EXPENDITURE REVIEW

Information & Communication Technologies (ICT) Undergraduate Skills Programme

Department of Education & Science
2007

The Undergraduate Skills programme is funded by the Irish Government under the 2000-2006 National Development Plan (NDP) and aided by the European Social Fund (ESF) under the 2000-2006 Community Support Framework (CSF).

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Acknowledgements

The work on this expenditure review began with the establishment of the Steering Committee in June 2004. The review required the identification and compilation of a great deal of data by staff of the Department of Education and Science and of the Higher Education Authority; without whose hard work this review would not have been possible.

Special thanks go to the following for their valued input into this review:

- Mr. Seamus Gallen, Enterprise Ireland for sharing his knowledge and expertise with the Steering Committee
- McIver Consultants for their work in carrying out market research – their full report is attached at Appendix 5 of this report
- The many companies and individuals who gave their assistance to McIver Consultants in carrying out their market research – these are named in Appendix 2 of this report
- HETAC for providing information to McIver Consultants
- Dr. Richard Boyle for performing a quality assessment of this report

ICT Undergraduate Skills
ERI Steering Committee
December 2007

Terms of Reference

The Terms of Reference for the review of the ICT Undergraduate Skills Programme were based on standard Terms of Reference which apply to all reviews across the Civil Service, with appropriate modifications specific to this programme. The Terms of Reference for this review are as follows:

- To identify the programme objectives.
- To examine the current validity of those objectives and their compatibility with overall strategy of the Department of Education & Science.
- To define the outputs of the undergraduate skills programme, and identify the level and trend of those outputs.
- To examine the extent to which the objectives have been achieved, and comment on the effectiveness with which they have been achieved.
- To identify the level and trend of costs and staffing resources associated with the programme and comment on the efficiency with which the programme has achieved its objectives.
- To evaluate the degree to which the objectives warrant the allocation of public funding on a current and ongoing basis and examine the scope for alternative approaches to achieving these objectives on a more efficient and effective basis.
- To specify potential future performance indicators that might be used to better monitor the performance of the programme.

Executive Summary

Introduction

All government departments are asked each year to include in their business plans a number of expenditure reviews to be carried out under the Expenditure Review Initiative (Value for Money and Policy Reviews)[1]. The review process is overseen by a Central Steering Committee on Programme Evaluation, chaired by the Secretary General of the Department of Finance and each year up to fifty programme areas are selected for review across the various Departments and Offices.

This expenditure review examines the ICT undergraduate skills programme ("the Programme"). This programme was selected in view of the large investment provided from Government to address the computing skills gap that manifested itself globally during the late nineties, and coincided with the boom in the ICT sector worldwide. The Department of Education and Science has made a substantial investment in ICT undergraduate skills and the review's objective is to examine whether this programme has contributed to the viability of the ICT sector in Ireland in the short, medium and long term by providing for the continued supply of high quality graduates in the appropriate disciplines from the higher education sector and, if so, to ensure that it continues to do so.

The review also examines how the global downturn in the ICT sector impacted on the delivery of the programme and on the achievement of its objectives. In addition, the review attempts to determine how the relationship between skills provision in the higher education sector and the needs of industry is affected by the cyclical nature of the ICT market.

Methodology

A Steering Committee was established to guide this expenditure review, comprising of staff members from relevant line sections and staff from the Higher Education Authority. Following the identification of the terms of reference of the study and the objectives of the ICT Undergraduate Skills Programme by the Steering Committee, performance indicators were agreed and the process of identification and extraction of data began. It was agreed to appoint consultants to carry out an analysis of the impact that the Skills Programme had both on the growth of the ICT sector in Ireland and its subsequent effect on the Irish economy. McIver Consulting were asked by the Steering Committee to carry out interviews with leading players in industry as well as looking at broad macroeconomic development issues. The full report of McIver Consulting is attached at Appendix 5.

Background

When it became apparent that there were significant skills shortages in Ireland which would hinder further development of the economy, the Government initiated a number of measures to remedy this problem, including the establishment of the (interim) Skills Group in late 1996 by Forfás under the chairmanship of Professor Frances Ruane. The First Report of the Skills Needs Steering Committee, chaired by Mr. Noel Lindsay, was published in June 1997. The Task Force on the Supply of Technicians was established in

[1] Minister for Finance, Brian Cowen T.D., announced the expansion and re-naming of the ERI in June 2006.

August 1997 under the chairmanship of Dr. Sean McDonagh, Director, Dundalk Institute of Technology.

In 1997, the Government recognised that an adequate supply of the skills required by industry would be a key determinant of the future growth potential of the economy. It was recognised as a key policy requirement that skill needs, both in terms of numbers and type, should be estimated and the correct policies put in place in sufficient time to ensure that the skills demands of the economy were met.

The Government therefore established the Expert Group on Future Skills Needs to analyse these issues and to make policy recommendations and its first report, under the chairmanship of Dr. Chris Horn, was published in December 1998. The second report of the Expert Group on Future Skills Needs, under the chairmanship of Dr. Danny O'Hare, continued to monitor changes in the ICT Skills area and did not recommend the creation of any further additional places.

The ICT Undergraduate Skills Programme was designed to provide a response by ensuring the provision of additional required places as identified by the Expert group and by the various skills reports.

Identification and Current Validity of Objectives

The first term of reference for this review was to identify and articulate the objectives of the ICT Undergraduate Skills Programme. These were identified as follows:

- ***To address identified and anticipated skills needs and to ensure an improvement in the supply of trained graduates in the short and medium term.***

- ***In the context that an adequate supply of the skills required by industry would be a key determinant of the future growth potential of the economy, it was recognised as a key policy requirement that skills needs, both in terms of numbers and type, should be estimated and the correct policies put in place in sufficient time to ensure that the skills demands of the economy are met.***

The review concludes that the first stated objective is still valid in the current climate. Recent research and the findings of the Expert Group on Future Skills Needs, in addition to the report commissioned for this review, have indicated that there is a current anticipation of a skills deficit in the ICT sector and that there is still a need to "ensure an improvement in the supply of trained graduates in the short and medium-term". The review concludes, however, that this situation does not mean that the programme did not work or failed to address its original objectives. Rather the worldwide downturn in the ICT sector led to a decrease in applicants to fill the courses due to a perception that employment prospects were no longer buoyant in the ICT industry.

The second, wider, objective also remains valid in the current climate of economic expansion and Ireland's oft stated aim of placing itself at the leading edge of the growing global knowledge economy. At a departmental level, this is explicitly stated in the Statement of Strategy and at a wider national level, Government has signed up to the ambitious aims of the Lisbon agenda. In gross numbers terms, demand for higher education in Ireland will continue to grow over the coming years. FAS and the ESRI have projected requirements for an additional 100,000 skilled graduates over the next ten years. The

achievement of our objectives under the Lisbon Strategy and the targets set out in the recently launched Government Strategy for Science Technology and Innovation demand significant further growth in research activity including, for example, a doubling of the number of PhD students by 2010. These will need to be fed by a supply of graduates from the appropriate areas of study as well as those attracted in from overseas. If more high-end technology industries are to be attracted to base their operations in Ireland, and if existing companies are to expand and/or upgrade their operations, an increased supply of trained computer graduates and post-graduates is still a real necessity. The ICT Undergraduate Skills programme, in this context still has a valuable role to perform.

Programme Objectives – Extent and Effectiveness of Achievement

To facilitate examination of the extent to which the objectives were achieved since the programme began and how effectively this was done (fourth term of reference), a number of key questions had to be asked and answered. These were

- ***Were identified skills needs addressed and was there an improvement in supply of graduates (level and trend of outputs)?***
- ***Did the timely skills supply become a key determinant of the future growth of the ICT industry in Ireland?***
- ***Did the change in environment brought about by the downturn in the economy during 2002 and 2003 affect the achievement of the objectives?***

The downturn in the ICT sector obviously had a serious impact on the achievement of original targets. This became apparent from 2002/03 when additional places being filled dropped sharply in both sectors, which in turn impacted on subsequent graduate numbers However, overall it can be concluded that in the earlier years the programme did achieve one of its primary objectives, which was to address identified skills needs and to increase the supply of graduates. Graduate numbers under Lindsay increased from 1009 in 1998 (the year before the first Lindsay graduates emerged) to 2320 in 2004 i.e. an increase of approximately 130%. This is a hugely significant increase in the supply of skilled graduates that has been unmatched anywhere else in this area. Goodbody's Research Review states that "Ireland was unique in Europe with its programs at 3rd level to provide key skills in ICT.[2]

McIver Consulting's report and other research show that this increase in supply of skilled graduates had a very significant effect in influencing inward investment by multi- nationals both in terms of expectation of an increased supply of skilled graduates and a perception that the Irish government were responsive to the needs of the ICT industry and were prepared to develop rapid policy and practical responses to those expressed needs. The rapid supply of technicians from the Accelerated Technician Programme (ATP) courses particularly contributed to the high growth experienced in the Celtic Tiger years. McIver Consulting's research also indicates that the programme contributed significantly to the retention of inward investment during the downturn, allowing existing firms to move up the value-added chain, migrating lower added value operations abroad and upgrading operations in Ireland.

The downturn experienced in Ireland in the ICT sector was part of a worldwide recession. The effects of the downturn on enrolment and destination of graduates are not associated with any deficiency in the programme delivery or objectives. Comparison of fig 3.2 and fig

[2] The Goodbody Stockbrokers Research Review, "*Irish Technology Review*" , July 2003

3.4 in McIver's Report[3] shows that patterns of employment in the ICT sector in both the U.S. and Ireland respectively show a very similar pattern throughout the downturn years. Graduates resulting from the increased intake under Lindsay who emerged into the labour market in 2001 at the start of the downturn did not suffer as much as might be expected considering the sudden collapse in demand for qualified workers in the ICT sector.

On the employment side, during the period 2001/2003 when there were significant increases in ICT graduate output, the percentage gaining employment or pursuing further study was in line with the national average for all graduates. Initial surveys of the 2004 ICT graduates indicated that employment levels had increased. Because of the lack of demand in the ICT sector, graduates progressing into employment were dispersed into other sectors which benefited from their skills during a time of increasing dependency on technology. Others progressed into further study, which is now of benefit in the context of increased demand by industry for post-graduates in the burgeoning knowledge economy.

Clearly the projected role to be played by the programme as a determinant of future growth of the industry was significantly affected by the downturn. However, it is also arguable that the downturn itself would have been far more serious without the existence of the programme during the critical period of growth. Under current circumstances, where demand for software and electronic engineering professionals has been picking up, the existence of a strong supply of graduates emerging in 2005 and from previous years will delay the onset of significant shortages. However, as a result of the downturn, the positive impact of the programme will dissipate sharply in the coming years unless the issue of falling enrolments is addressed. Recruitment to ICT related programmes has been falling sharply since 2001 and data from the CAO shows that recruitment in 2005 showed no significant improvement, although the decline appears to have bottomed out.

This fall in student intake will become apparent in 2006 with a decrease in degree graduate numbers in computing and electronic engineering and this will continue up to at least 2008.

Recommendations 1-8 are made in the review (*section 5.5*) to address the issues arising in this part of the review.

Efficiency of Achievement of Programme Objectives

In order to assess the efficiency with which the ICT undergraduate skills programme has achieved its objectives, the level and trend of costs associated with the programme were identified and the following key questions asked.

- ***Can the level and trend of costs be identified for the programme?***
- ***Can the staffing resources be identified that were specifically associated with the programme?***
- ***Was the programme delivered efficiently to achieve the stated objectives?***

The level and trend of costs were identified and unit costs arrived at by both the University sector and the Institute of Technology sector. It was found impossible to extract the staffing resources from the other costs of the programme. The overall costs for 2005 were identified and compared with overall Departmental expenditure. The following table sets out these costs.

[3] McIver Consulting "*Research into Impact of Undergraduate Skills Programme*", 2005

ICT Undergraduate Expenditure (Current and Capital) for 2005

Year	IoTs	Universities	Total	Overall Dept Exp.	% Dept. Exp.
2005	€11,651,629*	€29,197,808	€40,849,437	€6,983,896,000	.58%

*costs based on estimated additionality as final figures for 2005/06 academic year not yet available

Efficiency questions followed two strands, one of which related to cost and the other to approval of courses.

Costs

In relation to costs, the following questions were addressed.

- ***Taking into account the effectiveness of the programme, was the unit cost per student reasonable in comparison to the unit cost of provision for other kinds of degrees in the higher education sector?***
- ***Taking into account comparative unit costs did one sector emerge as more advantageously placed in terms of focussing future funding for the programme?***
- ***What happened to capital projects funded under the programme in terms of usage during the downturn period and what implications does this have in the event of resurgence in demand for undergraduate places on the courses?***
- ***Was the attrition rate for these courses significant in comparison to other degrees and if so, does this make the programme less cost effective?***

In answering these questions, it was found that in comparison to other degrees, it was cost efficient to produce ICT graduates, bearing in mind the benefit which accrued to the economy with the increased supply. This cost efficiency was especially marked in the university sector when costs for ICT Skills courses, some of which were engineering degrees, were compared to engineering degrees provided outside of the programme (table 6.4).

The review also concludes that a unit cost analysis of the provision of the programme should be carried out across both sectors following the establishment of a standard unit cost methodology. Following such an analysis, it was felt that further consideration should be given to concentrating/prioritising the programme in the sector which proves to be the most cost beneficial and advantageous with regards to completion rates and widening participation (*Section 6.4.4*).

In terms of capital investment the review concludes that the capital projects that were funded under the ICT Undergraduate Skills Programme increased the space available to institutions. Despite the downturn in numbers, the review concludes that this space was not wasted and has been utilised throughout the downturn, although only in part for the purpose originally intended. It remains a concern, however, that in the event of an upturn in demand for places on the programme, that it may not be possible to retrieve this space from its current usage.

The issue of attrition was also looked at in terms of cost efficiency. The review finds that although it is clear that in terms of effectiveness and also in terms of efficiency, high non-completion rates have a negative impact on the efficiency of the programme, the problem is being tackled on a national and a targeted level and considerable progress has been made. Research shows that in the context of ICT and engineering courses, the largest dropout rate comes after the first year of the undergraduate degree and improvements in this area should

be a key target for institutions aiming to boost their retention rates (*Recommendation 10, Section 6.4.11)*.

Course Approval

The second strand of the evaluation of the programme's efficiency related to the approval of courses, the following questions were asked.

- ***How were the courses selected and approved?***
- ***Were they the appropriate courses to serve the objectives?***
- ***Are the courses monitored to ensure they are still relevant in today's climate in order to ensure efficient delivery of the programme?***

The review concludes that those courses that were selected and approved under Lindsay, Horn and the Accelerated Technicians Programme (ATP) and the Institute Trainee Programme (ITP) were the appropriate courses to fill the skills gap that had been identified by the EGFSN and the joint education/industry taskforce. Selection of the courses involved a significant external consultation and evaluation process. Ireland's success in attracting inward investment and the growth of its indigenous industry were linked to the supply of suitably qualified graduates, as is clearly demonstrated in Chapters 4 and 5. This could not have occurred if courses had been selected and approved in an inefficient way. It was found that continuing relevance of courses is ensured in two ways. Firstly, the funding mechanism used in the university sector resulted in less funding being provided as enrolments decreased. This is not necessarily the case in the Institute of Technology (IoT) sector as courses are not funded on a unit cost basis. This has led to courses being dropped where required quotas were not filled. Secondly, systems of programmatic review exist in both sectors to ensure relevance to skills requirements identified by the Expert Group on Future Skills Needs.

The review concludes that there are substantial review systems in place in both sectors to ensure the ongoing relevance of the courses funded under the programme. This is a major plank in the ongoing efficient delivery of the programme. While supply and demand will ensure approved courses maintain relevance, McIver's research shows that course provision and design may need to be re-addressed in the context of the approval of any new courses under the programme. Recommendation 11 addresses this point (*Section 6.5.9)*.

The Impact of the Programme

In order to assess the broader outcome of the programme, i.e. the impact it had on broader macro-economic levels and whether other approaches might be necessary to continue to achieve the programme objectives the following key questions were asked.

- ***Was the ICT Undergraduate Skills Programme cost effective in broad economic terms, i.e. did the programme and its impact on the ICT sector have a major impact on the socio-economic situation?***
- ***How far does the impact contribute to the justification for current and ongoing public funding?***

- ***What issues have emerged from the review and how will this impact on future planning for the programme?***
- ***Are alternative approaches necessary to ensure future fulfilment of the programme objectives?***

The McIver Report deals in detail with the first question and concludes that the ICT Undergraduate Skills Programme had a significant impact on the growth of the Irish economy. McIver Consulting found that the electronic hardware sector and the foreign-owned part of the software sector relied heavily on expectations as to the future supply of graduates in relevant disciplines created by the programme, when making inward investment decisions from 1996 to 2001. The hardware sector also relied on the programme to produce a viable domestic supply of technicians over the high growth period between 1998 and 2000. Without the growth of this emergent sector the overall rate of growth experienced by the economy would have been seriously impacted.

This direct causality between the intervention of the programme and the so-called "Celtic Tiger" boom is significant enough to provide justification for the current and ongoing funding being provided from public monies, particularly in the context of the continued relevance of the programme objectives and current national prioritisation of the development of a knowledge economy.

The European Union, through its Structural Funds, has contributed to the development of education in Ireland and, in doing this, to our current economic success. The review outlines the funding sought and received from EU Structural Funds for the programme.

Major Issues Arising and Alternative Approaches to Graduate Supply and Programme Provision

The major issue that emerged from this review was the impact that the worldwide recession in the ICT sector had on the delivery of the programme and achievement of the programme objectives. This downturn was unforeseen by both industry and government and was unprecedented in its impact on employment both in national and in global terms. The review has explored the cyclical nature of the ICT sector (*section 5.3*), the impact of the downturn on the achievement of the programme objectives (*section 5.3*) and how the existence of the programme affected the impact that the downturn had on the Irish economy (*section 6.2*). The review also attempts to evaluate the implications for future planning of the programme.

Two strands emerge from an examination of this aspect of the changing environment during the course of the programme. The first of these is the inevitable gap in graduate supply that has resulted from the decrease in enrolments that began in 2000/01 and the best way to ensure continued provision of skilled workers in the short to medium term to overcome this. The second is to assess whether the downturn will recur and if so, how severe it is likely to be.

In order to bridge the gap in skilled graduate supply that will become apparent during the coming years, a number of recommendations are made in Chapter Seven to ensure continued provision of skilled workers *(Section 7.4.3)*.

Whether alternative approaches to actual programme provision are necessary is also investigated, particularly that of private provision. The review concludes that although further consideration could be given to the possibility of private college provision if response to the skills shortage becomes extremely urgent, for the present it makes more sense to continue provision through the publicly funded third level institutions, although, on the grounds of financial efficiency, an increasing focus on the role of the Institutes of Technology may be warranted in the context of strategic planning for the higher education system as a whole.

On the possibility of a future downturn, while it is inevitable that there will be peaks and troughs in demand for graduates, it is also true that the world economy is becoming increasingly reliant on technology and it is hard to envisage a future where there will be any significant decrease in this dependence. This review has shown that graduates continue to be needed in the areas covered by the programme, and even in the context of the recession, employment prospects for these graduates remained consistent although they were diversified throughout other sectors of the economy.

Although conversion courses and shorter diploma courses have a role to play, particularly in the context of improving our capacity to respond quickly when demand for skills begins its upward trend towards another peak, that does not detract from the need to maintain a continuous supply of high quality graduates. Undergraduate courses, although three or four years in length, produce just the kind of quality graduates that attracted inward investment and encouraged growth in the first place.

The cyclical nature of employment trends in the ICT sector was also looked at and the conclusion was reached that, in this context, there were aspects of programme delivery to be addressed, although the high level objectives of the programme remain valid. The review concludes that the Higher Education Authority needs to maintain a flexible brief regarding the strategic direction of funding towards either undergraduate or postgraduate conversion programmes as appropriate to the prevailing employment climate and recommends that the HEA keep this aspect of programme delivery under constant review. The review also recommends that staffing arrangements in the institutions should also be considered further in light of these conclusions. *(Section 7.4.7)*

Following the economic downturn and the resulting loss of low-end manufacturing jobs, Ireland has been left with a more streamlined ICT industry that is moving higher up the scale in its operations and output. This upward movement is critical to the future success of Ireland. A supply of graduates to feed the resulting demand for postgraduate students remains a priority in this context.

The review finds that there is clear justification for the maintenance of this programme. Although there may be opportunities to readdress certain aspects, particularly with regard to an expansion of the programme to allow greater flexibility to enable the institutions to respond appropriately to those issues, it is clear that the high level objectives of the programme remain relevant and that there is a continuing need for the State to intervene and take an interest in the supply of graduates in relevant disciplines to the ICT sector, particularly in computing and electronic engineering at primary and higher degree level.

Overall Conclusion and Recommendations

This report broadly concludes that the Department of Education and Science and the education sector's pro-activity and responsiveness to industry needs in the ICT sector met the ICT Programme's initial objective of creating the educational capacity required to ensure a steady supply of skilled graduates into the economy. Despite this success, the global downturn in the ICT industry and a realisation of the cyclical nature of the industry has created a climate of insecurity amongst potential students and this has had a seriously detrimental impact on enrolments on the courses funded under the ICT Undergraduate Skills programme.

Recommendations in this report recognise that the Department of Education and Science, the HEA and the Higher Education Institutes have an important role to play in the provision of future graduates in this area. The Department is implementing policies that will facilitate more flexible delivery and responsiveness to changing needs in the ICT sector and will continue to prioritise this area. However, the report recognises that the ICT industry must play a lead role in promoting the benefits of careers in their sector if demand for places is to recover and grow. The industry's commitment to providing work placements must also be maintained and developed.

A joint approach between Government, the education sector and industry should ensure that Ireland's reputation as a rich source of skilled graduates is consolidated and developed. This will allow a strong knowledge economy to flourish which will underpin Ireland's future economic success.

The recommendations are not prioritised but instead follow through from conclusions arising from the analysis throughout the chapters of the report.

