a significant development for the faculty as it seeks to meet the needs of the built environment sector by providing a programme that “develops the capability of individuals to work within a professional context” [RE3 02]. Graduates can specialise in one of four subject areas, with the needs of the spatial information society encompassed in the DBEnv (Spatial Planning) option. This matches the departmental mission of facilitating and undertaking “applied and fundamental research”.

Within the School of Spatial Planning, over 60 modules at MSc. level are already available and are being delivered to students on five programmes. In response to developments in industry and the professions, these programmes are continuously reviewed and updated and new programmes devised to fit particular niches. It is envisaged that future MSc programmes will allow students to customise their qualification by choosing from a range of electives based on the current portfolio of modules.

3.2 Flexible Delivery

Developing and delivering new programmes, short courses and CPD elements is very time-consuming and demanding of faculty resources. The Department of Spatial Information Sciences currently comprises 8 full-time lecturing staff plus Head of Department who deliver approximately 80% of the modules on the BSc and MSc courses, all CPD courses, and provide service lecturing to 6 programmes in 3 other schools within the faculty. In order to expand the range of geomatics education, more efficient modes of delivery need to be utilised to replace or supplement face to face teaching.

3.2.1 eLearning

With support from the DIT's Learning Technology Team, the department has developed a number of eLearning resources which can be fully delivered in an online environment using WebCT/Blackboard and a range of multimedia software [RE4 04]. The Coordinate Reference Systems course has been delivered as CPD for specific groups (Ordnance Survey Ireland and Cyprus's National Mapping Agency) but also as a short course offered by EuroSDR as part of its EduServ annual series of courses delivered to European National Mapping Agencies and interested individuals worldwide [RE5 04].

eLearning courses have thus proven to be very useful in broadening the usage and reusability of particular modules. However, the development of eLearning materials is very time-consuming and it is clearly not justifiable to devote such high resources to their development if the module does not have guaranteed longevity.

3.2.2 Distance Learning

Unlike eLearning, distance learning does not necessarily need to be computer-based. Typically however, students engaged in distance learning are either supported by tutors whom they meet in face-to-face group sessions or who are available online. As yet, DIT has not developed any specific distance learning

materials, but as a large amount of module materials are already in electronic format for usage with WebCT, adaptation is being considered in some cases.

3.2.3 Blended Learning

Due to the predominantly practical nature of some geomatics modules, delivery via eLearning or distance learning solutions only can be insufficient. One approach is to utilise a blended learning solution which incorporates a number of differing modes of delivery. An example of where DIT is considering implementing such a solution is in response to the needs of the Irish surveying industry for technologist level education via an apprenticeship-style system operated in parallel with private surveying companies and the professional bodies. Students would mainly work for a survey company and their learning during the normal working week would be supported by distance learning materials. On an organised basis, students would attend the DIT for tutorials and intensive classroom sessions.

3.3 Collaboration & Networking

As previously mentioned, the small size of the Department of Spatial Information Sciences requires very strategic usage of resources to ensure that our mission is fulfilled or, at least, well served. One strategy currently, and increasingly, employed is collaboration and networking both nationally and internationally on both the development of programmes and for engagement in research. These activities have resulted in significant benefits for students on taught programmes and for research being carried out at the department.

3.3.1 Faculty Networking

Faculty are active on both the national and international stage via a range of professional bodies and research networks.

Mr. Kevin Mooney is Secretary General of EuroSDR and since 2003/2004, the Secretariat has been hosted at DIT. This has benefited the DIT by providing access to leading academics and cutting edge research carried out in combination with European National Mapping Agencies. EuroSDR has held a number of seminars and workshops in Ireland to which DIT have made significant contributions.

Dr. W. P. Prendergast is a Past President of CLGE (The Council of European Geodetic Surveyors) and the Irish Institution of Surveyors and was co-author, with Prof. Stig Enemark, of renowned publications on the direction of geomatics education in Europe for CLGE and FIG. Currently Ms. Helen Murray is a member of FIG's Commission 3 (standards network) and previously attended and published at a number of FIG Working Weeks and workshops. Drs. Audrey Martin and Eugene McGovern have also been active in FIG as president and past president respectively, of the Geomatics branch of the Society of Chartered Surveyors. Dr Martin, Dr. McGovern and Mr. Mooney have also published at a number of ISPRS workshops and congresses with particular focus on the Commission for Education & Outreach.

Mr. Frank Prendergast's involvement with the EEGECS network has resulted in the hosting of a Congress meeting in Dublin and influenced many decisions related to the redevelopment of the BSc programme in 2005/2006.

3.3.2 ERASMUS

Through the ERASMUS programme, DIT is now linked to 6 European universities across 5 countries (Figure 6). These links have facilitated lecturer exchange programmes (Aalborg and Stuttgart), student exchange (Le Mans, Hamburg & Valencia), joint supervision of research students (Stuttgart), and student visits (Bergen & Hamburg), all of which have been very valuable to the taught and research agendas of the department.