1. *The ICT Undergraduate skills programme should continue to be a priority for the Department of Education and Science.(**Section 5.5**)*

2. *In addition to the continuation of the programmes to ensure future supply, the Department of Education and Science and the Higher Education Institutions must make recruitment into these courses a high priority. **(Section 5.5**)*

3. *The HEA need to support the Higher Education Institutions in retaining key resources while they campaign to increase enrolments. Pending an upturn in undergraduate enrolments, support should be provided for part-time and post - graduate programmes in ICT under the Information Technology Investment Fund. Specific action should be focused on the numbers of females enrolling on ICT courses. Initiatives such as interdisciplinary programmes between technology and other degree courses that attract a higher proportion of female students should be examined. The use of e-Learning in courses should be promoted to foster wider participation in full time and part time courses. (**Section 5.5**)*

4. *Industry needs to become pro-active in promoting careers in ICT. Programmes such as the ICT Ireland Champions programme and the Internship need to be strengthened.*[4] ***(Section 5.5)***

5. *Commitments made by industry to work placements etc. need to be maintained even through a variable economic climate.* ***(Section 5.5)***

6. *The Department of Education and Science and the HEA should look carefully at the possibility of using funding formulae to reward higher education institutions that are successful in recruiting students to study in ICT disciplines, and are successful in ultimately graduating them. (**Section 5.5)***

7. *Institutions should be strongly encouraged to meet the recognised increasing need for people with postgraduate technology degrees, both research degrees and taught degrees. (**Section 5.5)***

8. *There is a need for a continued focus on development of areas at school level such as guidance counselling, promotion of careers in ICT industry, exploitation of ICTs in the classroom, and take-up of the physical sciences. (**Section 5.5)***

9. *The Higher Education Authority should carry out a standard cost analysis exercise on the provision of the ICT Undergraduate Skills Programme to enable a policy decision to be taken regarding future provision of the programme. Based on the results of such a standard cost analysis exercise between the two sectors, further consideration should then be given to concentrating/prioritising the programme in the sector which proves to be the most cost beneficial and advantageous with regards to completion rates and widening participation. (**Section 6.4.4)***

10. *Appropriate intervention is required at institutional level to address difficulties experienced by first year students. A number of institutions already provide mentoring programmes and these have been shown to be very successful in tackling negative experiences by new students who may find it difficult to settle in and cope with increased workload and different demands to those experienced at second level.* ***(Section 6.4.11)***

11. *The HEA should strongly encourage Higher Education Institutions to develop an ongoing review process on course provision and design in the area of ICT Skills, which would include close consultation with industry leaders and take into consideration McIver Consulting's research findings. (**Section 6.5.9**)*

12. *In computing, graduate diploma conversion courses are well established as a means of producing additional graduates who can substitute for computing degree graduates in some, but not all, positions. It will be important that institutions continue to be supported in adding places on these courses as demand rises. (**Section 7.4.3**)*

13. *Institutions should consider providing more specialised graduate diploma courses that offer less breadth, but develop a significant level of skill in a specific area. (**Section 7.4.3**)*

14. *There will be a need to consider other innovative ways of responding to demand quickly. These could include:*

[4] The Champions programme provides recent graduates from industry as speakers for school recruitment. The Internship programme provides paid work experience in ICT industry two days a week to 3rd and 4th year undergraduates

- *Add-on ordinary bachelors and honours bachelors degrees in business information systems (half business, half computing) for business students;*
- *New third year and final year options in electronics design for engineering students from a range of disciplines and for computing students; and*
- *Graduate Diplomas and taught Masters degrees in electronics design for engineering graduates from a range of disciplines, computing graduates and graduates in physics. (**Section 7.4.3)***

15. *There will also be a role to play in assisting those currently in employment to up-skill. Possible courses along the lines of the ITP programme should again be looked at to address the gap in the short to medium term. (**Section 7.4.3**)*

16. *In line with the recommendations of the Enterprise Strategy Group Report of July 2004[5], part-time courses and modules should be available to provide ICT skills to those in employment especially the low-skilled. Funding for this activity in 3rd level institutions should be available from the National Training Fund. (**Section 7.4.3**)*

17. *The delivery of the programme should remain under constant review by the Higher Education Authority with reference to the Expert Group on Future Skills Needs. This will ensure strategic targeting of funding towards particular courses, whether undergraduate or otherwise, that will help bridge the skills gaps caused by inevitable upsurges and downturns in the ICT industry in relation to employment demand. **(Section 7.4.7)***

18. *Further consideration should be given to staffing arrangements on ICT courses in the higher education sector to allow the development of more flexible delivery models for the programme. **(Section 7.4.7)***

[5] "Ahead of the Curve, Ireland's Place in the Global Economy", Enterprise Strategy Group, July 2004

Chapter One

Introduction

1.1 Background to the Review

In May 1997, the Department of Finance established the Expenditure Review Initiative (ERI) in order to analyse, in a systematic manner, the returns achieved on Government expenditure, and thereby to provide a basis on which informed decisions can be taken in relation to prioritise within and between expenditure programmes and measures in order to enhance the effectiveness and efficiency of future expenditure on such programmes. Reviews conducted under the ERI form part of the annual business plans of Government Departments, and each year up to 50 programme areas are selected for review across the various Departments and Offices.

1.2 Structure of Review Programme

The individual expenditure reviews are undertaken under the aegis of steering groups representing the relevant Departments/Offices. The review process is overseen by the Central Steering Committee (CSC) on Programme Evaluation, which is chaired by the Secretary General, Department of Finance.

This Expenditure Review Report deals with the expenditure review of the ICT Undergraduate Skills Programme. As in the case of all ERI exercises, follow-up action will be taken to ensure implementation of recommendations where appropriate.

1.3 Terms of Reference

The Terms of Reference for the review of the ICT Undergraduate Skills Programme were based on standard Terms of Reference which apply to all reviews across the Civil Service, with appropriate modifications specific to this programme. The Terms of Reference for this review are as follows:

- To identify the programme objectives.
- To examine the current validity of those objectives and their compatibility with overall strategy of the Department of Education & Science.
- To define the outputs of the undergraduate skills programme, and identify the level and trend of those outputs.
- To examine the extent to which the objectives have been achieved, and comment on the effectiveness with which they have been achieved.
- To identify the level and trend of costs and staffing resources associated with the programme and comment on the efficiency with which the programme has achieved its objectives.
- To evaluate the degree to which the objectives warrant the allocation of public funding on a current and ongoing basis and examine the scope for alternative approaches to achieving these objectives on a more efficient and effective basis.

- To specify potential future performance indicators that might be used to better monitor the performance of the programme.

1.4 Objective of this Review

The objective of this review is to determine whether the ICT Undergraduate Skills Programme has contributed to the viability of the ICT sector in Ireland in the short, medium and long-term, by providing for the continued availability of a sufficient number of high quality graduates in the appropriate disciplines from both the university and technological sectors such that existing and predicted skills shortages in the sector are ameliorated.

1.5 Scope of this Review

The provision of funding for extra places in undergraduate ICT courses was identified as the most suitable subject for an expenditure review. In reviewing the ICT Undergraduate Skills Programme, the focus was kept on the process of providing extra places arising from the Lindsay Report, the First Report of the Expert Group on Future Skills Needs (EGFSN) and the joint education/industry task force on the supply of technicians.

1.6 Contributing factors to selection of review topic

Due to the action taken by the Government to address computing skills needs as outlined in paragraph 2.1 below and the subsequent large investment in ICT undergraduate skills, the Department of Education and Science saw this as an area appropriate for an expenditure review at this time so as to establish if the objectives of investment and the returns expected were achieved, and the effect which it has had, and continues to have on the economy in Ireland.

1.7 Steering Committee

The Steering Committee for this review consisted of the following:

Dept. of Education & Science:
Ruth Carmody*, Principal Officer, Higher Education - Policy Research & Science
Anne Marie Grenham, Assistant Principal Officer, Higher Education – Policy, Research & Science
Aoife Conduit**, Administrative Officer, Higher Education – Policy, Research & Science
Teresa O'Connor, Assistant Principal Officer, Higher Education – Technology & Training
Patricia Flannery, Higher Executive Officer, Higher Education – Technology & Training
Breda Kennedy, Assistant Principal Officer, NDP Structural Funds Unit
Enda Hughes, Higher Executive Officer, NDP Structural Funds Unit

Higher Education Authority (HEA):
Pat O'Connor, Head of ICT Skills

Jennifer Gygax, Recurrent Grants Section
Jane Sweetman, Recurrent Grants Section

*Ruth Carmody joined the Committee in November 2004, replacing Kevin McCarthy.
**Aoife Conduit joined the Committee in September 2004, replacing Fintan O'Brien.

The Committee held its first meeting in June 2004. The Committee met on 12 occasions. The penultimate draft review was submitted to an Independent Evaluation Expert, under the arrangements agreed by the Central Steering Committee, for external quality assessment on 13th October 2005. Following the Steering Committee's consideration of the recommendations made by the Independent Evaluation Expert, certain modifications were made to this review and the Steering Committee approved the review on 6th December 2005. The final review was subsequently submitted to the Secretary General.

1.8 Methodology

The Government's Expenditure Review Programme (ERI) commenced in 1997. Its objectives are to analyse Exchequer spending in a systematic manner and to provide a basis on which more informed decisions can be made.

This particular review examines the efficiency of the Governments response to addressing identified computing skills needs and the subsequent impact of that response at a broader sectoral and macro economic level.

After identifying the terms of reference for this review, which were submitted to the Department of Finance, the steering committee then commenced work on the actual review itself. This was done in the following way:

- Identifying the objectives of the Programme
- Agreeing performance indicators
- Identifying all courses which were expanded or introduced in response to the ICT undergraduate programmes i.e. Lindsay Report, Horn Report, Accelerated Technicians Programme and the Institute Trainee Programme. These programmes are described in detail in Chapter 2 below.
- Identifying the costs associated with the programmes
- Calculating the unit cost per student
- Identifying enrolment numbers and number of graduates from the ICT undergraduate skills courses
- Obtaining first destination report survey results
- Identifying funding claimed under European Social Fund
- Seeking to identify the macro economic affect which the skills programmes had on the Irish economy – this was done by identifying specific questions and appointing Consultants to undertake market research to establish the position

The identification and extraction of data information was done by the Department of Education and the Higher Education Authority. However, it was agreed to appoint consultants to carry out an analysis of the impact which the

skills programmes had on the economy. The full report of the consultants, McIver Consulting is attached at Appendix 5.

It was also agreed that a consultant would be appointed to quality assess the penultimate draft of the review report and his observations have been taken into account in this final document.

1.9 Format of Report

This report commences with the background to the establishment of the ICT Undergraduate Skills Programme, its rationale and objectives. There then follows an evaluation of the Programme which incorporates the following:

- Identification of Programme Objectives
- Current Validity of Programme Objectives
- Identification of Inputs, Outputs and Outcomes
- Potential Future Performance Indicators
- The extent to which the objectives were achieved
- The effectiveness of the Programme
- Identification of costs associated with the Programme
- The efficiency with regard to programme delivery in terms of courses and of costs
- The economic impact of the Programme
- Future fulfilment of Programme objectives
- Alternative approaches

Chapter Two

ICT Undergraduate Skills Programme

2.1 Background

In order for action to be taken to provide for computing skills as Ireland approached the millennium, the Department of Enterprise, Trade & Employment requested that Forfás (the statutory agency under the aegis of that Department which has policy advisory functions in relation to the development of industry in the State) set up a skills group to identify skills needs.

In late 1996 Forfás established the (interim) Skills Group under the chairmanship of Professor Frances Ruane. This Group identified skills needs in the areas of software engineering, engineering technicians and teleservices up to the end of the 20th Century. In relation to software engineering, the need for an annual additional output of some 1,000 computing graduates in the university sector was identified. In the area of engineering technicians, the Group recommended the provision of an additional 750 technician places each year.

The Government decided in 1997 that a Steering Committee should be established to commence the bidding and negotiation process to identify the most cost effective way of providing the additional places. This Steering Committee was chaired by Mr. Noel Lindsay, then Chairman of the Higher Education Authority, and included representatives of the Departments of Finance and Enterprise and Employment, which worked in conjunction with third-level institutions.

2.2 Task Force on the Supply of Technicians

In July 1997 the Minister for Education announced the establishment of a joint education/industry task force to improve the supply of technicians for high-technology industries. The Task Force on the Supply of Technicians was established in August 1997 under the chairmanship of Dr. Sean McDonagh, Director, Dundalk Institute of Technology. Its brief was to produce an action plan to address identified and anticipated needs and to ensure an improvement in the supply of trained technicians in the short and medium term. In particular, the Task Force was to identify and provide a range of practical proposals and programmes to develop the demand for and enrolment process and throughput of successful students on relevant Certificate and Diploma programmes of study. The first report of this Task Force was issued in November and recommended an increased intake on technicians and higher technicians' programmes in high demand disciplines (e.g. Computing, Electronics).

2.2.1 The main outcome of the work of the Task Force was the development of a number of new courses now known as **Accelerated Technician Programmes (ATP)** which commenced in January 1998. These courses include the National Certificate in Technology (Manufacturing Technology), National Certificate in Technology (Mouldmaking Technology), National Certificate in Computing (Information Technology Support), National Certificate in Industrial Science, National Certificate in Biomedical Manufacturing Technology, National Certificate in Precision

Engineering and National Certificate in Science in Good Manufacturing Practice and Technology. The accelerated technician programmes are 18-month courses combining attendance at an Institute of Technology with experience in industry. Two six-month periods in an institute span a six-month period of placement. Following public advertisement, selection of students is by a joint industry/institute process which could involve interviews, educational attainment and other tests.

2.2.2 The **Institute Trainee Programme (ITP),** which was introduced in 2001, also grew out of the joint education/industry task force. The programme is targeted at key technician skill needs and enables the acquisition of a National Certificate level qualification. It enables participants to combine study and paid employment as trainees are released from work to attend courses. Trainees are accepted into the programme by being released by their employers or by being recruited specifically by an employer for a trainee programme. The typical duration of the programme is three years.

2.2.3 The Institute Trainee Programme targets skills areas identified by the Expert Group on Future Skills Needs in the following sectors:

- Construction
- Electronics Manufacturing/Manufacturing Technology
- Pharmaceutical/Chemical/Healthcare/Food Technology
- E-Business
- Computing (Hardware/Software Technician)

2.2.4 The ITP was introduced in September 2001. The Programme was a partnership between industry/employers, the Institutes of Technology and the Department of Education and Science. There was no rigid format - the duration of a course depended on the rate of accumulated credits but did not exceed three years. Information booklets issued from the Skills Initiative Unit to all Institutes of Technology who then targeted employers/industry in their own area. Notices were also placed in local newspapers. Employers/industry wishing to participate in the programme contacted the relevant Institute of Technology. The Institutes applied for sanction from the Department to host specific courses, providing details on industrial partnerships, format of the course and proposed time frame for the programme. Institutes also forwarded to the Department formal written agreement between the Institute and relevant employer(s)/industrial partner(s).

2.3 Lindsay Report

2.3.1 The First Report of the Skills Needs Steering Committee, chaired by Mr Noel Lindsay, was published in June 1997. The Steering Committee was charged with overseeing a process of negotiation and making recommendations related to ensuring an increased output of not less than 1,000 software engineering graduates per annum and 750 technicians per annum in Electronic, Electrical, Mechanical and Production Engineering.

The Lindsay Steering Committee recommended that in order to allow for attrition (20-25%), an increased intake of circa 1,300 and circa 5,000 additional places

would be required in software engineering to achieve the desired output. Assuming 400 of the technicians exited at the certificate level and 350 at the diploma level, and a dropout rate of 30%, the Committee recommended an intake of circa 1,100 and circa 2,700 additional places would be required for engineering technicians.[6] Additional intakes began in the 1997/98 academic year.

2.3.2 The Lindsay Steering Committee, by advertisement in the public press, invited eligible institutions to indicate their interest in being part of such a programme. A detailed specification was drawn up (in consultation with industry) which was sent to all eligible institutions together with a format for submission proposals.

2.3.3 Degree Programme

Proposals for honours degree courses were received from:-

- 7 Universities
- 9 Institutes of Technology
- Dublin Institute of Technology
- 4 private colleges

The proposals were analysed by the Committee in detail and the aim was that a significant element of the total programme would commence in the academic year 1997/98, with the balance being in place for 1998/99. The Committee identified proposals in which the courses were appropriate and which would increase student intake immediately.

The Committee agreed that emerging needs extended far beyond the 1,000 software engineering graduates and indicated that providing for intake in the range 1,500 to 1,800 would be warranted. A projected total stock of 6135 places was agreed.

2.3.4 Engineering Technicians

It emerged that the measures needed to enhance output in the engineering technician programmes differed from those for the degree level programmes. In respect of the degree level programmes, demand for places far exceeded places available, whereas in the Institute of Technology Sector the main concern of the Lindsay Steering Committee was that of stimulating demand through adequate publicity.

2.3.5 Implementation of proposals

Senior officials from the Department of Education and Science met with Mr. Noel Lindsay and the Higher Education Authority in August 1997. The purpose of the meeting was to review the proposals to meet skills needs contained in the Lindsay Report which projected a total stock requirement of **6,135** undergraduate places and **2,939** additional sub-degree places. The following was agreed at the meeting in relation to intake in 1997 and 1998 for the Universities and Institutes of Technology:

[6] Extracted from the Lindsay Report

Table 2.1 – Proposed Intake Undergraduate Software Engineering Programme

Institutions	**Intake 1997**	**Intake 1998**	**Total Intake** (in these years)
Universities	410	705	1115
Technological Sector	243	235	478
Total	**653**	**940**	**1593**

Table 2.2 – Proposed Intake Engineering Technician Programme

Institutions	**Intake 1997**	**Intake 1998**	**Total Intake** (in these years)
Technological Sector	520	675	1195

2.4 Expert Group on Future Skills Needs (EGFSN)

In November 1997, the Government announced a €317.435m Scientific and Technological Education (Investment) Fund. As part of this announcement, the Tánaiste announced details of a programme to promote dialogue between Government, business and the education institutions, in relation to the education and training needs of the economy, to develop and facilitate the forecasting of skills requirements and to provide mechanisms for the speedy implementation of decisions.

The programme would consist of a Business, Education and Training Partnership to develop national strategies at the highest levels to tackle the issues of skills needs, manpower forecasting and education for industry and business. The Expert Group on Future Skills Needs (EGFSN) was an element of this partnership. The membership of the group is widely based and includes educationalists, business people, Irish Congress of Trade Unions, civil and public servants and members of the industrial promotion agencies.

The Government recognised that an adequate supply of the skills required by industry would be a key determinant of the future growth potential of the economy. It was recognised as a key policy requirement that skill needs, both in terms of numbers and type, should be estimated and the correct policies put in place in sufficient time to ensure that the skills demands of the economy could be met.

The Government established the EGFSN to analyse these issues and to make policy recommendations.

2.5 First Report of EGFSN (Horn Report)

The first report of the Expert Group on Future Skills Needs, under the chairmanship of Dr. Chris Horn was published in December 1998.

The objectives of the Expert Group were to:-

- identify in a systematic way the skill needs of different sectors and advise on the actions needed to address them;

- develop estimating techniques that would assist in anticipating the future skills needs and requirements of the economy and the associated resource requirements;

- advise on the promotion of education/continuous training and business links at national and local levels;

- advise on how to improve awareness among job seekers and school leavers of sectors where there are demands for skills, the qualifications required and how they can be obtained; and

- consider strategic issues in developing partnership between the business and education/continuous training sectors in meeting the skills needs of business.

The Expert Group viewed the information technology skill needs as a priority and the first report of the Expert Group identified the potential skills deficiency for information technology professionals and technicians and made a series of proposals which it intended would ensure that the potential skills gaps would be eliminated.

2.5.1 Proposals in Horn Report to address Technology Skills requirements[7]

The following table is an outline of the additional technologists' places which the Horn Report recommended for the period 1998 – 2003:

Table 2.3 – Recommended additional Technologists places 1998-2003 (Horn)

	Professionals	Annual Output	Additional Places Required
1.	Employee up-skilling	50	200
2.	Multi-skilling/Conversion courses	350	500
3.	Full-time education	400	2,100
1-3	**Gross Extra Graduates**	**800**	**2,800**
4.	Improved completion rates	100	0
1-4	**Net Extra Graduates**	**900**	**2,800**
	Technicians		
1.	Employee up-skilling	300	900
2.	Full-time/sandwich/block education	650	1,700
1-2	**Gross Extra Technicians**	**950**	**2,600**
3.	Improved completion rates	350	0
1-3	**Net Extra Technicians**	**1,300**	**2,600**
	Combined Total	**2,200**	**5,400**

Note: The places required to provide industry with the extra graduates (as identified above) took account of those who emigrate, those who do not complete courses and the normal length of the course.

The Expert Group put forward the following proposals:

- An additional 900 degree places per annum and 1,300 technician places per annum should be provided in third level, with a total of 5,400 additional places over the period 1998-2003 (3,000 degree and 2,400 technicians)
- Provision of additional graduates through Conversion Courses
- Employee up-skilling involving night-time and part-time study for existing employees
- Improved completion rates

[7] Extracted from the First Report of the Expert Group on Future Skills Needs

Increased funding of €75 million was to be provided to cater for the additional places.

The additional places to be provided in the Institutes of Technology were 1,008 degree places (393 in Computing and 615 in Engineering) and 2,243 technician places (653 in Computing and 1,590 in Engineering). Additional intake was to begin in the 1999/00 academic year. The Table under gives the breakdown by Institute.

Table 2.4 – Additional Degree Places 1998 to 2003– Institutes of Technology

Institute	**Computing**	**Engineering**	**Total**
Athlone	32	102	134
Cork	0	148	148
DIT	0	80	80
Dundalk	62	36	98
GMIT	211	90	301
Limerick	66	0	66
Sligo	0	92	92
Tallaght	10	0	10
Waterford	12	67	79
Total	**393**	**615**	**1,008**

Table 2.5 – Additional Technician Places 1998 to 2003 – Institutes of Technology

Institute	**Computing**	**Engineering**	**Total**
Athlone	58	44	102
Carlow	0	100	100
Cork	124	339	463
DIT	0	120	120
Dundalk	36	18	54
GMIT	96	275	371
Letterkenny	97	144	241
Limerick	48	68	116
Sligo	139	138	277
Tallaght	0	127	127
Tralee	0	100	100
Waterford	55	117	172
Total	**653**	**1,590**	**2,243**

Table 2.6 – Response to First Report EGFSN Additional places 1999 – Universities

Following publication of the First Report of the Expert Group on Future Skills Needs, the HEA sought proposals from the Universities for the provision of the additional places. Following a selection process within the HEA 2,154 places were allocated as per the following table:

Institution	Places
UCD	36
UCC	322
NUIG	265
TCD	331
NUIM	300
DCU	500
UL	400
Total	**2,154**

2.6 Second Report of EGFSN

The second report of the Expert Group on Future Skills Needs, published in March 2000 under the chairmanship of Dr. Danny O'Hare, continued to monitor changes in the ICT Skills area following the Government's investment of €95.23 million, to bridge the skills gap which was identified by the First Report of the Expert Group, by increasing the number of degree professionals and technicians which would be available each year.

In its second report, the Expert Group noted that as a result of the Government's investment, the projected annual supply of IT degree professionals would be more than double the 1996 levels by the year 2003, while the projected annual supply of IT technicians would be increased by 50%.

At the time of the report, the Expert Group stated that it was not recommending that further additional places be provided over the very substantial number of places being put in place at that time as a result of the recommendations in its first report.

Later reports from the Expert Group continued to monitor the ICT Skills area and are dealt with in detail in the next chapter.

Chapter Three

Programme Objectives – Identification & Validity

3.1 Identification of Programme Objectives

In any analysis of the success or otherwise of a programme that has been designed as a specific intervention in order to achieve a change in the status quo, it is critical to first identify the stated objectives of the programme. The first term of reference for this review was to identify and articulate the objectives of the ICT Undergraduate skills programme. The following objectives were identified:

3.1.1 The Objectives

- To address identified and anticipated skills needs and to ensure an improvement in the supply of trained graduates and technicians in the short and medium term.

- That an adequate supply of the skills required by industry would be a key determinant of the future growth potential of the economy. It was recognised as a key policy requirement that skill needs, both in terms of numbers and type, should be estimated and the correct policies put in place in sufficient time to ensure that the skills demands of the economy are met.

The objective of this actual expenditure review is:-

- To determine whether and to what extent the ICT Undergraduate Skills Programme contributed to the viability of the ICT sector in Ireland in the short, medium and long term by providing for the continued availability of a sufficient number of high quality graduates in the appropriate disciplines from both the university and technological sectors such that existing and predicted skills shortages in the sector are ameliorated.

3.2 Current Validity of Programme Objectives

The Steering Committee considered that the original objectives should be looked at firstly, in the context of current Departmental strategy and secondly against the wider background of national Government strategy to examine their continuing validity against today's needs in the growing knowledge economy.

3.2.1 The Department of Education and Science Strategy Statement 2005-2007 High Level Goal 3 states that "we will contribute to Ireland's economic prosperity, development and international competitiveness". The Strategy makes explicit this goal and as the move towards a knowledge based society gains momentum at national and EU levels, new sectors and new occupations are emerging which require a flexible and adaptable workforce. A key challenge for education is to develop the necessary mix of creativity and skills to enable a structured response to the needs of society as well to the current and projected needs of the labour market. Studies have demonstrated that one of these projected needs is for skilled personnel in the ICT and high technology sectors. The objectives of the ICT Undergraduate Skills programme still remain valid in this context.

3.2.2 While the validity of the objectives remains critical at this macro-level, it is also necessary to examine them in a more detailed way. Following the reports that identified the skills gap, the Expert Group on Future Skills Needs continued to monitor the validity of the ICT Programmes in their reports. These are detailed below. The Fourth Report of the Expert Skills Group (October 2003) made it clear that the ICT sector will continue to be a major driver of growth in the Irish economy. Among its key recommendations was the reinstatement of places on ICT courses. The report predicted that if current numbers of students entering computing degrees are maintained, there would be a shortfall of over 1,900 computing graduates in Irish industry by the time those commencing degrees in Autumn 2005 graduated.

3.3 Findings of subsequent reports of the Expert Group on Future Skills Needs

The Expert Group continued to monitor changes in the ICT Skills area following the Government's investment to bridge the skills gap (as identified by the First Report of the Expert Group) by increasing the number of degree professionals and technicians which would be available each year.

3.3.1 Second Report of EGFSN

In its second report, published in March 2000, the Expert Group noted that their first report was very well received and resulted in significant additional investment by Government and in the creation of a substantial increase in the number of places in third level colleges, at undergraduate and postgraduate level, as well as increased placed on relevant FÁS training programmes. The group noted that the main elements of this were:-

- In January 1999, the Accelerated Technician Programmes were expanded to include information technology and thus, at the time of the groups' second report, 1,100 students were enrolled on courses in the Institutes of Technology as part of the Accelerated Technician Programme.

- In April 1999, the Government approved an additional allocation of €95.23 million to the Department of Education and Science for the provision of 5,400 IT related third level places.

As a result of the Government's investment, the second report of EGFSN confirmed that the projected annual supply of IT degree professionals would be more than double the 1996 levels by the year 2003, while the projected annual supply of IT technicians would be increased by 50%.

The Expert Group found that the Government's significant investment made in response to the Expert Group's first report has had a very positive impact on the Information Technology sector.

3.3.2 Third Report of EGFSN

The third report of the Expert Group, published in July 2001, concurred with the second report in relation to the Governments response and actions to the recommendations of the first report of the Expert Group.

The third report of the Expert Group also stated the following:-

Given the strong growth in demand for IT skills, the changing composition of demand and critical changes in the factors affecting the supply of graduates, the Expert Group strongly feels that recommendations must be made to close the gap between the supply of and demand for third-level IT skills. Availability of a skilled labour force in IT is an increasingly important factor in attracting inward investment in the IT industry in Ireland. Given global skills shortages in the IT industry, the capacity to provide skilled IT graduates is a major competitive advantage for Ireland. The Expert Group calls for new measures to secure high-level IT skills in view of their importance to the future of the IT sector in Ireland, the importance of the sector in generating government revenues and in developing a knowledge-based economy. On the contrary, failure to adequately provide for high-level IT skills could have high costs for future employment, competitiveness and growth in the IT sector and in the economy as a whole.

In the past, the provision of more full-time student places has been the key focus of Expert Group recommendations. The resulting investment in the provision of third-level IT skills has begun to pay off. Now, the Expert Group recognises that significant labour market and demographic constraints operate against the provision of new full-time under-graduate places. The age cohort of 17-18 year olds, from which most third-level students are drawn, is projected to fall by some 15% between 1999-2005, and to fall further after that. As a result, the Group recommends that existing graduate potential be maximised by ensuring that all third-level places are filled and that retention rates in third-level institutions improve.[8]

3.3.3 Fourth Report of EGFSN

The fourth report of the Expert Group, published in October 2003, stated that the industry had suffered a severe downturn since late 2000 and although there were signs of a recovery, it was likely to be gradual, and there was no general agreement as to when it was likely to happen. In view of this, the Expert Group in association with Forfás undertook a broader study to examine the potential for the development of ICT clusters in Ireland and the skills needs of the sector to 2010.

It was assumed by the Expert Group that a market recovery would commence in 2004, although growth was expected to be significantly less than was experienced in the late 1990s. Competition between countries for ICT jobs would be more intense than was the case before the downturn.
Extract from the report:

Skills Gap Analysis and Summary of Recommendations

[8] Extracted from the Third Report of the Expert Group on Future Skills Needs

The ICT sector downturn has caused an excess of supply over demand for graduates, but the expected recovery in demand may lead to a shortage of graduates in the medium-term. Supply and demand are reasonably well balanced for computing degree graduates up to 2006. Thereafter, the analysis shows that demand is likely to overtake supply, and eventually exceed it by a substantial margin. The projection for computing diploma and certificate graduates shows a significant excess of demand over supply emerging, but this is of less concern than the degree-level gap, as it may be bridged more easily by alternative means of entry into the sector (e.g. conversion courses).A reasonable balance between supply and demand for engineering graduates is projected, but this comprises a shortage of electronic engineers and a potential surplus of other types of engineers, chiefly civil.

The Expert Group believes the ICT sector will continue to be a major driver of growth in the Irish economy. The recommendations focus on: continuing the ICT Investment Fund (established following recommendations in the Third Report); reinstating places on ICT courses; sales management and entrepreneurship training programmes; establishing critical mass of expertise in the higher education sector in the Management of Technology Enterprises (requiring the appointment of academic staff to specialise in teaching and research in the area); promoting interest in the study of ICT courses; addressing under-performance at second level in the areas of mathematics; and increasing transfer and progression from further Education programmes to third-level computing programmes.[9]

3.4 Recent Research that supports current validity of objectives

McIver Consulting's report for this review on the impact of the ICT Undergraduate Skills Programme on the industry also refers to the "beginnings of a recovery that emerged in 2004, and appears to now be continuing. The interview evidence confirms that industry now has much more positive expectations for the immediate future than it did a year ago, during the first half of 2004." The McIver report also concludes that "there is a continuing need for the State to take an interest in the supply of graduates in disciplines relevant to the ICT sector, particularly in computing and electronic engineering at primary degree level and higher degree level." [10]

This conclusion borne out by a survey carried out in May 2005 by Ms Laura Grehan and Professor Michael Ryan, School of Computing, Dublin City University. The survey, although quite limited in scope, gives a valid snapshot of a shortfall in personnel for available IT sector jobs and lends support to the contention of this review that the objectives of the programme remain valid.

The DCU survey shows a general upturn in the sector and also cites a recent online employment index survey conducted on five major online recruitment websites in Ireland. They both "reflected a general upturn in the sector, with a 7% increase in IT recruitment in the three months from February to April this year". The survey also notes that the top ten ICT companies in Ireland are employing more now than

[9] Extracted from the Fourth Report of the Expert Group on Future Skills Needs
[10] McIver Consulting "Research into the impact of the DES ICT Undergraduate Skills Programmes, Appendix 2

they did at the beginning of 2000 (Forfás/CSO). This recovery is reflected in the U.S. economy and there is plenty of evidence to bear this out. The survey also notes however, that since 2001 there has been a drop of more than 75% in students applying for computing degrees. This is due in part to the impression held by second level students and their parents that there are no longer good jobs available in the IT sector. The survey concludes with a recent statement from the Irish Computer Society. "*Now we have the prospect in the coming years of not just core IT companies such as IBM Microsoft and Oracle, but also our key industries such as Financial Services, looking at a supply of computer graduates that will fall far short of their requirements*".

3.4.1 Skills Shortages

The following table shows the predicted skills shortages between 2003 and 2010 from the Expert Group on Future Skills Needs.

Table 3.1 – Predicted Skills Gap 2003-2010 Computing and Engineering

Table Skills Gap Analysis for ICT Graduates			
Year	Demand	Supply	Gap
Computing Degree			
2003	870	2254	1384
2004	2016	2244	228
2005	2208	2134	-74
2006	2424	1818	-606
2007	2667	1698	-969
2008	2945	1876	-1069
2009	3254	2234	-1020
2010	3612	2395	-1217
Computing Diploma or Certificate			
2003	170	443	273
2004	325	372	47
2005	352	271	-81
2006	383	307	-76
2007	427	323	-104
2008	472	321	-151
2009	523	316	-207
2010	579	370	-209
Engineering Degree			
2003	795	1883	1088
2004	1305	1985	680
2005	1378	1840	462
2006	1443	1567	124
2007	1534	1608	74
2008	1582	1592	10
2009	1631	1664	33
2010	1679	1666	-13
Engineering Diploma or Certificate			
2003	1065	1690	625
2004	1449	1686	237
2005	1460	1680	220

2006	1437	1745	308
2007	1414	1696	282
2008	1417	1603	186
2009	1471	1541	70
2010	1507	1538	31

Source: Expert Skills Group on Future Skills Needs "Skills Needs in the Irish Economy – The role of Migration"

This table shows the likely skills gap in ICT and engineering over the next five years. The most recent research indicates that although there will be a reasonable balance between supply and demand in the engineering field, evidence of shortages in several categories of IT skills, particularly analysts, programmers and software engineers was found in the latest SLMRU analysis which has been published in an Expert Group on Future Skills Needs Report on *Skills Needs in the Irish Economy: the Role of Migration.* Their report also concludes that although there will be a surplus of engineers, this will include a shortage of electronic engineers balanced by an over supply of other engineers. The report predicts an average of 11 percent growth per annum in employment growth in ICT between 2004 and 2010.

3.5 Conclusion

The first stated objective, "*to address identified and anticipated skills needs and to ensure an improvement in the supply of trained graduates and technicians in the short and medium term*" is still valid in the current climate. Recent research and the findings of the Expert Group on Future Skills Needs, in addition to the report commissioned for this review, indicate that there is a current anticipation of skills needs in the ICT sector and that there is still a need to "ensure an improvement in the supply of trained graduates in the short and medium term". This does not mean, however, that the initiative did not work or failed to address its original objectives. The worldwide downturn in the ICT sector led to a decrease in applicants to fill the courses due to a perception that employment prospects were no longer buoyant in the ICT industry.

The second wider objective also remains valid in the current climate of economic expansion and Ireland's oft stated aim to place itself at the leading edge of the growing global knowledge economy. At a Departmental level, this is explicitly stated in the Statement of Strategy and at a wider national level, Government has signed up to the ambitious aims of the Lisbon agenda. In gross numbers terms, demand for higher education in Ireland will continue to grow over the coming years. FÁS and the ESRI have projected requirements for an additional 100,000 skilled graduates over the next ten years. The achievement of our objectives under the Lisbon Strategy demands significant further growth in research activity and a doubling of the number of PhD students by 2010 and these will need to be fed by a supply of undergraduates from the appropriate areas of study as well as those attracted in from overseas. If more high end technology industry is to be attracted to base their operations in Ireland, and if existing companies are to expand and/or upgrade their operations an increased supply of trained computer graduates and post-graduates is still a real necessity. The ICT Undergraduate Skills Programme, in this context still has a valuable role to perform.

Chapter Four

Programme Objectives – Extent of Achievement

4.1 Performance Indicators

Having established in the previous chapter the objectives of the programme and having put forward arguments as to the current and continuing validity of those objectives, an examination is now required of the extent to which the objectives were achieved since the programme began and how effectively this was done (fourth term of reference). To do this, a number of key questions had to be asked. These were

4.1.1 Key Questions

1. Were identified skills needs addressed and was there an improvement in supply of graduates (level and trend of outputs)?
2. Did the timely skills supply become a key determinant of the future growth of the ICT industry in Ireland?
3. Did the change in environment brought about by the downturn in the economy during 2002 and 2003 affect the achievement of the objectives?

The first of these questions will be examined in this chapter along with an examination of how the downturn affected the outputs of the programme. The second question will be examined in the next chapter and the report will also look at how the existence of the skills programmes affected the economy in the context of the global downturn in the ICT industry.

To answer the first question the steering committee had to first "define the outputs of the Undergraduate Skills Programme, and identify the level and trend of those outputs" (third term of reference).

4.1.2 Inputs

The inputs of the programme were identified as

- the costs associated with the programme, including the per student cost
- the additional staffing resources allocated to the third level institutions
- the capital costs associated with the programme

4.1.3 Outputs

The outputs identified by the steering committees were

- the additional intake on courses following the introduction of the programme
- the numbers of graduates from these courses

4.1.4 Outcomes

The outcomes agreed by the steering committee were

- the first destination reports of the graduates
- the extent to which the increased supply of skilled graduates was a factor in inward investment in Ireland during the boom years
- the subsequent impact that had on the growth of the ICT sector and its effect on the economic development of Ireland

4.1.5 Potential Future Performance Indicators

As is recommended in Chapter Six, a standard unit cost analysis across both the University and Institute of Technology sectors, the calculation of which should be possible with both sectors under the remit of the HEA, would be useful in future cost-benefit analysis.

Other recommended performance indicators include, the output of graduates from the courses, the extent of female participation, year by year completion rates and the proportion of graduates advancing to Masters Degrees.

4.2 Extent of achievement

The identification of the above performance indicators led the steering committee towards the examination of the fourth term of reference, i.e. "to examine the extent to which the objectives have been achieved and comment on the effectiveness with which they have been achieved".

4.2.1 Identified Skills Requirements

To analyse the extent to which the objectives of the programme have been achieved, the following question was asked: *"Once the skill requirements had been identified in the Skills reports, to what extent did the places in the Institutions themselves materialise?*" Table 4.5 shows the number of places identified in the Lindsay and Horn reports that were considered necessary to lessen the skills gap that had provided the initial incentive for the programme.

4.2.2 Actual Demand for Available Places

It was then necessary to look at the additional stock of students and to compare this additionality to the total student cohort for those years.

Additional places were identified as follows: a base year was taken as the year prior to the implementation of each new programme with the subsequent year being the first year of additional places (additionalities) as follows:

- Lindsay – Base year 1996/97 with additional places from 1997/98
- Horn – Base year 1998/99 with additional places from 1999/2000
- ATP courses are 18 month courses which commenced in January 1998 – as these were new courses there was 100% additionality
- ITP courses are typically of 3 year duration which commenced in September 2001 – as these were new courses there was 100% additionality

The following tables give additionality numbers in respect of ICT undergraduate courses.

Table 4.1 – Lindsay Additionality

Sector	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
IoT's		594	1047	1504	1743	1623	1459	1340	1068
Universities		482	1255	2107	2787	2872	2254	1929	1360
Total		1076	2357	3520	4222	4058	3044	2500	2428

Table 4.2 – Horn Additionality

Sector	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
IoT's				132	292	352	329	309	240
Universities				26	99	137	221	740	781
Total				158	391	489	550	1049	1021

Table 4.3 – ATP Additionality

Sector	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
IoT's		292	585	724	481	378	157	73	138

Table 4.4 – ITP Additionality

Sector	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
IoT's					46	114	15	57	63

4.2.3 Shortfall

These two elements (i.e. additional places and forecast demand) were then compared in the following table.

Table 4.5 – Comparison between Additional Stock and Forecast Demand

Report	Year	Additional Stock of Enrolments University Sector	Forecast Demand University Sector	Additional Stock of Enrolments IoT Sector	Forecast Demand IoT Sector
Lindsay	2001/02	2872	3780	1623	4325*
Horn	2003/04	682	2154	309	3251

*This figure includes 1486 degree places and 2939 technician places.

This table illustrates that the original targets for additional enrolments set by the Lindsay and Horn reports were not achieved and a number of reasons have been identified to explain the shortfall.

Additional places under the Lindsay Skills programme were provided from the academic year 1997/1998. A sharp increase in additional places occurred up to 2001/2002 when it peaked in the university sector at an additional 2872 students.

When total additional numbers across both sectors are examined, additionality peaked in 2000/01 with 4222 additional students. If uptake had remained at the 2001/2002 level then the target of an additional 3,780 students in the university sector would have been close to achievement in 2 years.

The Horn Skills programme had only commenced when the downturn in the ICT industry occurred and so the targets were not achieved. [With regard to the University sector, the additional stock are in respect of undergraduate courses only (the figure of 2154 for forecast demand was for all courses including postgraduate)]

4.3 Improvement in Supply

In view of the above, it was necessary to evaluate whether there had been an overall improvement in the supply of skilled graduates, and was this improvement enough to achieve the programme objectives?

The following tables show the graduate numbers in the years after the programme was introduced. Total numbers from both sectors show that places provided under Lindsay resulted in the biggest increase in graduates in 2001 compared to previous years. Numbers increased again in 2002 and again in 2003. Although there was a slight drop in the Institute of Technology sector this was offset by an increase in the University sector. This is because many of the courses in the Institute of Technology sector were at sub-degree level and were shorter by two years than the university degrees. The drop in intake that began in 2001/02 due to the downturn thus impacted the Institute of Technology sector two years earlier than in the University sector. It is apparent that there was a sharp increase in graduate supply overall from 2001 when the additional numbers of students under Lindsay from the university sector graduated and a steady increase until 2004. Provisional figures for 2005 show that graduate numbers from the University sector have dropped from the previous year, showing the effects of the downturn when employment prospects in the sector were not as buoyant as before, which affected enrolment rates from 2001/02. The targets were not achieved under Horn which had only just commenced when the downturn in the ICT sector occurred.

Table 4.6 - Graduate numbers in respect of ICT undergraduate courses - Lindsay

Sector	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
IoT's	612	756	934	1041	1028	986	1063	681
Universities	397	519	612	881	1134	1194	1257	1034
Total	1009	1275	1546	1922	2162	2180	2320	1715

Table 4.7 - Graduate numbers in respect of ICT undergraduate courses – Horn

Sector	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
IoT's			531	546	666	582	513	418
Universities			323	351	372	397	478	421
Total			854	897	1038	979	991	839

Table 4.8 - Graduate numbers in respect of ICT undergraduate courses – ATP and ITP*

Sector	1998	1999	2000	2001	2002	2003	2004	2005
IoT's	N/A	215	389	422	419	256	210	153

*Because the course titles for both the ATP and ITP are in most cases identical it is not possible to identify the graduate numbers separately

McIver Consulting's Report concludes that the impact of the ATP and ITP programmes in increasing the output of graduates at technician level was quite rapid.

- An increase in intake into a conventional certificate level course produced additional graduates in two years. Thus, the significant increases in intake that took place in 1997 and 1998 led to increases in graduate output in 1999 and 2000, two of the highest growth years that the ICT sector experienced.
- The establishment of the Accelerated Technician Programme in 1997 had a more immediate impact. Under this 18 month programme, a student studies in college for six months, undergoes a six month industry placement, and graduates after a further six months of study. Thus, a student was available for a time to an industry sponsor six months after commencing study, and available full time after 18 months. With (originally) two intakes per year, this programme was particularly useful to major electronics manufacturers needing to ramp up their activities quickly.

Thus, the programmes that increased intake into technician level programmes had a major impact on technician supply for some of the key growth years experienced by the sector, from 1997 to 2001.

McIver Consulting's report summarises the trend of outputs in the context of the changing face of the labour market during the relevant period in Fig 3.1 of their report[11] (see Appendix 5).

4.3.1 Conclusion

Although the downturn obviously had a serious impact on the achievement of stated targets, which became apparent from 20002/03 when additional places being filled dropped sharply in both sectors, and this in turn impacted on subsequent graduate numbers, it can be concluded that the ICT Undergraduate Skill Programme did achieve one of its primary objectives, which was to address identified skills needs and to increase the supply of graduates. Under Lindsay, graduate numbers increased from 1009 in 1998 (the year before the first Lindsay graduates emerged) to 2320 in 2004 i.e. an increase of approximately 130%. This is a hugely significant increase in the supply of skilled graduates that has been unmatched in Europe in this context. Goodbody's Research Review states that "Ireland was unique in Europe with its programs at 3rd level to provide key skills in ICT.[12]

[11] McIver Consulting "Research into the impact of the DES ICT Undergraduate Skills Programmes, Appendix 2

[12] The Goodbody Stockbrokers Research Review titled, Irish Technology Review , July 2003

4.4 Destination of Graduates

In answering the first of the key questions set out at the beginning of this chapter, the final crucial stage was to ascertain whether or not the skilled graduates that emerged as a result of the increased funding were able to pursue careers in the ICT sector and to what extent they fed into the areas in which the original gaps had been identified. Inevitably the downturn in the economy had significant effects on these outputs.

Table 4.9 - First destination reports of graduates

The following are total numbers in relation to first destination of ICT under graduates from the 2000/01 to 2002/03 academic years:

Year and Sector	Total ICT graduates examined for FDR (Lindsay, Horn, ATP & ITP)		In Employment	In further study	Seeking employment	Not available for employment or further study
2001						
IoT's	**904**		**33.6%**	**60.6%**	**4.9%**	**0.9%**
Universities	**1015**		**68%**	**18%**	**9%**	**5%**
2002						
IoT's	**647**		**28.6%**	**65.5%**	**4.5%**	**1.4%**
Universities	**1326**		**54%**	**29%**	**8%**	**9%**
2003						
IoT's	**414**		**34.1%**	**57.7%**	**5.8%**	**2.4%**
Universities	**1420**		**55%**	**30%**	**6%**	**9%**

4.4.1 Destination of ICT graduates into Employment/Further Study by Sector

The Higher Education Authority have also supplied data regarding the destination of those ICT university graduates surveyed from 2001-03 when the numbers sharply increased and which sectors of employment they entered to ascertain whether there was an increased supply of graduates into the targeted sectors, i.e. manufacturing and high-tech sectors. This table shows that a significant number of university graduates from the skills courses who progressed into further study went into the ICT, engineering and science fields. The percentage of graduates from the university sector going into further study had increased significantly from 18 – 30% from 2001-03 (see table 4.9).