Fig. 6. ERASMUS links of the Department of Spatial Information Sciences, DIT

4. Professional Accreditation and Marketing

4.1 Professional Accreditation

The DIT recognizes the importance of having professional accreditation for the BSc. (Hons) Geomatics programme as this strengthens the transferability of the graduate's skills and qualifications internationally. Professional bodies regulate the

profession in the public interest and oversee all aspects of the profession, from education through to qualification and the continuing maintenance of the highest professional standards. The programme is professionally accredited by the Society of Chartered Surveyors (SCS), the Irish Institution of Surveyors (IIS), the Royal Institution of Chartered Surveyors (RICS), and the Institution of Civil Engineering Surveyors (ICES).

The SCS is the professional body for chartered surveyors practising in all areas of the property and construction industry in Ireland and through its dual membership arrangements with the RICS in the United Kingdom, represents over 140,000 members practising in Real Estate, Construction and Geomatics in more than 146 countries worldwide. Within Ireland there are approximately 2,000 chartered surveyors. The IIS has a membership of approximately 500 individual Geomatics practitioners in Ireland at levels from technician through professional to fellow, as well as approximately 40 Corporate and Affiliate members. It is particularly active in forging links between the geodetic industry and other professions such as the legal profession with respect to mapping issues for land and property registration in Ireland, and in developing a discussion forum for commercial interests. The ICES represents surveyors working within the civil engineering industry and is an associated body of the Institution of Civil Engineers (ICE). Internationally, ICES is an active member of both the International Federation of Surveyors (FIG) and PI-UK (China). The ICES through its role as an accreditation body, supports the CPD of surveyors working within commercial management and geospatial engineering.

Professional Accreditation from professional bodies enables our graduates to become eligible for full professional membership status upon graduation. With full membership of the SCS and RICS, our graduates are permitted to use the 'Chartered Surveyor' designation.

A number of the short and eLearning courses mentioned in section 2 have also been approved by these professional bodies as part fulfilment of their CPD requirements (see 2.2.2).

4.2 Marketing Initiatives

Against a background of declining student numbers (average yearly intake is 35 students approx.), the Department have commenced a proactive marketing campaign to promote the Geomatics profession in Ireland and the DIT BSc. (Hons) course specifically. The primary objectives are *inter alia*, to address the following issues:

- increased awareness of the profession amongst school students;
- increased awareness by school students and mature applicants of the educational programmes that supply the industry with graduates;
- targeted advertising;

- attracting undergraduates at advanced entry level from other disciplines who are dissatisfied with their current programme of study;
- coordinated involvement of the professional bodies in marketing and professional.

The promotional work consists of an extensive 'feeder' schools initiative which involves inviting potential students to visit the Department and meet with lecturing staff. Recent graduates and current students have been invited to visit their respective local school to promote awareness of Geomatics as a potential career path for school leavers. A new suite of Geomatics promotional material has been developed and circulated to Career Guidance/Information Technology/Geography teachers at secondary school level and work is on-going on improving the visibility of the Geomatics web pages within the DIT website.

For applicants from the new accession countries of the EU, the DIT Admissions Office has now the facility to provide translation and explanation of 'equivalencies' service for non Irish leaving certificate candidates. International students (non EU) are assisted by the DIT International Students Office which has the expertise to advise and counsel students who are considering joining our academic programmes, and support them when they come to live in Ireland. At present the Dublin Institute of Technology is building a multicultural, multinational environment with students from the 27 EU member countries as well as 35 other nations. Student exchanges via the ERASMUS links mentioned in section 3 have enabled 6 undergraduate students and 1 postgraduate researcher to undertake one or two semesters of study at DIT. This has proven to be very valuable for the individual students and for the cohorts with which they study.

5. Summary and Conclusions

Notwithstanding all of the positive factors and actions discussed, DIT's successful undergraduate programme in Geomatics is vulnerable, due in part to a perceived crisis of identity in the geodetic surveying profession in Ireland (a phenomenon not unique to Ireland). Faculty and the profession therefore identify the urgent need to attract a greater number of high quality applicants through improved promotion of the Bachelor level programme, the career and the profession. In a parallel development, using the medium of modularisation and the expansion of DIT's distance learning capabilities, a structure is emerging for the flexible delivery of modules from traditional programmes to non full-time off-campus learners. This strategy is viewed as facilitating the continuing educational and professional development requirements of geodetic surveyors working in private industry and public bodies, and enabling the development of more applied certificate and diploma-level programmes.

Furthermore, the Department of Spatial Information Sciences is examining the development of a suite of specialist postgraduate programmes at national and international level, supported by collaboration with other universities. It also sees

the delivery of customised professional short courses as key to a more integrated approach to continuous learning in this discipline.

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