Table 4.10 - Destination of ICT University Graduates into Further Study by Sector

Field of Further Study	2002	2003
Arts	3%	5%
Business	15%	14%
Computer & IT	44%	40%
Engineering	21%	24%
Medicine	0%	1%
Science	5%	7%
Unknown	13%	8%
Total	100%	100%

Table 4.11 - Destination of ICT University Graduates into Employment by Sector

Table 1.1B1
Overview of graduates in Employment Classified by Sector - Skills 1 and 2
(rounded to nearest point)
Full table can be seen at appendix 4

	Ireland			Overseas		
Employment Sector	**2001 %**	**2002 %**	**2003 %**	**2001 %**	**2002 %**	**2003 %**
AGRICULTURE, FORESTRY AND FISHERIES						
Sub Total	***0.4***	***1.0***	***1.0***	***0.0***	***0.0***	***3.0***
MANUFACTURING INDUSTRIES						
Sub Total	***26.3***	***28.3***	***28.7***	***15.8***	***11.9***	***16.1***
ELECTRICITY, GAS AND WATER SUPPLY						
Sub Total	***2.2***	***0.6***	***2.2***	***0.0***	***1.0***	***1.4***
BUILDING AND CONSTRUCTION						
Sub Total	***2.4***	***3.1***	***3.7***	***4.2***	***2.0***	***1.4***
DISTRIBUTION						
Sub Total	***3.3***	***5.3***	***3.7***	***1.1***	***2.0***	***0.0***
BUSINESS, FINANCE AND INSURANCE SERVICES						
Sub Total	***19.0***	***18.8***	***17.5***	***26.3***	***28.7***	***35.1***
COMPUTING AND SOFTWARE APPLICATIONS						
Sub Total	***18.5***	***15.4***	***17.2***	***23.2***	***12.9***	***20.3***
TRANSPORT, STORAGE AND COMMUNICATIONS						
Sub Total	***6.8***	***5.7***	***9.5***	***4.2***	***6.9***	***4.1***
NON MARKET SERVICES						
Sub Total	***10.2***	***9.1***	***6.9***	***12.6***	***14.9***	***12.0***
PROFESSIONAL SERVICES n.e.c.						
Sub Total	***3.1***	***2.4***	***0.8***	***1.1***	***3.0***	***0.0***
PERSONAL AND RECREATIONAL SERVICES						
Sub Total	***2.9***	***3.2***	***2.2***	***5.3***	***5.0***	***0.0***
OTHER INDUSTRIES OR INDUSTRY NOT STATED						
Sub Total	***4.9***	***7.1***	***6.8***	***6.3***	***11.9***	***6.8***
Total	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***

These figures show that the percentages going into employment in manufacturing, business and finance and computer software remained fairly constant between 2001 and 2003, although because the percentage going into employment dropped by 14 and 15% in 2002 and 2003 respectively (the percentage going into further study rose by 11 and 10% respectively in those years), these are percentages of a lower proportion of the graduates. The significant rise in percentage employed by sector in the job market is the percentage of those finding employment overseas in the business, finance and insurance sector, which rose by 9% during this period.

4.4.2 Destination of Graduates by Type of Degree

For college leaving cohorts in computing and electronic engineering at degree level, and in engineering at certificate and diploma level, up to the class of 2000, employment rates were high, as can be seen Table 4.12 below.

Table 4.12 - Graduates of 1996, 1998 and 2000 – position after graduation

		1996	1998	2000
Computer Science Degree	Research or Further Study	6.7%	7.1%	8.7%
	Not Available for Employment or Study	0.9%	2.3%	1.9%
	Seeking Employment	0.6%	1.1%	3.4%
	Gained Employment	91.9%	89.5%	85.9%
Electronic/ Electrical Engineering Degree	Research or Further Study	16.4%	13.2%	12.8%
	Not Available for Employment or Study	2.6%	2.4%	5.7%
	Seeking Employment	2.3%	2.8%	1.7%
	Gained Employment	78.7%	81.7%	79.8%
Engineering Certificate and Diploma	Research or Further Study	57.7%	52.6%	58.6%
	Not Available for Employment or Study	1.0%	1.1%	1.9%
	Seeking Employment	3.3%	1.6%	1.0%
	Gained Employment	38.0%	44.7%	38.4%

Notes: (1) There was a change in survey methodology for graduates of 2001, after which comparable numbers were not prepared. (2) The "Research or Further Study" category has had the small numbers going into "Other Vocational and Professional Education and Training" and state "Work Experience" programmes added to it, to reduce the level of detail in the Table. (3) Separate data was not published on computing certificates and diplomas.

Source: Annual First Destination of Award Recipients in Higher Education Reports, HEA

4.4.3 Destination of Graduates of Sub-degree Courses funded under the ICT Skills Programme

The table below shows that unemployment rates for certificate and diploma graduates of 2003 are very low. Most graduates have progressed into further study.

Table 4.13 - Situation of Graduates from Certificate and Diploma Courses of 2003 Supported Under Undergraduate ICT Skills Programmes

	Situation of Graduates of 2003 When Surveyed
Employed	18%
In Further Study	76%
Seeking Employment	4%
Not Available for Employment or Study	2%

Source: McIver Consulting Analysis of HETAC First Destination of Award Recipients Data for graduates of 2003 (Relevant response rate is approximately 41%.)

4.5 Conclusions

The downturn experienced in Ireland in the ICT sector was part of a world wide recession. The effects of the downturn on enrolment and destination of graduates cannot be associated with any deficiency in the programme delivery or objectives. Comparison of fig 3.2 and fig 3.4 in McIver's Report[13] showing patterns of employment in the ICT sector in both the U.S. and Ireland respectively show a very similar pattern throughout the downturn years. It is now recognised that the ICT industry is cyclical in nature and consideration of the implications of this for the future planning of the programme will be examined in greater detail in Chapter Seven.

The downturn had a significant effect on the intake into ICT courses from 2000/01 and this is beginning to show in decreased graduate numbers. There is evidence to suggest that the graduates resulting from the increased intake under Lindsay and who emerged into the labour market at the start of the downturn did not suffer as much as might be expected considering the sudden collapse in demand for qualified workers in the ICT sector. On the employment side, during the period 2001-2003 when there were significant increases in ICT graduate output, the percentage gaining employment or pursuing further study was in line with the national average for all graduates. Initial surveys of the 2004 ICT graduates indicate that employment levels have increased.

First Destination Reports from the University sector show a sharp increase in graduates going into further study from 2001/02 onwards (see table 4.9). Table 4.10 shows clearly that of these graduates in 2002 and 2003, 70% and 71% respectively

[13] McIvers Consulting "Research on the Impact of the ICT Undergraduate Skills Programme on the Irish Economy" June 2005

progressed into further study in the fields of ICT, Engineering and Science. This happily coincided with a huge increase in government investment in research and development through the Programme for Research in Third Level Institutions (PRTLI), the Irish Research Council for Humanities and Social Sciences, the Irish Research Council for Science Engineering and Technology and Science Foundation Ireland, which has led to an increased demand for research postgraduates. In today's burgeoning knowledge economy, where McIvers interviews with the ICT industry show that there will in future be an increasing reliance on the supply of graduates at Masters level and above, this is another unintended benefit from the downturn in the ICT sector between 2001 and 2003. Table 4.13 shows that of those emerging from sub-degree ICT Skills courses in 2003, 76% had progressed into further study.

Chapter Five

Programme Objectives – Effectiveness of the Programme

5.1 Key Questions

In evaluating the effectiveness with which the programme objectives of the ICT Undergraduate Skills Programme were achieved, we posed a number of key questions. We have dealt with the first of these in the previous chapter. The second and third were

- Did timely skills supply become a key determinant of the future growth of the ICT industry in Ireland as envisaged at the beginning of the programme?
- Did the change in environment brought about by the downturn in the economy during 2002 and 2003 affect the achievement of the objectives?

In order to answer the first of these questions upon which the effectiveness of the ICT Undergraduate Skills programme pivots, the steering group decided to have recourse to private research, undertaken by McIver Consulting, after the appropriate tendering process. Their report is attached in full in Appendix 5.

5.2 McIver Consulting Report

Under the Terms of Reference given to them by the Steering Committee, McIver Consulting were required to answer the following questions through research and the conduct of a series of interviews within the ICT industry.

5.2.1 Questions Posed by Terms of Reference

- Have the Department's ICT Skills Programmes resulted in attracting and retaining overseas industry into Ireland because of the availability of sufficient numbers of suitably qualified ICT graduates?
- Has the ICT Industry in Ireland experienced expansion/growth due to the availability of suitably qualified graduates?"
- Has the ICT Undergraduate Skills Programme contributed to the viability of the ICT sector in the short, medium and long term?"
- What has been the overall economic impact for Ireland of the ICT Undergraduate Skills Programme?
- What recommendations can you put forward in relation to alternative approaches to the provision of qualified ICT graduates?

5.2.2 Relevant Questions

The first three of these questions are dealt with in this chapter. The final two will be dealt with in Chapter Seven, when this review will examine the broader economic impact of the programme in order to establish the validity of its funding with public monies.

5.2.3 Foreign Direct Investment – Supporting Research

The economic boom experienced in Ireland during the 1990's and up until 2001 has been well documented. While this review is not going to attempt to attribute sole or even primary causality for the boom to the ICT Undergraduate Skills programme, we hope to show that the education system in Ireland and particularly the perceived responsiveness by the Irish Government to the needs of industry in the ICT sector had a direct influence in attracting foreign direct investment into Ireland as well as encouraging the growth of indigenous industry in this area.

Research in this area has been summarised by Dr Frank Barry in his paper "*Third Level Education, Foreign Direct Investment and Economic Boom in Ireland*"[14]. He notes that "Ferreira and Vanhoudt (2002)[15] conclude that "higher education, especially the vocational/technical slant of education provision, and the sector composition of FDI in favour of high-tech industries, were self-reinforcing factors" behind the boom. He also notes that Wickham and Bouchier (2004)[16] argue that the key feature of the Irish education system – in comparison to those of the Asian Tigers and the rest of the OECD – has been its inexpensive 'volume production of technical graduates', undertaken without incurring the 'costs' of tackling educational disadvantage or developing a research based innovation system". Dr Barry himself concludes that "it is clear that Ireland could not have upgraded in to the high-tech sectors that it has been successful in attracting had it not been able to furnish the kinds of skilled workers that these sectors require".[17]

5.2.4 Inward Investment and Skills Programmes

<u>IDA Ireland Client Survey Data</u>

These surveys which cover the period 1996 to 2000, (fig. 4.1 in McIver's report) show that the IDA's ICT and engineering clients saw difficulty in attracting skilled workers along with rising wage costs become a significant threat to their Irish operations in the late 1990's. In spite of this the threat perceived by other countries' competition in attracting industry fell sharply over the same period. This demonstrates, according to McIvers' interpretation that although the skills programmes were not meeting all the demands for labour, companies were still successful in meeting or exceeding corporate performance expectations. In addition to this, it appears that ICT manpower availability difficulties were more prevalent in other countries and that crucially "Ireland was seen as having responded more effectively than other countries in the shortage through the undergraduate skills programmes and other related programmes".[18]

[14] Barry, F Dr "Third level Education, Foreign Direct Investment and Economic Boom in Ireland" to be published in *International Journal of Technology Management*, May 2005

[15] Ferreira, L., and P. Vanhoudt (2004) "Catching the Celtic Tiger by Its Tail" in *European Journal of Education, Volume 39, Issue 2*

[16] Wickham, J. and G. Boucher (2004) "Training cubs for the Celtic Tiger: The volume production of technical graduates in the Irish educational system", *Journal of Education and Work*, 17, 4, 377-395

[17] Barry, F, Dr *ibid*

[18] McIver Consulting "*Research into the impact of the DES ICT Undergraduate Skills Programme*", Chapter Four

Electronic Hardware Industry

McIver Consulting also found that there was a substantial volume of inward investment by electronic hardware companies over the period 1997-2000. Their interview evidence shows that skills availability was among the top issues under consideration by decision makers in these companies when deciding suitable overseas locations, along with Ireland's corporation tax regime, and that the existence of the programme had a major impact on Ireland's credibility on skills supply.

Programmes taken at technician level had an impact on investor confidence and also a direct impact on the supply of graduates available within the timeframe of the high growth period. The ATP Programme produced certificate level graduates, who already had six months work experience, usually with their eventual employer, in 1999 and continued to produce significant numbers of good quality graduates throughout the remainder of the high growth period. The Irish operations of multi-nationals interviewed by McIver Consulting confirmed that this supply of technicians allowed them to take on incremental investments and thus built up the trust and confidence of international management. The overriding consideration amongst international decision-makers was deciding which of their operations globally could be trusted to "ramp up production quickly" to meet fast-growing market demand. Without the programme, continuing investment in Ireland would likely have been undermined.

Software Industry

McIver Consulting's report shows that there was a substantial volume of inward investment in software from 1996-2001 and that the announcement by the government in 1996 and 1997 of plans for substantial increases in the intake into Irish computing courses, particularly at degree level and the resulting increases in third level intake "*appear to have had the effect of distinguishing Ireland from other possible European locations for inward investment whose responses were slower and more incremental*" The interviews carried out by McIver Consulting show that

- the undergraduate ICT skills programmes were influential in allowing Ireland to achieve this high market share (IDA data shows 42% of mobile software development investment in Europe 1999-2001 was in Ireland) of software inward investment as skills availability was one of the main factors considered by ICT corporations.
- The "*visibility of a strong future supply of computing graduates gave investors confidence about the medium to long-term viability of investments*", bearing in mind that the anticipated increase in degree graduates would not affect skills supply for another four or five years. [19]

Again McIver Consulting concludes that although it cannot be said that any of these investments would definitely not have occurred without the skills programmes, the future supply of professionals for both the hardware and software industry over the period was such a high profile issue that "the programmes must have made a difference in a significant proportion of cases".

[19] McIver Consulting "*Research into Impact of DES ICT Undergraduate Skills Programme*", Chapter 4, section 4.3.2

5.2.5 Growth and the Skills Programmes

As has been already noted, the overseas owned parts of the ICT sector over the period 1996-2001 underwent significant expansion and this can be largely attributed to the effectiveness of the skills programmes during that period. The programmes, however, have had a more limited impact on growth in relation to indigenous industry in the sector, which is dominated by software and IT services. McIver attributes this to fact that while the overseas sector was influenced by a strong expectation of future increases in graduate numbers, the Irish owned industries "*lived more in the present*" and established development operations abroad, as far as Australia, India and the U.S., if they could not staff operations effectively within Ireland, using indigenous workers or migrant workers. Just as the first supply of degree graduates came on stream in 2001, the downturn started and "*the programmes appear to have had a modest positive impact throughout the downturn, limiting pay inflation, which threatened the sector's competitiveness, and adding to the available supply of people*".[20]

5.2.6 Continuing Viability of the ICT Sector

McIvers argue that the transformation of the ICT sector in Ireland since the first of the undergraduate skills programmes has made it less vulnerable to the low cost competition that has emerged from Eastern Europe, India and the Philippines in the meantime. This is because the electronic hardware sector has "shed most of its lower value added manufacturing work, through a mix of closures and progressive replacement of existing activities". This has resulted in higher value added activities in the sector and in many cases operations in Ireland have taken a global lead in improving manufacturing processes. These developments will not just underpin the sector's viability over the short term, but over the medium and long term as the scope for further development of this capacity now exists. This moving away from "low value positioning" that occupied the sector in the mid nineties is enabling it to thrive again.

The main mechanisms through which the undergraduate ICT skills programmes played a significant role are outlined by McIver Consulting are as follows

- Encouraging inward investment, and re-investment, by overseas-owned ICT companies;
- Providing many of the technicians required by the electronic hardware sector to upgrade its capabilities, particularly over the period to 2000;
- Contributing to boosting the supply of graduates in computing with higher degrees;
- Boosting the supply of graduates available in the current year, from among new graduates and from among the underutilised pool of graduates from previous years, to fuel renewed growth over the immediate future; and
- Boosting graduate recruitment to some extent during the downturn in demand of 2002 and 2003

[20] McIvers Report, Appendix 2, Section 5.3.2

5.2.7 Conclusion

With regard to the first key question posed at the beginning of this chapter, it is apparent, taking into account the above, that the undergraduate skills programme and the resulting skills supply did become a determinant in the growth of the ICT industry in Ireland up to 2001. There were two strands to the success of the programme. The first of these was the actual production of skilled graduates, and McIvers found that the most influential of these outputs was the supply of engineering technicians, computing and electronic engineering graduates. The second strand was the positive perception generated by the implementation of the programme of the Irish government's commitment to the nurturing of the industry and their obvious responsiveness to that industry's needs. It is critical to remember that although the anticipated supply of graduates at degree level did not come on stream until 2001 which coincided with the start of the downturn, this does not detract from the impact of their expectation on decisions made by industry between 1997 and 2000.

5.3 The Downturn

The second question posed at the beginning of this chapter was whether the change in environment brought about by the downturn in the economy during 2002 and 2003 affected the achievement of the objectives? Analysis of the graduate numbers and First Destination Reports shows the impact that the downturn had on the level and trend of outputs of the programme (***Section 4.5, Conclusion***). It is concluded that the downturn had an effect on enrolments after 2001/02 and on graduate numbers from 2003/04. First destination reports, however, show that the graduates from these courses went into employment in numbers comparable to the national average for all other courses. This demonstrates that ICT graduates were spread more evenly throughout the labour market during the downturn, bringing their ICT skills with them. This would have had a beneficial effect on those companies, whose business operations have become increasingly reliant on technological literacy in the modern age. In addition to this, the decrease in employment opportunities in the ICT sector partly contributed to graduates pursuing further study as an alternative and there was a sharp increase during those years. As has been previously noted, the growing knowledge economy is becoming increasingly reliant on graduates with Masters Degrees and above. This increase in supply has been another unintended side effect of the downturn on the ICT undergraduate skills programme, and the achievement of its objectives.

In this chapter, the effect that the downturn had on the achievement of another aspect of the programme objectives, i.e., the role the programme was to play in the growth of the ICT industry in Ireland will be examined.

5.3.1 Industry Closures

It is a fact that a significant proportion of past inward ICT investment has been lost since 2000, particularly in electronic hardware, but also in software. McIver Consulting's research shows the impact of this in the employment data presented in Section Three of their report. However, "*a substantial proportion of these losses are attributable to the closure or downsizing of relatively low value-added activities that were present in Ireland prior to the establishment of the undergraduate ICT skills programme.*" This trend was apparent even throughout the boom years, of migration by low value added manufacturing operations and closure of inward investment operations by companies that were losing out in global competition.

Overseas owned ICT operations which were established in the late 1990's, or which had attracted substantial reinvestment at this time have survived and maintained employment levels similar to level achieved by 2001. This "*stability at a macro-level*" is underpinned by massive transformation within these operations during the last few years, as evidenced by the interviews by McIver Consulting. These operations have substantially upgraded their activities to a much higher level while migrating low value added activities overseas. In the electronic hardware industry, the Irish end has become increasingly involved in the improvement of production processes, development work, product management and a wide range of business functions in addition to the retention of responsibility for the management of production activities that have been sent overseas.

In the software industry, the focus within the corporate value chain has moved away from routine coding work towards higher level development work. Again more routine work has gone overseas and these companies express a need now to employ computing graduates with postgraduate degrees or with high levels of experience and expertise.

McIver Consulting conclude that without the ICT Undergraduate Skills Programme it appears likely that "the retention performance of the sector would have been significantly poorer" as the inward investment experienced in the latter half of the nineties would have been lessened and the resilience of the sector harmed.

McIver argue that while inward investment slowed from 2001 it did not cease completely despite the fact that competition for mobile investment from Eastern Europe, India and the Philippines became a bigger issue. The interview evidence from McIvers' research indicates that this continued reputation was rooted in part in Ireland's previous responsiveness to the priority needs of the ICT sector. The skills programmes over the period 1996-2001 had "*been a necessary link in this chain*".[21]

5.3.2 ICT Ireland's Graduate Placement Programme

ICT Ireland, in association with the Institute of Engineers responded to the downturn in demand for new graduates by launching a programme to place graduates in industry in 2003. In 2005, nineteen firms participated in the programme, including Ericsson, Intel, IBM and Oracle. The existence and scale of the programme can be attributed partly to the ICT Undergraduate Skills Programme. Having asked for an increase in graduate numbers the sector felt a responsibility to offset the problems faced by graduates due to the fall in demand. They also wished to maximise the availability to the sector and generate positive news about employment to encourage ongoing applications to relevant courses. This went some way to maintaining the flow of graduates into the sector through the downturn.

5.4 Conclusions

<u>The Good News</u>

Clearly the projected role to be played by the programme as a determinant of future growth of the industry was significantly affected by the downturn. However, it is also arguable that the downturn itself would have been far more serious without the existence of the programme during the critical period of growth. Under the current

[21] McIvers Report, Appendix 2, Section 4

circumstances, where demand for software and electronic engineering professionals has been picking up, the existence of a strong supply of graduates this year and from previous years will delay the onset of significant shortages.

McIver Consulting's research concludes that the supply has also limited the scope for pay inflation beyond the level present in the rest of the economy, which is particularly positive for the software sector.

The increased output of higher degree graduates, which is partly attributable to the downturn, will also have a positive impact on the future growth of the sector as it moves into higher value added activities and a strong emphasis on research and development and innovation.[22]

The Bad News

As a result of the downturn, the positive impact of the ICT skills programme can be expected to dissipate sharply in the coming years. Enrolment on ICT-related programmes has been falling sharply since 2001 and data from the CAO shows that recruitment in 2005 has shown no significant improvement.

This fall in student intake will become apparent this year, with a decrease in degree graduate numbers in computing and electronic engineering and this will continue up to 2008. A number of those interviewed by McIver expressed concerns regarding the adequacy of the future supply of graduates, both in terms of quality and numbers. Graduate quality will become increasingly important as the sector develops towards high-end activity. These concerns have been expressed most forcefully by electronics design companies.

In particular there has been a dramatic fall off in the % of females enrolling on University ICT courses, down from 32% in 2001 to 18 % in 2004 accounting for almost half the reduction in enrolments. (In the IoTs, the comparable figures are 23% in 2001/02 and 17% in 2003/04)

5.4.1 Future Supply and Demand for Researchers

A study on the future supply and demand for researchers and research personnel in Ireland was undertaken by the EGFSN and Forfás to inform the development of the report, *"Building Ireland's Knowledge Economy - The Irish Action Plan for Increasing Research and Development to 2010"*.[23] The study outlines that based on current trends, Ireland may experience a shortage of at least 3,600 researchers over the period to 2010. The main areas where shortages of researchers are projected to emerge are in ICT and biotechnology / pharmaceutical related disciplines.

This again underlines the critical importance of a strong supply of undergraduates in ICT to feed the growing demand for researchers in this area.

[22] McIver Consulting "*Research on Impact of DES ICT Undergraduate Skills Programme*, Appendix 2, Section 5.3.4

[23] Expert Group on Future Skills Needs/Forfás "*Building Ireland's Knowledge Economy – The Irish Action Plan for Increasing Research & Development to 2010*", September 2004

5.5 Recommendations

1. *The ICT Undergraduate skills programme should continue to be a priority for the Department of Education and Science.(**Section 5.5**)*

2. *In addition to the continuation of the programmes to ensure future supply, the Department of Education and Science and the Higher Education Institutions must make recruitment into these courses a high priority. **(Section 5.5**)*

3. *The HEA need to support the Higher Education Institutions in retaining key resources while they campaign to increase enrolments. Pending an upturn in undergraduate enrolments, support should be provided for part-time and post - graduate programmes in ICT under the Information Technology Investment Fund. Specific action should be focused on the numbers of females enrolling on ICT courses. Initiatives such as interdisciplinary programmes between technology and other degree courses that attract a higher proportion of female students should be examined. The use of e-Learning in courses should be promoted to foster wider participation in full time and part time courses. (**Section 5.5**)*

4. *Industry needs to become pro-active in promoting careers in ICT. Programmes such as the ICT Ireland Champions programme and the Internship need to be strengthened.[24] (**Section 5.5**)*

5. *Commitments made by industry to work placements etc. need to be maintained even through a variable economic climate. **(Section 5.5**)*

6. *The Department of Education and Science and the HEA should look carefully at the possibility of using funding formulae to reward higher education institutions that are successful in recruiting students to study in ICT disciplines, and are successful in ultimately graduating them. (**Section 5.5)***

7. *Institutions should be strongly encouraged to meet the recognised increasing need for people with postgraduate technology degrees, both research degrees and taught degrees. (**Section 5.5)***

8. *There is a need for a continued focus on development of areas at school level such as guidance counselling, promotion of careers in ICT industry, exploitation of ICTs in the classroom, and take-up of the physical sciences. (**Section 5.5)***

[24] The Champions programme provides recent graduates from industry as speakers for school recruitment. The Internship programme provides paid work experience in ICT industry two days a week to 3rd and 4th year undergraduates

Chapter Six

Programme Objectives – Cost and Efficiency of Achievement

6.1 Introduction

This chapter sets out to identify the level and trend of costs and staffing resources associated with the programme and to comment on the efficiency with which the ICT undergraduate skills programme has achieved its objectives (sixth term of reference). We have also included tables showing the cost of the programme as a proportion of the Department of Education and Science's overall budget for each year.

6.2 Key Questions

- Can the level and trend of costs be identified for the programme?
- Can the staffing resources specifically associated with the programme be identified?
- Was the programme delivered efficiently to achieve the stated objectives?

6.3 Identified costs associated with the programmes

The costs identified for the programme were based on a unit cost approach, i.e. the cost per student. The unit cost includes staffing costs, administrative costs and tuition fees.

6.3.1 Background – Recurrent Funding

University Sector

Recurrent funding from the State to the university sector is currently made up of four main components allocated through a block grant mechanism:

- a core grant determined on the basis of a formula-based unit cost allocation system dating from 1993;
- a grant in lieu of fees, based on student enrolments, which dates from the introduction of fee remission (free fees) for eligible full-time undergraduate students in 1996;
- a targeted initiatives programme which is focussed on priority areas identified by the HEA which amounts to about 2% of total grant; and
- a skills programmes funding scheme which mainly relates to increasing the output of ICT graduates but which also includes the output of teachers and health professionals where shortages have been identified, amounting to about 8% of total grant.

The following table shows the total recurrent cost of the ICT Undergraduate Skills Programme per financial year in respect of the University sector.

Table 6.1 - Total Recurrent Cost of ICT programme per Financial Year In respect of Universities

Year	Amount
1997	€671,306
1998	€3,811,803
1999	€8,716,639
2000	€14,762,089
2001	€19,788,783
2002	€20,860,320
2003	€19,732,659
2004	€22,137,274
2005	€21,750,000

Institute of Technology Sector

Recurrent funding from the State to the Institutes of Technology is by means of an annual budget allocation to each Institute which is then responsible for managing within the limits of its budget. The annual budget is at present allocated on the basis of total pay and non-pay requirements following consideration of the annual Programmes and Budget submission as required under the Regional Technical Colleges/Dublin Institute of Technology Acts. The allocation takes into account the complexity of the Institute, the range of courses and facilities offered to students, the total number of students (both full-time and part-time) and the nature of the infrastructure. Decisions on the allocations also have regard to government policy and priorities.

There was some specific funding provided to institutes of technology in 1997 to cater for additional staffing and non-pay costs associated with the provision of additional places approved under the Lindsay report. There was also specific funding provided for some of the Accelerated Technician Programmes (ATP) in the early years. This funding formed part of the institutes' base funding thereafter. Apart from this specific funding, additional costs associated with the skills programmes were met from the annual budget allocations.

The following table shows the overall recurrent costs allocated for each financial year in respect of the ICT undergraduate skills programme in the Institutes of Technology. These costs were based on the unit cost per student which was calculated by reference to the cost of additional staffing approved, the non-pay costs and the appropriate tuition fee for each financial year. This amount was then multiplied by the number of additional places provided in that year.

Table 6.2 - Total Recurrent Cost of ICT Undergraduate Skills Programme per Financial Year In respect of Institutes of Technology

Year	Amount
1997	€873,410
1998	€6,312,525
1999	€10,894,775
2000	€14,867,780
2001	€16,596,835
2002	€16,024,504
2003	€13,815,339
2004	€12,699,241
2005*	€11,414,628

***Costs based on estimated additionality as final figures for 2005/06 academic year not yet available**

6.3.2 Total 2005 expenditure which ICT Undergraduate Skills Programme represents compared to overall Departmental budget

The following table shows the costs associated with the ICT Undergraduate Skills Programme for the 2005 financial year (1 January to 31 December) and the overall Departmental expenditure for the year.

Table 6.3 ICT Undergraduate Expenditure (Current and Capital) for 2005

Year	IoTs	Universities	Total	Overall Dept Exp.	% Dept. Exp.
2005	€11,651,629*	€29,197,808	€40,849,437	€6,983,896,000	.58%

***Costs based on estimated additionality as final figures for 2005/06 academic year not yet available**

6.3.3 Unit cost

In order to identify a unit cost in respect of additional places allocated due to the Programme, the following methodology was used to get a unit cost, excluding capital costs, in each sector.

University Sector

The HEA has collected unit cost data since the early 1990s. The university receives a grant for each additional student. A grant per student was arrived at based on calculated unit costs. The average unit cost for science was used to determine the recurrent grant per student. In respect of the Lindsay report, recurrent funding of £2,000 (€2,539) per student in additional to fees was provided in 1997/98. In respect of the Horn report, recurrent funding of £2,250 per student (€2,857) for full-time courses and £1,000 (€1,270) for part-time courses per student (in addition to fees) was provided for the academic year 1999/00. These grants were reviewed and inflated annually.

Institute of Technology Sector

A unit cost system of allocating funds to the Institutes of Technology is not in place, the annual budget for each institute is allocated on the basis of its total pay and non-pay requirements following consideration of its annual Programmes and Budget submission. For the purpose of this exercise it was decided to look at one of the larger institutes and one that was already providing courses at sub-degree and degree level in the areas recommended by the Lindsay Report. For this reason Cork Institute of Technology was selected as 'typical' of the sector. The unit cost was calculated by reference to the cost of the additional staffing approved for the Institute for 1997/98, the amount provided for additional non-pay and the appropriate tuition fee. The total cost was divided by the number of additional places approved to arrive at a cost per student.

The average unit cost of providing the additional places in both sectors is shown in table 6.5.

6.3.4 Staffing Resources

Having included the identification of staffing resources in the terms of reference, the steering group subsequently realised that it would not be possible to isolate these from the overall cost of the programme due to the following reasons.

University Sector

Responsibility for staffing belongs to the Universities under the Universities Act 1997. There was, therefore, no specific staffing approval under the Skills Programme, however universities would have appointed such staff as required taking into account student numbers and recurrent resources made available under the Skills Programme.

Institute of Technology Sector

There was some specific staffing approved in 1997/98 to cater for the additional student intake under the Lindsay report. These additional posts would have remained in the Institutes' base funding for following years. There was also some specific staffing approved for Accelerated Technician Programmes (ATP) in the early stages which would also have remained in the base funding for following years.

There was no specific staffing approved for additional student places provided under the Horn report or for any year after 1997/98 in relation to further additional student numbers under Lindsay. Additional staffing would have been approved for Institutes as part of the normal annual Programmes and Budget process.

Because of this it is not possible to identify the total additional staffing resources allocated to the Institutes under the Skills Programmes.

6.4 Efficiency of Delivery of Programme – Costs

An evaluation of the efficient delivery of the programme followed two strands. Firstly, with regard to the costs incurred by the programme, the following questions were asked.

- Taking into account the effectiveness of the programme, was the unit cost per student reasonable in comparison to the unit cost of provision for other kinds of degrees in the higher education sector?
- Taking into account comparative unit costs did one sector emerge as more advantageously placed in terms of focussing future funding for the programme?
- What happened to capital projects funded under the programme in terms of usage during the downturn period and what implications does this have in the event of resurgence in demand for undergraduate places on the courses?
- Was the attrition rate for these courses significant in comparison to other courses and if so, does this make the programme less cost effective?

6.4.1 Cost Provision of ICT Skills Courses in comparison to other degrees in Higher Education Sector

University Sector

The table below shows that unit costs of the ICT skills programme compare favourably with the cost of delivering other similar degrees in the University sector. Although the cost is higher than that of providing an Arts Degree, it is lower than for the provision of an undergraduate engineering degree. Course lists in Appendix 3 show that some of the courses under Lindsay, and approximately two thirds of those under Horn, are engineering degrees. The Programme is delivering those engineering degrees specific to its remit at a lower cost than other engineering degrees which do not fall within the remit of the ICT Undergraduate Skills Programme.

Table 6.4 – Cost Provision of University Degrees 2001/02 and 2005/06

Type of Degree	**2001/02 Unit Cost €**	**2005/06 Unit Cost €**
ICT Skills Programme	8,866.00	11,459.00
Undergraduate Arts Degree	6,381.00	8,247.00
Undergraduate Engineering Degrees*	9,272.00	11,984.00

*****not in ICT Undergraduate Skills Programme

6.4.2 Sectoral Comparison

A sectoral comparison of unit costs including fees between the two sectors (see table 6.5 below) shows that it is less costly overall to provide the courses in the Institute of Technology Sector. However it must be borne in mind that different methodologies were used to arrive at a unit cost for the two sectors, (see paragraph 6.3.3). To allow the Department to formulate future policy with regard to these courses, the Higher Education Authority should be asked to undertake a unit cost analysis across both sectors on ICT Undergraduate Skills Programme courses to enable valid comparisons to be drawn.

Table 6.5 – Unit Cost in both Sectors (Recurrent incl. fees)

Unit Cost in both Sectors - Recurrent		
Financial Year	**IoT Sector Unit Cost per Student**	**University Sector Unit Cost per Student**
1998	€5,563.33	€7,402.57
1999	€5,811.58	€7,233.70
2000	€6,125.15	€7,951.10
2001	€6,559.15	€8.866.00
2002	€6,973.24	€9,397.96
2003	€7,345.98	€10,008.83
2004	€7,696.51	€10,709.45
2005	€8,072.58	€11,459.11

6.4.3 Conclusion

Following such a unit cost analysis, a policy decision can then be taken on concentrating/prioritising the programme in the sector which proves to be the most cost beneficial and advantageous with regards to completion rates and widening participation

6.4.4 Recommendation

9. The Higher Education Authority should carry out a standard cost analysis exercise on the provision of the ICT Undergraduate Skills Programme to enable a policy decision to be taken regarding future provision of the programme. Based on the results of such a standard cost analysis exercise between the two sectors, further consideration should then be given to concentrating/prioritising the programme in the sector which proves to be the most cost beneficial and advantageous with regards to completion rates and widening participation.

6.4.5 Capital Expenditure

The following tables illustrate, (i) the capital expenditure incurred by the ICT Undergraduate Skills Programme by financial year in the IoT sector and (ii) the capital expenditure incurred on the programme relative to the amount initially allocated following the recommendations of the Lindsay and Horn reports in the university sector. A comparison shows that considerably more capital expenditure occurred overall in the university sector.

Table 6.6 Total Capital Cost of ICT Undergraduate Skills Programme per Financial Year in respect of Institutes of Technology

1997	1998	1999	2000	2001	2002	2003	2004	2005*
€49,500	€190,181	€314,213	€406,845	€424,109	€385,168	€315,218	€275,216	€237,001

***Costs based on estimated additionality as final figures for 2005/06 academic year not yet available**

Table 6.7 Total Capital Cost of ICT Undergraduate Skills Programme in respect of Universities

Report	Allocation	Expenditure to December 2005
Lindsay	€43,171,093.00	€38,718,002.00
Horn	€38,409,577.00	€28,800,168.61

The above table shows that there was an under-utilisation of the available capital funding following the Lindsay and Horn reports in the University sector. This can be explained by the drop in demand for places during the downturn. However, the ICT Undergraduate Skills Programme was established in response to the projected needs of the ICT sector in Ireland. Section 7.4.4 demonstrates that this sector experiences upturns and downturns of a cyclical nature. A concern must be whether the provision of funding for capital projects may result in empty buildings and unused facilities during the downturn periods.

However, the review of current building stock carried out for the Kelly report on capital projects in the higher education sector[25] shows that overall in the sector the net average usable space stands at c. $8m^2$ per student which compares with a range of $10m^2 - 11.3m^2$ per student in the UK and Australia. This would strongly suggest that the sector as a whole is not suffering from a surfeit of space and indeed the report recommends a significantly increased programme of government expenditure in the sector over the next decade.

[25] Review and Prioritisation of Capital Projects in the Higher Education sector – Report of the Review Group, HEA, September 2004

With the decrease in enrolments on the ICT Undergraduate Skills Programme all of the Universities have experienced significant reductions in funding. Accordingly, they have reallocated resources to other disciplines and to research. In cases where part-time staff members were used, contracts have not been renewed. One concern remains that as the enrolments increase again on the ICT Undergraduate Skills Programme, ICT departments may have difficult obtaining resources from the institution.

6.4.6 Conclusion

The capital projects that were funded under the ICT Undergraduate Skills Programme increased the physical resources available to institutions. However, some of these resources were reallocated to other uses as a result of decreasing student numbers during the downturn. It remains a concern that in the event of an upturn in demand for places on the programme that it may prove difficult to retrieve resources that were re-allocated for the use of the undergraduate skills students.

6.4.7 Attrition Rates - Research

Attrition rates have to be taken into consideration when assessing the efficient use of public funding. Until this year, with the publication of the Circa Group's report on completion rates in the Institutes of technology and DIT[26], the latest published quantitative research undertaken by the Education Research Centre was published in 2001 in separate reports for the University and Institute of Technology sectors. It should be borne in mind, however that the data used in these reports dates back to 1996/1997. A report for each sector was published.

University Sector

As illustrated below in Table 6.8, the ERC report[27] showed that attrition rates on Computer Studies courses, Science courses and Engineering courses were high in comparison to the average non-completion rates of 16.8%.

Table 6.8 – Attrition Rates in the University Sector

Type of Course	**Non-Completion Rate**
Computer Studies	26.9%
Science	22.2%
Engineering/Arch.	19.6%

[26] *Completion Rates for students taking full-time programmes of study in Institutes of Technology – A study carried out for the Council of Directors of Institutes of Technology and the Dublin Institute of Technology*, The Circa Group, Europe, May 2006

[27] Morgan, M., Flanagan, R., & Kellaghan, T. (2001). *A study of non-completion in undergraduate university courses.* Dublin: Higher Education Authority.

Institute of Technology Sector

As illustrated in Table 6.9 below, the ERC study[28] of eleven institutes of technology (not including DIT) showed an overall attrition rate of 42.6%. A separate study conducted by the DIT showed an attrition rate of 39.46%.

The ERC study of the eleven institutes of technology showed that the three fields of study with the highest non-completion rates were Engineering, Computing and Science. These rates are significantly higher than in the University sector.

Table 6.9 – Attrition Rates in the Institute of Technology Sector from ERC Report, 2000

Type of Course	**Non-Completion Rate**
Engineering	50.9%
Computing	50%
Science	39.7%

The Circa Group report that was commissioned on behalf of the Council of Directors of Institutes of Technology and the Dublin Institute of Technology published in May 2006 shows a very significant improvement in completion rates although the completion rates for Engineering, Manufacturing and Construction (ISCED Category areas of study) are still lower than those on other types of courses. Table 6.10 shows non-completion rates for 2002, 2003 and 2004 in areas of study ISCED no. 4, i.e. Science, Mathematics and Computing and ISCED no. 5, i.e. Engineering, Manufacturing and Construction. Courses funded under the ICT Undergraduate Skills Programme are included in these categories.

Table 6.10 – Non Completion Rates in Institutes of Technology and Dublin Institute of Technology from Data in Circa Group Report 2006

ISCED Category	**2002 Non Completion Rates**			**2003 Non Completion Rates**			**2004 Non Completion Rates**		
	Certs/Dips	Degrees	All	Certs/Dips	Degrees	All	Certs/ Dips	Degrees	All
Science/Maths/Computing	29.7	19.1	26.9	34.2	20	30.9	36.1	22.2	31.9
Eng/Man/Construction	39.7	20	37.8	37.7	25	36.2	34	31.8	32.4

[28] Flanagan, R., Morgan, M., & Kellaghan, T. (2000). *A study of non-completion in Institute of Technology Courses*. Report to Council of Directors of Institutes of Technology.

6.4.8 Government Action

The Government has taken specific targeted measures to address levels of attrition in third level education. Through the Strategic Initiative Scheme, the HEA has worked to support the universities and other HEA designated institutions to identify and address student non-completion. The student retention initiative was introduced in 2000 and funded appropriate pilot projects and activities that examined and improved student retention and participation in HEA funded institutions. Since 2000 a total of €4.659 million has been allocated under the Student Retention Strategic Initiative. In addition, the Technology in Education Strategic Initiative supports a range of activities including those that specifically address non-completion in IT-related areas. Since 2000 a total of €4.478 million has been allocated under the Technology in Education Strategic Initiative.

Since 1999, additional funding has been provided to the Institute of Technology sector to address the area of non-completion. This funding has supported the appointment of Retention Officers and School Liaison Officers, provision of additional advisory services including counselling, academic support and career guidance, the establishment of staff training seminars, upgrading of orientation programmes and the expansion of mentoring programmes. While socio-economic factors are one very important consideration, the reasons for non-completion are more complex with factors such as motivation, capabilities and suitability all involved. The ERC published a further report in 2003 on the programmes in universities being provided to improve non-completion[29] which evaluates the range of strategies and measures in place to tackle non-completion at both national and institutional level. In addition, student retention rates in the areas funded under the ICT Undergraduate Skills Programme were also specifically targeted by the Information Technology Investment Fund as outlined below.

6.4.9 Information Technology Investment Fund

Arising partly from concerns regarding student retention and based on the recommendations of the Expert Group, the Minister for Education and Science and the Tánaiste and Minister for Enterprise, Trade and Employment established an Information Technology Investment Fund to support the provision of high-level ICT skills by third level institutions in 2002.

The Fund is administered by the Higher Education Authority with the support of an Advisory Group comprising of the third level institutions, the Expert Group, the Department of Education and Science, IBEC and ICTU. A dedicated unit within the HEA has been established for this purpose. Student retention is among the aims of the fund which aims to

- Expand participation in ICT education, particularly through use of part-time education in the institutions, and including in-company training
- Support ICT education and training through post-graduate conversion courses
- Improve completion rates in ICT courses

[29] Flanagan, R., & Morgan, M. (2003). *Evaluation of programmes targeting retention in universities: A preliminary report of projects funded by the Higher Education Authority.* Report to the Higher Education Authority. Dublin: Educational Research Centre.

- Provide for equipment renewal and the development of state-of–the-art facilities for third level education in ICT course.

All Seven Universities, 13 Institutes of Technology, the Dublin Institute of Technology, the National College of Art and Design, the National College of Ireland, and the Tipperary Rural and Business Development Institute are supported by the Fund. The programme supports courses that provide education and training in the area of Information & Communications Technology.

Since 2003, the Department of Education and Science through the Higher Education Authority under the Information Technology Investment Fund has been providing annual funding of €1.5m to all of the 3rd level institutions to improve completion rates on ICT skills courses. Firm statistics on the results of these measures will be available shortly. Anecdotal feedback from the institutions indicates that they are succeeding.

6.4.10 Conclusion

It is clear that in terms of effectiveness and also in terms of efficiency, high non-completion rates have a negative impact on the efficiency of the programme. This is a problem that is being tackled on a national and a targeted level and considerable progress has been made. Government policy needs to continue to address this issue. There is evidence to suggest that in the context of ICT and engineering courses, the largest dropout rate comes after the first year of the undergraduate degree and that this where institutions should target resources. The Circa Group Report also indicated that non-completion, particularly drop-out in first year, was frequently due to "a lack of understanding on the part of students of the courses chosen by them, together with a lack of preparation for student life in a third-level college"[30] The report also identifies poor attendance due to part-time employment, financial difficulties and personal problems as factors in non-completion. In relation to the first of these factors, there is a clear role for guidance counsellors in school to ensure that adequate information about course content and broader information on modern student life in higher education institutions is available to second level students as they make critical choices about third level.

6.4.11 Recommendation

10. Appropriate intervention is required at institutional level to address difficulties experienced by first year students. A number of institutions already provide mentoring programmes and these have been shown to be very successful in tackling negative experiences by new students who may find it difficult to settle in and cope with increased workload which places different demands to those experienced at second level.

[30] *Completion Rates for students taking full-time programmes of study in Institutes of Technology – A study carried out for the Council of Directors of Institutes of Technology and the Dublin Institute of Technology*, The Circa Group, Europe, May 2006, Section 6.9

6.5 Efficient Delivery of Programme - Courses

The second strand of the evaluation of the programme's efficiency related to the approved courses, the following questions were asked.

- How were the courses selected and approved?
- Were they the appropriate courses to serve the objectives?
- Are the courses monitored to ensure they are still relevant in today's climate in order to ensure efficient delivery of the programme?

6.5.1 Course Selection and Approval

University Sector

With regard to the Universities, the HEA advises the DES on courses for inclusion in the programme. For the places following the Interim Skills Group Report and the First Report of the Expert Group on Future Skills Needs, the HEA involved external experts in the assessment of proposals received from institutions.

Institute of Technology Sector

With regard to the Institute of Technology sector, courses were selected on the basis of proposals submitted to the Expert Group on Future Skills Needs (EGFSN).

New initiatives such as the Accelerated Technician Programme (ATP) and the Institute Trainee Programme (ITP) were developed as a result of the joint education/industry Task Force.

6.5.2 Relevance of Courses

A full list of courses approved under the undergraduate skills programme is attached in Appendix 3.

The McIver Consulting Report notes that in 1996, ICT representative organisations and major companies highlighted an impending shortage of technology staff to the Irish Government, triggering the establishment of a succession of advisory groups, which recommended substantial increases in the intake into relevant higher education courses, as well as a range of other programmes to increase the supply of suitable labour.

The main higher education interventions recommended involved the following:

- Increasing the numbers undertaking engineering and computing technician courses, both through conventional courses, and through the new Accelerated Technician Programme and Institute Trainee Programme;
- Increasing the numbers undertaking computing and software engineering degree programmes;
- Increasing the numbers taking degree programmes in electronic engineering**;** and
- Increasing numbers taking Graduate Diploma (and some Master's degree) conversion courses in computing and software engineering.

Plans to increase the output of graduates with technician level qualifications, and with computing/software engineering qualifications were generally successful, resulting in substantial increases in student intake over the period from 1996 to 2000, and ultimately in graduate numbers.

Plans to increase the output of graduates with degrees in electronic engineering had only a modest impact on intake and on graduate numbers; although the creation of two-year add-on degree programmes in electronic engineering in a number of Institutes of Technology had the effect of converting to degree level graduates some of those who had entered technician level courses.

As can be seen from the list of courses attached, the intervention by the programme did result in an increase in the number of places available on the type of courses that had been specifically recommended.

6.5.3 Conclusion

Those courses that were selected and approved under Lindsay, Horn and the ATP and ITP programmes were the appropriate courses to fill the skills gap that had been identified by the EGFSN and the joint education/industry Taskforce. Ireland's success in attracting inward investment and the growth of its indigenous industry were linked to the supply of suitably qualified graduates, as has been shown in the previous chapters. This could not have occurred if courses had been selected and approved in an inefficient way.

6.5.4 Continuing Relevance and Monitoring of Courses

Finally, in relation to courses, the question must be asked as to whether there is continuing monitoring of the courses and also whether there is a need to re-evaluate the courses that are currently being funded in light of the changing needs of industry.

6.5.5 Programmatic Review

The continuing relevance of the courses that are being funded is ensured in two ways. In the University sector, the funding allocation mechanism bases the amount of funding on the number of places filled. Laws of supply and demand thus dictate the amount of funding received and ensure that courses which do not maintain adequate demand for places are dropped from the programme.

Secondly there is a systematic Programme Review in both the University sector and in the Institute of Technology Sector which ensures that courses are kept up to date and relevant.

University Sector

The Universities undertake programmatic reviews at departmental level on average every three years covering all courses and other activities including research. Industry representatives are often included in these reviews.

A EUA (European Universities Association) Review on Quality Assurance in Irish Universities in February 2005 confirmed that the Universities had an unparalleled approach to quality assurance with a quality promotion committee at each university, which in most cases is a subcommittee of Governing Authority or Academic Council which is charged with ensuring overall university policy in this field. The daily work is coordinated by a dedicated quality promotion unit in each university, usually led by a senior academic with one or two assistants, reporting directly either to the Registrar or, in some cases, to the President. Strong internal and external quality review processes are in place in each University.

Institutes of Technology Sector

Within the Technological Sector programmes are accredited for a maximum period of five years, after which they must undergo evaluation in accordance with procedures agreed with the Higher Education and Training Awards Council. All evaluations must involve persons who are competent in making national and international comparisons, learners, industry representatives and other stakeholders related to the programme in accordance with Section 28 of the Qualifications (Education and Training Act 1999)). The Higher Education and Training Awards Council then considers findings arising out of these evaluations and makes recommendations that the Institutes must implement. HETAC also reports results of reviews to the National Qualifications Authority.

On an annual basis, as part of their internal quality assurance process, Institutes of Technology, through their course boards and Academic Councils, review the recruitment and performance of students on various programmes and taking into account comments and suggestions of external examiners implement changes where necessary, to reflect new developments in disciplines, improvements in teaching and learning and the continuing relevance to the workplace.

Under Section 13 – 'Programmes and Budget' – of the Regional Technical Colleges Act, 1992 and Section 14 – 'Programmes and Budget' – of the Dublin Institute of Technology Act, 1992 all programmes offered by Institutes of Technology must have prior approval by the Minister for Education and Science.

6.5.6 Diversity of Courses

McIver Consultants, during their interviews with clients, got feedback from the industry regarding course content and design. This is relevant here in the context of future efficient delivery of the undergraduate skills programme. An examination of the appropriateness of the type and length of courses (i.e. degrees) being funded will follow in the next chapter.

Looking to the longer term, the industry response to McIver Consultants' research indicates that there is a need for a greater diversity of course provision at degree level, with mores cross-disciplinary courses combining, for example:

- Business with computing (business information systems);

- Biological sciences with computing (bioinformatics); and
- Electronic engineering design with software engineering.

6.5.7 Course Design

Issues relating to degree level course design that interviewees tended to highlight include the following:

– "Co-op"/work placement or intern programmes, which are part of most computing and electronic engineering degree programmes, are seen as being highly valuable in preparing students to operate in a working environment. Many interviewees were of the view that they should form a part of all degree level ICT programmes. While the primary reasons for providing placements are to do with maintaining close relationships with the education system, some interviewees indicated that students "on co-op" make a significant contribution to their companies.

– Interpersonal/teamworking/communications skills of graduates have generally improved, but the need for strong skills in this area is also increasing, and there is room for further improvement on many courses.

– Some interviewees suggest that there is a need for an increased focus on project management skills

– Interviewees suggest that some courses need more practical project work, so as to ensure that graduates have useful skills as well as a good education when they enter the labour market.

6.5.8 Conclusion

There are substantial review systems in place in both sectors to ensure the ongoing relevance of the courses funded under the ICT Undergraduate Skills Programme. This is a major plank in the ongoing efficient delivery of the programme. While supply and demand will ensure approved courses maintain relevance, McIver research shows that diversity of course provision and design may need to be kept under review in the context of the approval of any new courses under the programme.

6.5.9 Recommendations

11. The HEA should strongly encourage Higher Education Institutions to develop an ongoing review process on course provision and design in the area of ICT Skills, which would include close consultation with industry leaders and take into consideration McIver Consulting's research findings.

Chapter Seven

Programme Objectives – Impact and other Approaches

7.1 Introduction

The previous chapters have examined effectiveness and efficiency questions in relation to the ICT undergraduate skills programme. While there is much evidence that points to the effectiveness of the intervention, the picture emerging from this review is not overwhelmingly positive. The objectives remain relevant, however, and this chapter will show the impact that the programme has had on the broad economic development of Ireland's economy. In this chapter, it is hoped to pinpoint issues that have emerged from the review and their implications for future planning and to examine whether alternative or additional approaches are necessary (sixth term of reference).

7.2 Key Questions

- Was the ICT Undergraduate Skills Programme cost-effective in broad economic terms, i.e. did the programme and its impact on the ICT sector have a major impact on the socio-economic situation?
- How far does the impact contribute to the justification for current and ongoing public funding?
- What issues have emerged from the review and how will this impact on future planning for the programme?
- Are alternative approaches necessary to ensure future fulfilment of the programme objectives?

7.3 Economic Impact of ICT Undergraduate Skills Programme

The Steering Committee, having established the sixth term of reference for the review as "to evaluate the degree to which the objectives warrant the allocation of public funding on a current and ongoing basis and examine the scope for alternative approaches to achieving these objectives on a more efficient and effective basis", decided to incorporate this question into the terms of reference for the research to be carried out by McIver Consulting. McIver's research also gives a detailed analysis and response in their report (see Appendix 5) in answer to the fourth question posed by their terms of reference, i.e.

- What has been the overall economic impact for Ireland of the ICT Skills Programme?

This chapter will summarise their key findings.

7.3.1 McIver Consultings' Research

McIver Consulting's research shows that the ICT sector impacts on the Irish economy, not just directly through the value of what it produces, but also through the money it pumps into the wider economy through salaries and purchasing of goods and services domestically. ABS data on Irish economy expenditure of ICT

sector (***Section 7.3.1 McIver Report***) shows that ICT Irish economy expenditure rose from 21% of Irish economy expenditure of all manufacturing and internationally traded services sectors in 1995, peaked at 34% in 2000 and dropped again to 28% in 2003 (still a significant increase on the 1995 figure). The period of rapid growth in the ICT sector and its Irish economy expenditure coincided with the Celtic Tiger years of real GDP and GNP growth rates in excess of 7% per annum. McIver conclude that ICT sector growth was the leading short to medium term accelerator of economic growth over the latter half of the 1990s.

McIver's report further argues that although a significant volume of ICT investment has been lost since 2000, *"a substantial proportion of these losses is attributable to the closure or downsizing of relatively low value-added activities that were present in Ireland prior to the establishment of the undergraduate ICT Skills initiatives."* Their interviews in the ICT sector shows that in the overseas ICT operations that were established in the late 1990's or who received substantial reinvestment at that time, significantly changed their level of operation, sending lower value added operations overseas and adding higher value added activities in Ireland."[31]

7.3.2 Conclusion

While it is not possible to quantify with certainty what contribution the ICT Undergraduate Skills Programme made to the growth of the Irish economy, it seems clear that growth would have been significantly less without it. The electronic hardware sector and the foreign-owned part of the software sector relied heavily on expectations as to the future supply of graduates in relevant disciplines, that were based on the ICT Undergraduate Skills Programme, when making inward investment decisions from 1996 to 2001, and the hardware sector relied on the programmes to produce a viable domestic supply of technicians over the high growth period between 1998 and 2000.

Furthermore McIver's research demonstrates that without the ICT Undergraduate Skills Programme, it is likely that the retention performance of the sector would have been significantly poorer. With less inward investment in the late 1990's, the resilience of the sector would also have suffered. In conclusion,

- The longer established, lower value added, operations that actually closed would have closed anyway.
- The high value added operations that have survived would, in many cases, not have existed, either because the inward investment had never occurred, or because the original operations from which they developed were constrained from moving to higher value added activities by shortages (or anticipated shortages) of high skilled staff.
- Industry would have had more difficulty in sourcing people with higher degrees. The number of people graduating with higher degrees in computing and electronic engineering has risen in recent years, driven by several factors, which include the increase in primary degree graduate numbers, increases in funding for postgraduate research and the reduced opportunities in industry for primary degree graduates since 2001.

Without the developments facilitated in the electronic hardware sector by the ICT Undergraduate Skills Programme, there is every possibility that this sector would

[31] McIvers Report, Appendix 2, Chapter Four

now be no more than a rump, rather than a still-strong industry. The overseas-owned software sector would have been more resilient than the hardware sector, but would have entered the downturn weaker, and almost certainly have suffered more through the downturn as a result.[32]

7.3.3 Impact on Business Expenditure on R&D (BERD)

McIver conclude that increasing Business Expenditure on R&D is one of the Government's major economic development policy objectives. The ICT sector is the leading business sector involved in R&D, accounting for 65% of all business R&D spending in 2001. It is also one of the main sectors with potential for R&D growth. Growth in R&D in the sector would likely have been substantially less without the undergraduate skills programmes, which contributed to boosting industry scale, and to improving the supply of people with relevant higher degree qualifications[33]

7.3.4 Taxation

IDA Ireland indicated in an interview with McIver that it estimates its ICT clients pay approximately €500m per annum in corporation tax. This is in addition to the boost in tax take that occurred through increasing activity in the sector.

7.3.5 Productivity Growth

The sector made a major contribution to national productivity growth through the latter half of the 1990s. Productivity improvement in ICT manufacturing (i.e. electronic hardware) alone added 0.9% per annum to national labour productivity growth between 1995 and 2001. Capital deepening through ICT investment in the broader economy also had a positive impact on productivity growth. Both sources of productivity growth were underpinned by the skills programmes. The flow of graduates in ICT disciplines into the wider economy that has occurred since the start of the downturn, has the potential to underpin faster productivity growth.

7.3.6 Drawdown of EU Funding - Undergraduate Skills Programme

European Union funding has contributed enormously to the transformation of our third level campuses. The development of our technological sector has been significantly assisted by investment from both the European Regional Development Fund and, more particularly, from the European Social Fund. It is widely acknowledged that the Universities and Institutes have been at the forefront of the success of transforming Ireland into a high-skill, knowledge-based economy. Without this investment, there is no doubt that the unprecedented levels of economic growth in the past decade in Ireland would not have been achieved.

In particular, the objective of EU aid in the education sector has been to maximise the potential of Ireland's most significant resource, its people

The Undergraduate Skills Programme is funded under the National Development Plan and part funded by the European Commission under the Community Support

[32] McIvers Report, Appendix 2, Section 4.4
[33] McIvers Report, Appendix 2, Section 7.6

Framework 2000-2006. Funding is being drawn down from the European Commission under the European Social Fund (ESF).

Under the 2000-2006 round of funding, the Undergraduate Skills programme funds the provision of third-level places to meet the identified skills needs of the high-technology sector, with particular emphasis on Information and Communication Technologies (ICT's). The programmes included in this programme are those recommended by the Expert Group on Future Skills Needs (EGFSN) and the joint education/industry Task Force on the Supply of Technicians. The Undergraduate Skills Programme funded under the NDP/CSF 2000-2006 also makes provision for some non-ICT undergraduate courses also approved by the Expert Group on Future Skills Needs.

The intended beneficiaries of the ICT Undergraduate Skills Programme are school leavers, mature students and industry operatives requiring education/training to acquire sustainable employment or to improve their sustainable employment prospects.

Under the current round (2000-2006) the country is divided into two regions – the Border, Midlands & West Region (BMW) and the South & East Region (S&E). An aid rate of 75% applies to the BMW region with a 50% aid rate applying to the S&E region. Such aid only applies to costs related to the **additional** students on specific courses (as identified by the Expert Group on Future Skills Needs and the joint education/industry Task Force on the Supply of Technicians) and to costs deemed eligible under EU rules, regulations and procedures.

ICT Undergraduate Courses

Claims for ESF aid amounting to approximately €63m in respect of **ICT undergraduate courses** have been forwarded to the European Commission under this programme. These claims refer to activity in the years 2000, 2001, 2002, 2003 and part of 2004.

7.3.7 Claims processed for ICT Undergraduate Courses

The following tables show total claims processed to date under ESF in respect of ICT undergraduate courses:

Table 7.1 – Total Claims processed to date under ESF in respect of ICT Undergraduate Courses under Lindsay
All figures in €'000

Sector	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004***
IoT's				3,153	3,802	4,077	3,945	2,622
Universities				4,417	4,364	4,515	4,636	2,593
Total				7,570	8,166	8,592	8,581	5,215

**ESF claims have been processed up to Aug 2004 for the IOT's and up to Sept 2004 for Universities*

Table 7.2 – Total Claims processed to date under ESF in respect of ICT Undergraduate Courses under Horn
All figures in €'000

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Sector	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004***
IoT's				1,173	1,813	1,920	1,349	710
Universities				620	1,550	1,590	1,364	1,045
Total				1,793	3,363	3,510	2,713	1,755

** ESF claims have been processed up to Aug 2004 for the IoT's and up to Sept 2004 for Universities.*

Table 7.3 – Total Claims processed to date under ESF in respect of ICT Undergraduate Courses under ATP
All figures in €'000

Sector	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004***
IoT's				2,792	3,069	2,710	1,388	1,184

** ESF claims for ATP courses have been processed up to Aug 2004.*

Table 7.4 – Total Claims processed to date under ESF in respect of ICT Undergraduate Courses under ITP
All figures in €'000

Sector	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004***
IoT's					120	298	147	67

** ESF claims for ITP courses have been processed up to Aug 2004.*

7.3.8 Conclusion

It is clear from McIver Consulting's research that the ICT Undergraduate skills programme had a significant effect on the growth of the ICT sector, which in turn had a massive impact on the economic expansion in Ireland. Although the degree to which this is the case is arguable and difficult to quantify, there is evidence of direct causality between the intervention of the programme and the so-called "Celtic Tiger" boom. McIvers research also provides good evidence that the initiatives contributed to the retention of inward investment in Ireland during the downturn, with lower value added operations being replaced by higher value added operations. These effects are significant enough to provide justification for the current and ongoing funding being provided from public monies, particularly noting the continued relevance of the programme objectives and current national prioritisation of the development of a knowledge economy (see also chapter four).

The European Union, through its Structural Funds, has contributed to the development of education in Ireland and in doing this, to our current economic success.

7.4 Major Issues Arising

The major issue that emerged from this review was the impact that the worldwide recession in the ICT sector had on the delivery of the programme and achievement of the programme objectives. This downturn was unforeseen by both industry and government and was unprecedented in its impact on employment both in national and in global terms. The review has explored the impact of the downturn on the achievement of the programme objectives (***section 4.3 – Improvement in Supply***) and how the existence of the programme affected the impact that the downturn had on the Irish economy (***section 5.3 – The Downturn***). What remains is to evaluate the implications for future planning of the programme.

Two strands emerge from an examination of this aspect of the changing environment during the course of the programme. The first of these is the inevitable gap in graduate supply that has resulted from the decrease in enrolments that began in 2000/01 and the best way to ensure continued provision of skilled workers in the short to medium term to overcome this. The second is to assess whether the downturn will recur and if so, how severe is it likely to be.

7.4.1 Gap in Graduate Supply

The worldwide recession in the ICT sector and its main impact on the achievement of the programme objectives can be summarised in the following way:

- the decrease in intake of students onto the approved courses began to show a detrimental effect on graduate supply from 2002/03 in the IoT sector and from 2004/05 in the University sector. Although the steady decrease in enrolment appears to have bottomed out, there will be a gap in graduate supply until at least 2009/10, pre-supposing an upturn in undergraduate enrolments in the near future.

This deficiency will need to be addressed firstly by increasing uptake, and this issue has been comprehensively addressed in Chapter 5 (***see Section 5.5 - Recommendations***) and also by the provision of shorter programmes and conversion programmes, which will allow a supply to bridge the gap that will become steadily more apparent in the next few years. This mismatch between demand and supply is relevant particularly with regard to honours degree graduates in computing and electronic engineering.

7.4.2 Alternative Approaches to Degree Graduate Supply

McIver Consulting, the Department of Education and Science and the HEA have made a number of recommendations to address this deficiency. These are as follows.

7.4.3 Recommendations

12. *In computing, graduate diploma conversion courses are well established as a means of producing additional graduates who can substitute for computing degree graduates in some, but not all, positions. It will be important that institutions continue to be supported in adding places on these courses as demand rises.*

13. *Institutions should consider providing more specialised graduate diploma courses that may offer less breadth, but develop a significant level of skill in a specific area.*

14. *There will be a need to consider other innovative ways of responding to demand quickly. These could include:*

    - *Add-on ordinary bachelors and honours bachelors degrees in business information systems (half business, half computing) for business students;*
    - *New third year and final year options in electronics design for engineering students from a range of disciplines and for computing students; and*
    - *Graduate Diplomas and taught Masters degrees in electronics design for engineering graduates from a range of disciplines, computing graduates and graduates in physics.*

15. *There will also be a role to play to assist those currently in employment to up-skill. Possible courses along the lines of the ITP programme should again be looked at to address the gap in the short to medium term.*

16. *In line with the recommendations of the Enterprise Strategy Group Report of July 2004[34], part-time courses and modules should be available to provide ICT skills to those in employment especially the low-skilled. Funding for this activity in 3rd level institutions should be available from the National Training Fund.*

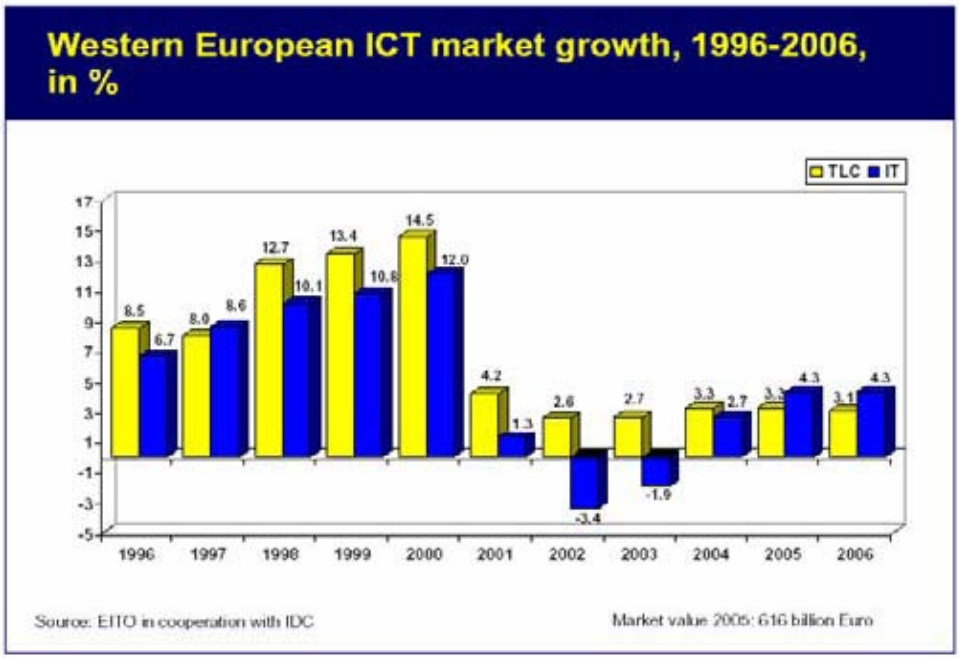
7.4.4 Future Planning for the Programme

Because of the unforeseen nature of the worldwide recession experienced in the ICT sector there are obvious concerns that such deterioration in the socio-economic situation may recur in the future. This has clear implications for the ICT Undergraduate Skills Programme.

Although the ICT sector is cyclical in nature, and there will inevitably be periods where demand peaks and falls, it is considered unlikely that a recession in the sector on the scale of that experienced between 2000 and 2005 will recur. The recession was a result of an unusual confluence of circumstances that resulted in a "bubble", which created overly high expectations both within the industry and in government circles. The downturn was a severe reality check and valuable lessons have been learned. This is expressed in an article by G Rohde of Union Network International who notes that "The EITO [European Information Technology Observatory] analysts are predicting a more marked cyclical development. The industry as a whole will in future continue to grow, but we will have to become used to the fact that in some segments there is also a downturn"[35] The table below shows the period of excessively high market growth in Western Europe during the late nineties that then led to the crash in the IT sector in 2002 and 2003. This table illustrates the more gentle upward curve experienced during 2004/2005 and projected into 2006.

[34] "Ahead of the Curve, Ireland's Place in the Global Economy", Enterprise Strategy Group, July 2004
[35] "Employment Trends in the ICT Sector" G Rohde, UNI, 2002 http://www.union-network.org

Fig. 7.1 – Western European ICT Market Growth 1996-2006 in %



7.4.5 Alternative Approaches

The Steering Committee discussed whether alternative approaches to provision of the programme were necessary or advisable. The most obvious alternative approach that emerged from this discussion was the possibility of provision of the courses through the private sector, i.e. through the increasing numbers of private colleges that have emerged on the education scene. There are two main arguments against this approach. They are the following

- Firstly, the free fees scheme currently in place, which allows for free tuition for all first-time undergraduates, is operating under departmental policy which restricts eligibility to courses provided by approved existing higher education institutions.
- Secondly, significant capital investment has been provided for this programme (***see Chapter 6***) and a capital infrastructure is in place for programme provision.

7.4.6 Conclusions

The arguments emerging from the issue of alternative approaches led to the conclusion that although further consideration could be given by the Department of Education and Science and the HEA to the possibility of private college provision if a response to the skills shortage becomes extremely urgent, at the moment it makes more sense to continue provision through the Universities and Institutes of Technology, and an increasing focus on the role of the Institutes of Technology in this area may be appropriate in the context of strategic planning for the higher education system as a whole.

In the context of a future downturn, that there will be peaks and troughs in demand for graduates is inevitable, but it is also true that the world economy is becoming increasingly reliant on technology and it is hard to envisage a future where there will be any significant decrease in this dependence. This review has shown that graduates continue to be needed in the areas covered by the programme, and even in the context of the recession, employment prospects for these graduates remained consistent although they were diversified throughout other sectors of the economy.

Although conversion courses and shorter diploma courses have a role to play, particularly in the context of improving our capacity to respond quickly when demand for skills begins its upward trend towards another peak, that does not detract from the need to maintain a continuous supply of high quality graduates. Undergraduate courses, although three or four years in length produce just the kind of quality graduates that attracted inward investment and encouraged growth in the first place.

Because the cyclical nature of employment within the ICT industry has been shown to have a considerable impact on student numbers during the downturn period, the Higher Education Authority, who will soon have both the Universities and the Institutes of Technology under their remit, will need to maintain a flexible brief in relation to the direction of funding and strategy for this programme. This will allow more funding to be directed towards post-graduate conversion courses and shorter courses when appropriate. This will be necessary to bridge the gap that has been engendered by falling numbers throughout the downturn, and will also accommodate the reskilling or upskilling for those graduates who were unable to find suitable employment during that period, as the job market strengthens.

As it is likely that the ICT industry will continue to experience upsurges and downturns in terms of employment needs, it is likely that student numbers will also fluctuate. When student numbers fall, the fixed costs of provision of the programme remain constant. This is primarily due to staffing arrangements in the sector. More flexibility is required in this aspect of delivery of the programme and should be further considered.

Chapter Six also shows that many of the job losses experienced during the downturn resulted from industry shedding its lower end manufacturing capacity or exporting it elsewhere. Ireland has been left with a more streamlined industry that is moving higher up the scale in its operations and output. This upward movement is critical to the future success of Ireland. The need for massive investment in research & development and innovation has been addressed in other reports, most notably in the report of the Enterprise Strategy Group[36], the draft Examiners' Report for the OECD Review of Higher Education in Ireland and will also be a focus of the forthcoming National Research Plan. A supply of graduates to feed the resulting demand for postgraduate students remains a priority in this context.

While recognising the critical importance of addressing the above deficiencies in provision, this review cannot lose sight of the clear justification that has emerged for the maintenance of this programme. Although there may be opportunities to re-address some of the issues raised, particularly with regard to an expansion of the

[36] "Ahead of the Curve" Report of the Enterprise Strategy Group to the Department of Enterprise Trade and Employment, 2004

programme to allow greater flexibility to the institutions to respond appropriately to those issues, it is clear that the objectives of the programme are still valid.

7.4.7 Recommendations

17. The delivery of the programme should remain under constant review by the Higher Education Authority with reference to the Expert Group on Future Skills Needs. This will ensure strategic targeting of funding towards particular courses, whether undergraduate or otherwise, that will help bridge the skills gaps caused by inevitable upsurges and downturns in the ICT industry in relation to employment demand.

18. Further consideration should be given by Higher Education Institutions to staffing arrangements on ICT courses in the third level sector to allow the development of more flexible delivery models.

Chapter Eight

Overall Conclusion and Recommendations

This report broadly concludes that the Department of Education and Science and the education sector's pro-activity and responsiveness to industry needs in the ICT sector met the ICT Programme's initial objective of creating the educational capacity required to ensure a steady supply of skilled graduates into the economy. Despite this success, the global downturn in the ICT industry and a realisation of the cyclical nature of the industry has created a climate of insecurity amongst potential students and this has had a seriously detrimental impact on enrolments on the courses funded under the ICT Undergraduate Skills programme.

Recommendations in this report recognise that the Department of Education and Science, the HEA and the Higher Education Institutes have an important role to play in the provision of future graduates in this area. The Department is implementing policies that will facilitate more flexible delivery and responsiveness to changing needs in the ICT sector and will continue to prioritise this area. However, the report recognises that the ICT industry must play a lead role in promoting the benefits of careers in their sector if demand for places is to recover and grow. The industry's commitment to providing work placements must also be maintained and developed.

A joint approach between Government, the education sector and industry should ensure that Ireland's reputation as a rich source of skilled graduates is consolidated and developed. This will allow a strong knowledge economy to flourish which will underpin Ireland's future economic success.

The recommendations are not prioritised but instead follow through from conclusions arising from the analysis throughout the chapters of the report.

1. *The ICT Undergraduate skills programme should continue to be a priority for the Department of Education and Science.(**Section 5.5**)*

2. *In addition to the continuation of the programmes to ensure future supply, the Department of Education and Science and the Higher Education Institutions must make recruitment into these courses a high priority. **(Section 5.5**)*

3. *The HEA need to support the Higher Education Institutions in retaining key resources while they campaign to increase enrolments. Pending an upturn in undergraduate enrolments, support should be provided for part-time and post - graduate programmes in ICT under the Information Technology Investment Fund. Specific action should be focused on the numbers of females enrolling on ICT courses. Initiatives such as interdisciplinary programmes between technology and other degree courses that attract a higher proportion of female students should be examined. The use of e-Learning in courses should be promoted to foster wider participation in full time and part time courses. (**Section 5.5**)*

4. *Industry needs to become pro-active in promoting careers in ICT. Programmes such as the ICT Ireland Champions programme and the Internship need to be strengthened.*[37] ***(Section 5.5)***

5. *Commitments made by industry to work placements etc. need to be maintained even through a variable economic climate.* ***(Section 5.5)***

6. *The Department of Education and Science and the HEA should look carefully at the possibility of using funding formulae to reward higher education institutions that are successful in recruiting students to study in ICT disciplines, and are successful in ultimately graduating them. (**Section 5.5)***

7. *Institutions should be strongly encouraged to meet the recognised increasing need for people with postgraduate technology degrees, both research degrees and taught degrees. (**Section 5.5)***

8. *There is a need for a continued focus on development of areas at school level such as guidance counselling, promotion of careers in ICT industry, exploitation of ICTs in the classroom, and take-up of the physical sciences. (**Section 5.5)***

9. *The Higher Education Authority should carry out a standard cost analysis exercise on the provision of the ICT Undergraduate Skills Programme to enable a policy decision to be taken regarding future provision of the programme. Based on the results of such a standard cost analysis exercise between the two sectors, further consideration should then be given to concentrating/prioritising the programme in the sector which proves to be the most cost beneficial and advantageous with regards to completion rates and widening participation. (**Section 6.4.4)***

10. *Appropriate intervention is required at institutional level to address difficulties experienced by first year students. A number of institutions already provide mentoring programmes and these have been shown to be very successful in tackling negative experiences by new students who may find it difficult to settle in and cope with increased workload and different demands to those experienced at second level.* ***(Section 6.4.11)***

11. *The HEA should strongly encourage Higher Education Institutions to develop an ongoing review process on course provision and design in the area of ICT Skills, which would include close consultation with industry leaders and take into consideration McIver Consulting's research findings. (**Section 6.5.9**)*

12. *In computing, graduate diploma conversion courses are well established as a means of producing additional graduates who can substitute for computing degree graduates in some, but not all, positions. It will be important that institutions continue to be supported in adding places on these courses as demand rises. (**Section 7.4.3**)*

13. *Institutions should consider providing more specialised graduate diploma courses that offer less breadth, but develop a significant level of skill in a specific area. (**Section 7.4.3**)*

14. *There will be a need to consider other innovative ways of responding to demand quickly. These could include:*

[37] The Champions programme provides recent graduates from industry as speakers for school recruitment. The Internship programme provides paid work experience in ICT industry two days a week to 3rd and 4th year undergraduates

- *Add-on ordinary bachelors and honours bachelors degrees in business information systems (half business, half computing) for business students;*
- *New third year and final year options in electronics design for engineering students from a range of disciplines and for computing students; and*
- *Graduate Diplomas and taught Masters degrees in electronics design for engineering graduates from a range of disciplines, computing graduates and graduates in physics. (**Section 7.4.3)***

15. *There will also be a role to play in assisting those currently in employment to up-skill. Possible courses along the lines of the ITP programme should again be looked at to address the gap in the short to medium term. (**Section 7.4.3**)*

16. *In line with the recommendations of the Enterprise Strategy Group Report of July 2004[38], part-time courses and modules should be available to provide ICT skills to those in employment especially the low-skilled. Funding for this activity in 3rd level institutions should be available from the National Training Fund. (**Section 7.4.3**)*

17. *The delivery of the programme should remain under constant review by the Higher Education Authority with reference to the Expert Group on Future Skills Needs. This will ensure strategic targeting of funding towards particular courses, whether undergraduate or otherwise, that will help bridge the skills gaps caused by inevitable upsurges and downturns in the ICT industry in relation to employment demand. **(Section 7.4.7)***

18. *Further consideration should be given to staffing arrangements on ICT courses in the higher education sector to allow the development of more flexible delivery models for the programme. **(Section 7.4.7)***

[38] "Ahead of the Curve, Ireland's Place in the Global Economy", Enterprise Strategy Group, July 2004

Appendices

Appendix 1

Abbreviations

ATP	Accelerated Technician Programme
CSC	Central Steering Committee
CSF	Community Support Framework
DIT	Dublin Institute of Technology
EGFSN	Expert Group on Future Skills Needs
ERDF	European Regional Development Fund
ERI	Expenditure Review Initiative
ESF	European Social Fund
EU	European Union
FDR	First Destination Report
HEA	Higher Education Authority
ICT	Information and Communication Technologies
IOT	Institute of Technology
IT	Information Technology
ITP	Institute Trainee Programme
NDP	National Development Plan
OECD	Organisation for Economic Co-operation and Development
PRTLI	Programme for Research in Third Level Institutions
R & D	Research and Development
RTC	Regional Technical College
SFI	Science Foundation Ireland

Appendix 2

List of companies/organisation/individuals interviewed by McIver Consulting as part of market research:

Type of Organisation	**Name**		**Type of Organisation**	**Name**
Indigenous Software Companies	Iona Technologies – Dr. Chris Horn		Integrated Circuit Development	Analog Devices, Limerick Xilinx
Overseas-owned Software Companies	Microsoft Ericsson Pramerica, Letterkenny Overture/Yahoo		Industry Organisations	ICT Ireland Irish Software Association
IT Services Companies	Accenture		Relevant State Agencies	Enterprise Ireland IDA Ireland Higher Education Authority
Overseas-owned Electronics Hardware Companies	Intel Dell, Limerick IBM Hewlett Packard		Others	Dr. Sean McDonagh Bernie Cullinan Peter McManamon

The Department appreciates the co-operation given to McIver Consultants by the above named as this market research would not have been possible without the contribution of their valued knowledge.

Appendix 3

Courses funded under ICT Undergraduate Skills Programme

University Sector Courses

Skills One

University College Dublin
B. Sc. (taking Computer Science)
B.Sc. Computer Science (Denominated)
B. A. Computer Science

University College, Cork
B.SC Computer Science
B.Sc. Business Information Systems
B.E. Electronic Engineering

National University of Ireland, Galway
B.Sc. Information Technology
B.E. Electronic & Computing
B.Sc. Computing Studies

National University of Ireland, Maynooth
B.Sc Degree (Additional 2nd yr intake)
B.Sc. Computer Science /Software Eng.

Trinity College Dublin
B.A. Mod Inform.& Comm.Technology
B.Sc. Computational Physics/Chemistry
BA Computer Science (Once Off)

University of Limerick
B.Sc. Computer Systems (Incl comp sys with French)
B.Tech. Information Technology
B.Eng Electronics
B. Eng. Computer Eng.

Dublin City University
B. Sc. Computer Applications

Skills 2

University College, Cork
BE Microelectronics

National University of Ireland, Galway
B.Eng.
B.Eng. (4 Year) - excluding civil, bio, el &com, IT, Env,
B.Sc. Applied Physics/Elec
B.Sc. Bus Info Systems

National University of Ireland, Maynooth
B.Sc. Engineering (Electronics)
B.Sc. Engineering (Communications)
B.Sc. Engineering (Computers)

Trinity College Dublin
B.Sc. Business &IT
B.Sc. Computer Sci (Evening)
B.Sc. Advanced Materials Science
B.Sc. Manufacturing Eng & Mgt

University of Limerick
B.Eng Mech Eng (including French)
B.Eng Mech Eng & a Language (German)
B.Eng Manufacturing Product Design
B.Eng. Computer Integrated Design
B.Eng Biomedical Engineering
B.Eng Manufacturing Engineering

Dublin City University
B. Eng Electronic Engineering
B. Eng Telecoms renamed BEng Information and Communications Engineering in 04
B. Eng Electronic Systems
BEng Information and Communications Engineering
Formerly B.Eng Telecommunications Engineering (above)
B. Eng Mechatronic
B. Eng CA Mech and Manuf Eng
B. Eng Medical Mecha Eng
B. Eng Manu Eng and Business
B. Eng Digital Media
B.Eng Mech & Manufacturing
B.Eng Common Entry

Institute of Technology Sector Courses

Athlone Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Institute Trainee Programme
NC Manufacturing Technology

Skills 1
NC Engineering (Electrical and Computers)
NC Computer Software Engineering (1 year post-cert conversion course)
ND Mechatronic Engineering (ab-initio)
ND Computing
Graduate Diploma in Computing
B.Sc Computer Software Engineering (ab-initio)

Skills 2
ND Computer Engineering (add-on)
B.Sc Computer & Software Engineering FT 4 Years
Graduate Diploma German & IT - FT 1 Year

Institute of Technology Blanchardstown

Accelerated Technician Programme
NC Computing (Information Technology Support)

Institute Trainee Programme
NC Engineering (Mechatronics)
NC Computing (Systems Support)

Institute of Technology Carlow

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Skills 1
NC Electronics & Computer Technology – Communications Systems
NC Electro-Mechanical Systems
ND Electronic Engineering Process Control & Instrumentation (ab-initio)

Cork Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Institute Trainee Programme
NC Manufacturing Technology

Skills 1
NC Electronic Engineering
NC Mechanical Engineering
B.Sc Computer Applications
B.Sc Networking & Software Development
B.Sc Software Development + Language

Skills 2
ND Engineering (Manufacturing Engineering) (Add-on)
ND Engineering (Semiconductor Technology) (ab-initio)
B.Sc Computerised Instrument Systems FT 4 Years
B.Sc Electronics & Manufacturing PT 2 Years Upskilling
B.Sc Manufacturing & Product Design PT Sandwich

Dublin Institute of Technology

Skills 1
Certificate Manutronics Automation

Certificate Industrial Electronic Systems
Diploma Manutronics Automation
Diploma Industrial Electronic Systems
B.Sc Computer Science
B.Sc (Eng) Computer Engineering (new specialism)
B.Sc (Eng) Computer Engineering (new course)

Skills 2
ND Engineering (Industrial Maintenance) (ab-initio)
ND Engineering (Microelectronics) (ab-initio)
B.Sc Manutronics Engineering FT 4 Years

Dundalk Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Institute Trainee Programme
NC Manufacturing Engineering

Skills 1
NC Manufacturing Engineering
NC Mechanical Engineering

Skills 2
B.Eng Product Design Systems FT 2 Years
B.Eng Product Design Engineering PT 4/5 Years
B.Sc Commercial Computing FT 1 Year Upskilling
B.Sc Commercial Computing PT 4/5 Years Upskilling

Galway-Mayo Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Institute Trainee Programme
NC Manufacturing Technology

Skills 1
ND Software Development
ND Electronic Engineering
B.Sc Business Computing
B. Engineering Digital & Software Systems

Skills 2
NC Engineering (Electronics)
ND Engineering (Electronics) (Add-on)
ND Computing (Software) (ab-initio)
B.Sc Software Development FT 4 Years

B.Tech Manufacturing Technology PT 2.5 Years Upskilling
B.Eng Digital & Software Engineering PT 1.5 Years Upskilling
Galway - B.Sc Information Technology PT 4 Years Distance Educ
Mayo - B.Sc Information Technology PT 4 Years Distance Educ

Letterkenny Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Skills 1
NC Electronic Engineering
NC Electronics and Computer Engineering
NC Mechanical Engineering
ND Mechanical Engineering
ND Computer Engineering
ND Electronic Engineering

Skills 2
ND Electronics & Computer Engineering (ab-initio)
ND Computing Maths (Add-on)

Limerick Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Skills 2
NC Business Computing
NC Applied Computing
B.Sc Information Technology PT 2 Years
Membership British Computer Society PT 4 Years

Institute of Technology Sligo

Accelerated Technician Programme
NC Computing (Information Technology Support)
NC Technology (Mouldmaking Technology)

Skills 2
NC Computing
NC Engineering (Automation)
ND Engineering (Embedded Electronics) (Add-on)
ND Engineering (Software Engineering) (Add-on)
B.Eng Product Design Engineering PT 3 Years Upskilling
B.Eng Product Design Engineering FT 2 Years

Institute of Technology Tallaght

Accelerated Technician Programme

NC Science (Good Manufacturing Practice and Technology)

Institute Trainee Programme
NC Engineering (Microelectronics)

Skills 1
NC Electronic Engineering
NC Mechanical Engineering
ND Electronic Engineering
ND Mechanical Engineering
B.Sc Computing

Skills 2
NC Computing
ND Computing (Add-on)
B.Sc Computing FT 1 Year

Institute of Technology Tralee

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)
NC Precision Engineering

Tipperary Rural and Business Development Institute

Accelerated Technician Programme
NC Computing (Information Technology Support)

Waterford Institute of Technology

Accelerated Technician Programme
NC Technology (Manufacturing Technology)
NC Computing (Information Technology Support)

Institute Trainee Programme
NC Science (Good Manufacturing Practice and Technology)

Skills 1
B.Tech in Electronic Engineering
B.Sc Applied Computing
B.Sc Commercial Software Development (1 year add-on)

Skills 2
NC Engineering (Mechanical Engineering) Sandwich 1.5 years
NC Engineering (Electronics) Sandwich 1.5 years
B.Sc Manufacturing Systems Engineering FT 4 Years
B.Sc Software Development PT 2 Years Upskilling
B.Tech Computer Aided Manufacturing PT 2 Years Upskilling

Appendix 4

Destination of ICT graduates into Employment by Sector

Table 1.1B1 Graduates in Employment Classified by Sector - Skills 1 and 2 (rounded to nearest point)						
	Ireland			Overseas		
Employment Sector	**2001 %**	**2002 %**	**2003 %**	**2001 %**	**2002 %**	**2003 %**
AGRICULTURE, FORESTRY AND FISHERIES						
Agriculture, Forestry and Fishing	0.4	0.6	0.7	0.0	0.0	2.7
Sub Total	***0.4***	***1.0***	***1.0***	***0.0***	***0.0***	***3.0***
MANUFACTURING INDUSTRIES						
Food and Drink Industries						
Food and Drink Industries	2.4	2.3	1.8	2.1	0.0	0.0
Chemical, Rubber and Plastic Products						
Pharmaceuticals, Perfumery, Toilet Preparations	1.1	2.0	4.6	0.0	1.0	2.6
Other Chemical Products	0.2	0.8	0.9	1.1	0.0	0.0
Chemical Products n.f.s.	0.2	0.2	0.0	0.0	2.0	0.0
Computer and Electronic Manufacturing						
Metals, Metal Products, Mechanical and Electrical Engineering	4.6	3.1	5.3	1.1	1.0	5.4
Computer and Electronic Office Equipment, Office Machinery, Instrument Eng	10.4	16.6	12.6	4.2	5.9	6.8
Computer Electronic Manufacturing n.f.s.	5.3	1.4	1.1	2.1	1.0	0.0
Other Industries (incl mining etc.)						
Other Industries (incl mining etc)	1.7	0.4	0.0	3.2	0.0	0.0
Manufacturing Industries n.f.s.						
Manufacturing Industries n.f.s.	0.6	1.6	2.4	2.1	1.0	1.4
Sub Total	***26.3***	***28.3***	***28.7***	***15.8***	***11.9***	***16.1***
ELECTRICITY, GAS AND WATER SUPPLY						
Electricity, Gas and Water Supply						
Electricity, Gas and Water Supply	2.2	0.6	2.2	0.0	1.0	1.4
Sub Total	***2.2***	***0.6***	***2.2***	***0.0***	***1.0***	***1.4***
BUILDING AND CONSTRUCTION						
Building and Construction						
Local Authority Building and Construction (incl. OPW)	0.0	0.0	0.6	0.0	0.0	1.4
Other (private) Building and Construction	0.7	2.2	0.9	2.1	1.0	0.0
Building and Construction n.f.s.						
Building and Construction n.f.s.	1.7	1.0	2.2	2.1	1.0	0.0
Sub Total	***2.4***	***3.1***	***3.7***	***4.2***	***2.0***	***1.4***
DISTRIBUTION						
Wholesale Distribution						
Wholesale Distribution	0.4	0.6	0.0	0.0	0.0	0.0
Retail Distribution						
Food etc	0.6	0.4	0.4	0.0	0.0	0.0
Other Retailing (excl bars etc)	2.0	2.9	2.4	0.0	1.0	0.0
Retail Distribution n.f.s.	0.4	1.4	0.9	1.1	1.0	0.0
Distribution n.f.s.						
Distribution n.f.s.	0.0	0.0	0.0	0.0	0.0	0.0

Sub Total	***3.3***	***5.3***	***3.7***	***1.1***	***2.0***	***0.0***
BUSINESS, FINANCE AND INSURANCE SERVICES						
Business, Finance and Insurance Services						
Banking, Finance and Insurance	8.2	8.8	7.9	20.0	23.8	21.6
Accountancy and Legal Services	2.4	1.8	2.4	0.0	0.0	5.4
Consultant Engineering and Architectural Services	1.5	2.2	2.0	2.1	0.0	2.7
Call Centres and Shared Services Facilities	0.9	1.0	0.6	0.0	0.0	0.0
Other Business Services (incl Mgmt and IT Consulting)	5.1	4.3	3.1	3.2	3.0	5.4
Business, Finance, Insurance Services n.f.s						
Business, Finance, Insurance Services n.f.s	0.9	0.8	1.6	1.1	2.0	0.0
Sub Total	***19.0***	***18.8***	***17.5***	***26.3***	***28.7***	***35.1***
COMPUTING AND SOFTWARE APPLICATIONS						
Computing and Software Applications						
Computing and Software Applications	18.5	15.4	17.2	23.2	12.9	20.3
Sub Total	***18.5***	***15.4***	***17.2***	***23.2***	***12.9***	***20.3***
TRANSPORT, STORAGE AND COMMUNICATIONS						
Transport, Storage and Communications						
Transport, Storage and Support Services	0.7	0.6	0.9	0.0	1.0	1.4
Telecommunications, Postal Services	5.9	5.1	8.6	4.2	5.9	1.4
Transport, Storage, Communications n.f.s						
Transport, Storage, Communications n.f.s	0.2	0.0	0.0	0.0	0.0	1.4
Sub Total	***6.8***	***5.7***	***9.5***	***4.2***	***6.9***	***4.1***
NON MARKET SERVICES						
Public Administration and Defence						
Defence Forces, Gardai	0.4	0.0	0.6	0.0	0.0	1.4
Civil Service, Local Authorities (other than Building and Construction)	2.4	2.6	1.3	0.0	0.0	1.4
Public Administration and Defence n.f.s.	0.0	0.0	0.0	0.0	0.0	0.0
Education						
Primary Education	0.0	0.4	0.2	0.0	0.0	0.0
Secondary Education	0.4	2.2	0.6	1.1	1.0	2.6
Third Level Education	2.2	2.3	1.3	1.1	3.0	0.0
Other Education (incl Language Schools)	0.4	0.0	0.6	10.5	5.9	5.3
Education n.f.s.	0.4	0.6	0.7	0.0	4.0	1.4
Health Services						
Health Services (both Health Board and Other)	3.7	1.0	1.1	0.0	0.0	0.0
Other Non Market Services						
Research, Planning, Art Galleries etc.	0.2	0.0	0.6	0.0	0.0	0.0
Social and Charitable Services	0.4	0.0	0.2	0.0	1.0	0.0
Non-Market Services n.f.s.	0.0	0.0	0.0	0.0	0.0	0.0
Sub Total	***10.2***	***9.1***	***6.9***	***12.6***	***14.9***	***12.0***
PROFESSIONAL SERVICES n.e.c.						
Professional Services n.e.c.						
Professional Services n.e.c.	3.1	2.4	0.8	1.1	3.0	0.0
Sub Total	***3.1***	***2.4***	***0.8***	***1.1***	***3.0***	***0.0***
PERSONAL AND RECREATIONAL SERVICES						
Personal and Recreational Services						
Hotels and Guesthouses, Bars, Restaurant	2.2	2.4	1.1	3.2	2.0	0.0
Other Personal Services (incl Recreational	0.6	0.4	1.1	1.1	3.0	0.0

Facilities)						
Personal and Recreation Services n.f.s.						
Personal and Recreation Services n.f.s.	0.2	0.4	0.0	1.1	0.0	0.0
Sub Total	***2.9***	***3.2***	***2.2***	***5.3***	***5.0***	***0.0***
OTHER INDUSTRIES OR INDUSTRY NOT STATED						
Other Industries or Industry not stated						
Other Industries or Industry not stated	4.9	7.1	6.8	6.3	11.9	6.8
Sub Total	***4.9***	***7.1***	***6.8***	***6.3***	***11.9***	***6.8***
Total	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***

Appendix 5

Research into the Impact of the Department of Education and Science's Undergraduate ICT Skills Programmes

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Report

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Presented to the

Department of Education & Science

by

McIver Consulting

16 June 2005

Section 1

Executive Summary

1.1 Introduction

This report is based on research undertaken by McIver Consulting on behalf of the Department of Education and Science into the industry and economic impact of the Government's undergraduate ICT skills initiatives. The first of these was announced in 1997. Together, they led to significant increases in numbers graduating in computing and, at technician level, in engineering. The technician level initiatives had quite a rapid impact on graduate supply, but the computing degree initiatives only started to produce significant numbers of additional graduates from around 2001.

All relevant ICT sectors grew rapidly in Ireland from before the time the first initiative was announced up to around 2000 or 2001. A major global ICT market downturn started in 2001, which impacted negatively on demand for skills. ICT markets only recovered sufficiently to drive significant renewed demand for people during 2004. The modest recovery that started in 2004 appears to have continued so far during 2005, and industry expectations are the recovery will continue.

1.2 Impact on Attraction and Retention of Overseas Industry

The first question posed by the terms of reference for the research is as follows:

"Have the Department's ICT Skills Initiatives resulted in attracting and retaining overseas industry into Ireland because of the availability of sufficient numbers of suitably qualified ICT graduates?"

The research finds that the initiatives have resulted in attracting and retaining overseas industry into Ireland. Major points supporting this are as follows.

- The skills initiatives gave inward investors confidence in the future availability of ICT professionals at a time of significant shortages internationally. This appears to have given a significant boost to inward investment over the period up to 2001.
- The skills initiatives boosted the supply of technicians around 1998-2000, when this was critically important in allowing major investments by electronic hardware companies to take place.
- The skills initiatives boosted retention of overseas industry by facilitating and encouraging upgrading of their operations, and by attracting new, more resilient investment. Even where an operation held its staff numbers constant, the level of skills, and the complexity and value of the work undertaken, went up over time in the companies consulted during the study. Many jobs requiring no higher education qualifications were replaced by jobs requiring technician level qualifications; many requiring technician level qualifications were replaced by those requiring degrees, and within degree level qualifications the emphasis on postgraduate degrees increased strongly. Basic manufacturing operations were superseded by more advanced operations and by other business functions, such as finance, marketing and sales.

1.3 Impact on Expansion and Growth

The second question posed by the terms of reference for the research is as follows:

> *"Has the ICT Industry in Ireland experienced expansion/growth due to the availability of suitably qualified graduates?"*

The research finds that the initiatives resulted in expansion and growth due to the availability of suitably qualified graduates, and due to the expectation of future availability, during the period up to 2001, and during the period of recovery in value added, which started from 2003, and the period of recovery in employment, which started during 2004.

ICT Ireland's Graduate Placement Programme, whose existence is partly a consequence of the skills initiatives, made a contribution to maintaining the flow of graduates into the sector through the downturn in demand for ICT staff.

1.4 Impact on ICT Sector's Viability

The third question posed by the terms of reference for the research is as follows:

> *"Have the ICT Undergraduate Skills Initiatives contributed to the viability of the ICT sector in the short, medium and long term*?"

The research finds that the initiatives have contributed to the viability of the sector through facilitating a transformation of sector, with low value-adding activities being shed, with higher value adding activities being added, and with activities being upgraded so as to add more value. The initiatives also, critically, maintained Ireland's reputation as a good location for ICT investment, a reputation that might have otherwise been lost.

However, the sector's viability may be compromised by a fall in intake into many relevant courses, that may result in labour shortages as demand for ICT professionals recovers.

1.5 Economic Impact

The fourth question posed by the terms of reference for the research is as follows:

> *"What has been the overall economic impact for Ireland of the ICT skills initiatives*?"

The research finds that the initiatives have had a significant positive economic impact, despite the fact that demand for graduates has not been as great as projected over the period from 2002 to 2004. It notes that the **labour market performance** of new graduates, as measured by the First Destination of Award Recipients survey, has actually been reasonably satisfactory.

Taking a national level view, the ICT sector made a major contribution to **economic growth** over the period to 2001, both directly and through spending in the domestic economy. Forfás Annual Business Survey data shows that the sector accounted for 69% of the real growth in Irish economy expenditures by manufacturing and internationally traded service companies over the period between 1995 and 2000, and thus must have been one of the major drivers of growth in the non-traded economy over the Celtic Tiger years. The undergraduate ICT skills initiatives made a substantial contribution to this by underpinning ICT sector growth. Real Irish GDP rose by a total 33% (€20.8bn) in 1998, 1999 and 2000, the years in which the initiatives had the greatest immediate impact on economic growth.

Increasing Business Expenditure on **R&D** is one of the Government's major economic development policy objectives. The ICT sector is the leading business sector involved in

R&D, accounting for 65% of all business R&D spending in 2001. It is also one of the main sectors with potential for R&D growth. Growth in R&D in the sector would likely have been substantially less without the undergraduate skills initiatives, which contributed to boosting industry scale, and to improving the supply of people with relevant higher degree qualifications.

The initiatives appear to have boosted the **tax** take significantly, through allowing activity in the sector to increase.

The sector made a major contribution to national **productivity growth** through the latter half of the 1990s, with productivity improvement in ICT manufacturing (i.e. electronic hardware) alone adding 0.9% per annum to national labour productivity growth between 1995 and 2001. Capital deepening through ICT investment in the broader economy also had a positive impact on productivity growth. Both sources of productivity growth were underpinned by the skills initiatives. The flow of graduates in ICT disciplines into the wider economy, that has occurred since the start of the downturn, has the potential to underpin faster productivity growth.

The initiatives were funded under the National Development Plan and part funded by the European Commission under the Community Support Framework 2000-2006.

1.6 Recommendations for Alternative Approaches

The fifth, and final, question posed by the terms of reference for the research is as follows:

> "*What recommendations can you put forward in relation to alternative approaches to the provision of qualified ICT graduates?*"

The main points, which are set out in more detail in Section 8 of the report, are as follows.

- There is a continuing need for the State to take an interest in the supply of graduates in disciplines relevant to the ICT sector, particularly in computing and electronic engineering at primary degree level and higher degree level.
- There is a need for an increased focus on graduate quality, with at least some courses in computing and electronic engineering positioned, and resourced, so as to be competitive with world leading courses. More generally there is a need for a greater focus on graduate quality through all programmes in these disciplines.
- The Department of Education and Science and the HEA should look carefully at the possibility of using funding formulae to reward higher education institutions that are successful in recruiting students to study in ICT disciplines, and are successful in ultimately graduating them.
- There is an increased need for people with postgraduate technology degrees, both research degrees and taught degrees.
- There is a need for a renewed focus on reform at school level in areas such as guidance counselling, promotion of careers in ICT industry, exploitation of ICTs in the classroom, and take-up of the physical sciences.
- Immigration forms a significant part of the recruitment strategies of many companies in the sector. There is a need to address a number of issues with immigration policy.
- If the interest of college applicants and students in ICT qualifications is renewed as demand for graduates recovers, the delay between students entering a degree

programme and completing it will still cause problems. There will be a need to develop graduate diploma conversion courses, and possibly ICT-focused add on qualifications for students who started their studies in other disciplines, and to ensure that funding does not form an obstacle to this.

- Industry interviewees indicated that they saw a need for some developments at the level of course design, including: making internships a standard part of all ICT degree programmes; further strengthening interpersonal/teamworking/ communications skills of graduates; developing a greater focus on project management skills; and increasing the amount of project work undertaken.
- There is a need for more activity in continuing education and training of graduates, particularly in indigenous ICT companies.

Section 2

Introduction and Description of Methodology

2.1 Terms of Reference

The Terms of Reference for the study specify that the study should look at the extent to which the Undergraduate Skills Initiatives have impacted on the economy and the labour market as follows:

- Have the Department's ICT Skills Initiatives resulted in attracting and retaining overseas industry into Ireland because of the availability of sufficient numbers of suitably qualified ICT graduates?
- Has the ICT Industry in Ireland experienced expansion/growth due to the availability of suitably qualified graduates?
- Have the ICT Undergraduate Skills Initiatives contributed to the viability of the ICT sector in the short, medium and long term?
- What has been the overall economic impact for Ireland of the ICT Skills initiatives?
- What recommendations can you put forward in relation to alternative approaches to the provision of qualified ICT graduates.

2.2 Methodology

The research followed two main tracks – interviews and secondary research.

Interviews were undertaken with senior managers at 15 companies, representing a cross-section of the industry in terms of overseas-owned versus Irish-owned, and in terms of the various sectors of significance – electronic hardware, software, electronics design, IT services and e-Business. The interviews focused on leading companies in each sector, such as Intel, Microsoft, Hewlett Packard, IBM, Analog Devices and Iona Technologies.

Interviews were also undertaken with ICT Ireland, which represents all sectors of the ICT industry, and with the Irish Software Association, which represents the software sector, with a particular focus on Irish-owned companies.

Interviews were also undertaken with the relevant agencies:

- Higher Education Authority
- IDA Ireland and
- Enterprise Ireland

Secondary research was also undertaken to identify statistically how the ICT sector had developed since the first of the skills initiatives was announced, and to put this in the context both of international developments, and Ireland's national economy.

2.3 This Report

This introductory chapter, is followed by a chapter describing the initiatives briefly, and putting this description in the context of developments in the sector, both descriptively and statistically.

A further five chapters follow, each addressing one of the five questions posed by the Terms of Reference.

Section 3

Timing of Initiatives versus Timing of Industry Developments

3.1 Introduction

To understand the impact of the Government's undergraduate ICT skills initiatives, it is necessary to set the initiatives in context. This section of the study provides a brief overview of the main higher education interventions and the timing of their impact. The timing is set in the context of the development of the ICT sector, both internationally and in Ireland. Establishing this context is essential to undertaking an assessment into the impact which this initiative had on the economy and industry in Ireland. The development of the sector is examined in terms of employment, industry output and value added.

3.2 Overview of the Initiatives

In 1996, ICT representative organisations and major companies highlighted an impending shortage of technology staff to the Irish Government, triggering the establishment of a succession of advisory groups, which recommended substantial increases in the intake into relevant higher education courses, as well as a range of other measures to increase the supply of suitable labour.

The main higher education interventions recommended involved the following:

- Increasing the numbers undertaking **engineering and computing technician courses**, both through conventional courses, and through the new Accelerated Technician Programme and Institute Trainee Programme;
- Increasing the numbers undertaking **computing and software engineering degree programmes;**
- Increasing the numbers taking **degree programmes in electronic engineering;** and
- Increasing numbers taking **graduate diploma** (and some master's degree) **conversion courses in computing and software engineering.**

Plans to increase the output of graduates with technician level qualifications, and with computing/software engineering qualifications were generally successful, resulting in substantial increases in student intake over the period from 1996 to 2000, and ultimately in graduate numbers.

Plans to increase the output of graduates with degrees in electronic engineering had only a modest impact on intake and on graduate numbers, although the creation of two-year add-on degree programmes in electronic engineering in a number of Institutes of Technology had the effect of converting to degree level graduates some of those who had entered technician level courses.

While only the first three of the above interventions are within the remit of the current research, the fourth (conversion courses) was also important. It produced graduates that were, for some purposes, able to substitute effectively for people with four year computing degrees. As they were mostly only one year in duration, increases in intake responded much faster to the requirement for additional graduates than did four-year degree programmes.

Intake into ICT-related courses, at all of the levels described above, turned down in 2001, with the onset of negative news about the sector's prospects, and fell progressively in 2002, 2003 and 2004.

Early indications from data published by the CAO, and from anecdotes originating in colleges, are that the downward trend has levelled off, and that numbers admitted in 2005 will be similar to those for 2004.

3.3 Timing of Impact on Actual Graduate Output

The impact of the initiatives in increasing the output of **graduates at technician level** was quite rapid.

- An increase in intake into a conventional certificate level course produced additional graduates in two years. Thus, the significant increases in intake that took place in 1997 and 1998 led to increases in graduate output in 1999 and 2000, two of the highest growth years that the ICT sector experienced.
- The establishment of the Accelerated Technician Programme in 1998 had a more immediate impact. Under this 18 month programme, a student studies in college for 6 months, undergoes a 6 month industry placement, and graduates after a further 6 months of study. Thus, a student was available for a time to an industry sponsor 6 months after commencing study, and available full time after 18 months. With (originally) two intakes per year, this programme was particularly useful to major electronics manufacturers needing to ramp up their activities quickly.

Thus, the initiatives that increased intake into technician level programmes had a major impact on technician supply for some of the key growth years experienced by the sector, from 1997 to 2001.

The impact of the initiatives on numbers of **degree level graduates in computing** took longer to work through. There was some increase in student intake in 1996, which would have worked through to an increase in graduate numbers in 2000, while the sector was still growing rapidly.

The main increases took place in 1997, 1998 and 1999, producing increased numbers of graduates in 2001, 2002 and 2003. The employment market was still moderately buoyant in 2001, but the increases in 2002 and 2003 coincided with the downturn in employment in the sector.

Figure 3.1 presents an overview of the timeline described.

Figure 3.1 Timeline of Industry Developments, Skills Initiatives and Skills Outputs

		Industry	Skills Initiatives -	Skills Outputs
Growth Period to mid 2001	1996	Rapid industry growth Signs of shortages Requests from industry	First skills initiatives	
	1997	Rapid growth Intensifying shortages	Increased intake – Degree, subdegree, ATP	
	1998 - 2000	Continuing rapid growth	Continuing increases in student intake	ATP programme impact starts Subdegree impact comes on stream Small increase in Degree output in 2000
	2001	Employment peaks	Student intake turns down	Computing degree output ramps up
Recession Period Mid 2001 to Mid 2004	2002 - 2003	Employment falls	Student intake falls progressively	Computing degree output continues to ramp up Net technician output falls
	2004	Employment stabilises		Computing degree output peaks Net technician output falls
Recovery 2005	2005	Employment rebounds moderately (all companies interviewed so far are growing)	Share of applications attracted by ICT disciplines appears to have bottomed out.	Computing, Electronic Engineering, Net technician output falls

3.4 International Developments in ICT Labour Availability

International developments, over the period since the mid-1990s, form an important part of the context for the undergraduate ICT skills initiatives.

The shortages that inspired the initiatives were rooted in a period of rapid global growth in demand for ICT goods and services. This rapid growth in demand impacted on demand for ICT professionals in two key ways that affected Ireland:

- The software and IT service sectors of virtually every developed country underwent rapid growth, leading to near-universal shortages of computing and software engineering professionals, and to deficiencies in the quality of the skills available.

  While most countries took measures of some sort to boost the supply of people through facilitating increases in education, training and inward migration (from e.g. Eastern Europe and India), Ireland's response was both early and decisively substantial when compared with others. The undergraduate skills initiatives formed a significant part of the overall Irish response.

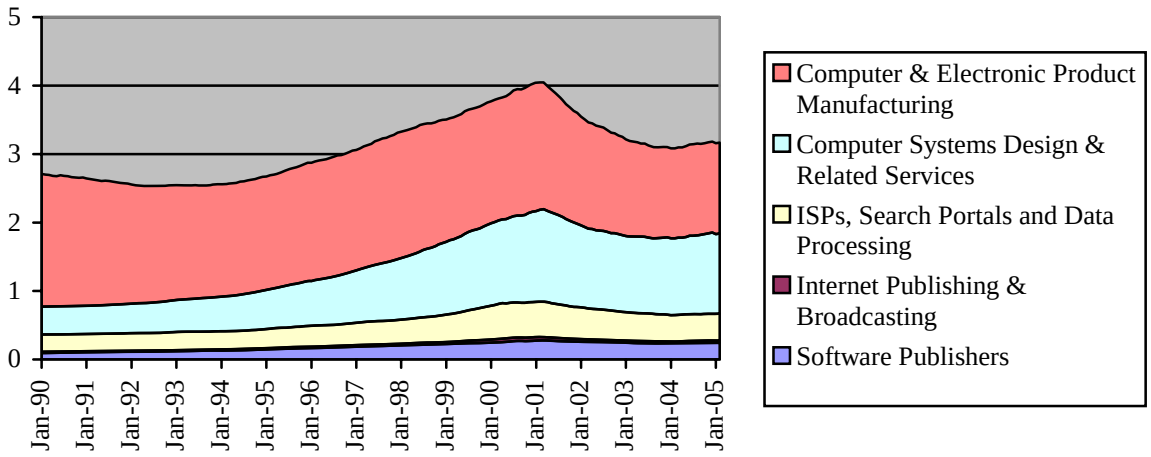
- The growth in demand drove a substantial volume of investment by US ICT companies into the EU, which was targeted by IDA Ireland. Hardware companies needed significant numbers of technicians and engineers (particularly manufacturing/production/mechanical and electronic), as well as some computing/software professionals.

- Software companies needed substantial numbers of computing and software engineering professionals. Existing streams of graduates gave rise to concerns about the supply of suitable recruits anywhere in Europe, including Ireland. The undergraduate skills initiatives again formed an important part of the overall Irish response.

3.5 Trends in ICT Employment in the United States

The downturn in employment experienced by the Irish ICT sector also reflects international developments. Internationally, the dot.com boom slowed, and started to go into reverse from mid-1999. However, as the dot.com sector represented only a small part of the global ICT sector, this just slowed the overall pace of ICT growth a little.

Figure 3.2 US ICT Sector Employment



Source: Bureau of Labor Statistics

Late in 2000, research reporting an impending fall in ICT spending in the US flagged the beginning of a much broader global market downturn that gathered pace through 2001, and continued through 2002. Global ICT spending started to recover in 2003 and 2004, leading to the beginnings of a recovery in the US ICT labour market during 2004 that coincided approximately with the start of an Irish recovery.

3.6 ICT employment in Ireland and EU

The ICT downturn in Ireland has been somewhat more severe than for most other EU countries. The reasons for the greater severity of the downturn in Ireland appear to be related to the sector's strong links with the US, and to its exposure to international markets at a time of slow growth and increased competition from locations with lower labour costs. In contrast, the software and IT services sectors of most other established Member States of the EU primarily service domestic markets, which gives them a degree of protection from international competition.

According to Labour Force Survey data, most existing EU states have increased their employment in "Computer and Related Activities[39]" although more modestly than in the accession states. The accession states have actually gone through a period of significant ICT sector growth, reflecting a combination of cost advantages, favourable location, catching up with more developed EU states, and a strong supply of people with suitable skills.

The downturn in the intake of students into ICT-related higher education courses experienced in Ireland since 2000 is reflected in most other developed countries.

3.6 ICT Sector Employment Trends in Ireland

ICT sector employment rose rapidly over the period from 1996 when the undergraduate skills initiatives were being devised and introduced, with the growth being concentrated particularly among software and IT services companies.

- Employment in electronic hardware peaked in 2000 or 2001 (depending on the data series used for reference), up 64% on the 1995 figure, using data derived from the Forfás Annual Business Survey of Economic Impact (ABS).
- Employment in software and IT services peaked in 2001, up 207% on the 1995 figure, using ABS data.

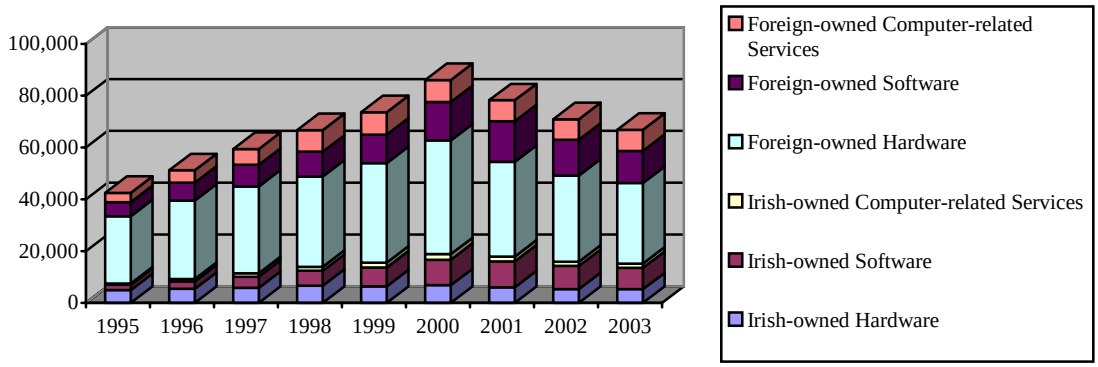
Employment across the sector fell in 2002, 2003 and at least the first half of 2004, with the losses being concentrated particularly among electronic hardware companies.

- ABS data shows employment in electronic hardware falling by 28% to 2003.
- ABS data shows employment in software and IT services falling by 14% to 2003.

Other data sources show broadly the same picture, but with somewhat different rates of growth and decline that reflect differences in the timing of surveys and differences in survey methodologies.

The Forfás Annual Business Survey of Economic Impact (ABS) shows strong growth in employment between 1995 up to a peak in 2000.

Figure 3.3 ABS Data on ICT Sector Employment

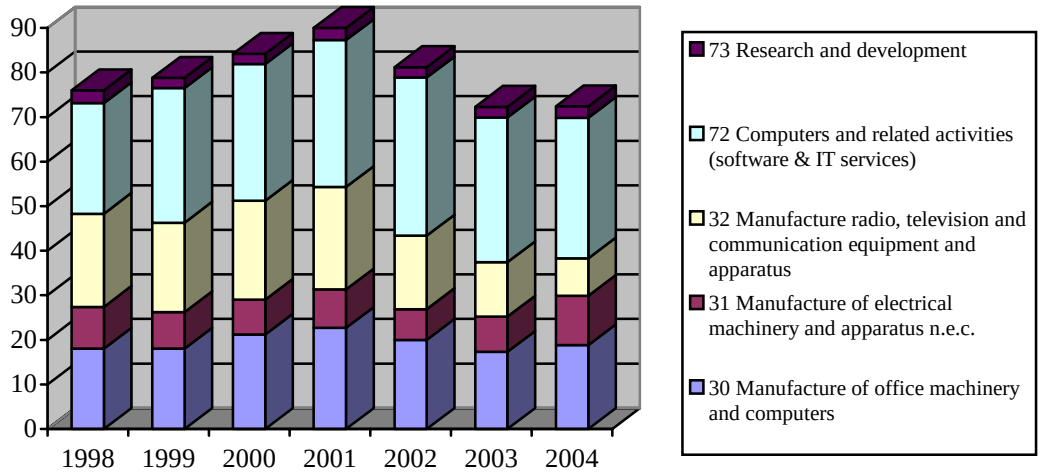


Source: Forfás – Annual Business Survey of Economic Impact (2000-03); Irish Economy Expenditure Survey (1995-1999)

[39] This industrial classification encompasses software and IT services, but not hardware.

Employment has fallen from the peak through to 2003, where there is evidence of employment starting to stabilise. QNHS data shows employment peaking in 2001, rather than the 2000 peak visible in ABS data (presumably because the ABS survey is conducted close to year end, while the QNHS averages four surveys undertaken quarterly). The fall in employment across the sector appears to have bottomed out late in 2003 or early in 2004, prior to an initially modest recovery, as can be seen in Figure 3.4.

Figure 3.4 QNHS Data on ICT Sector Employment

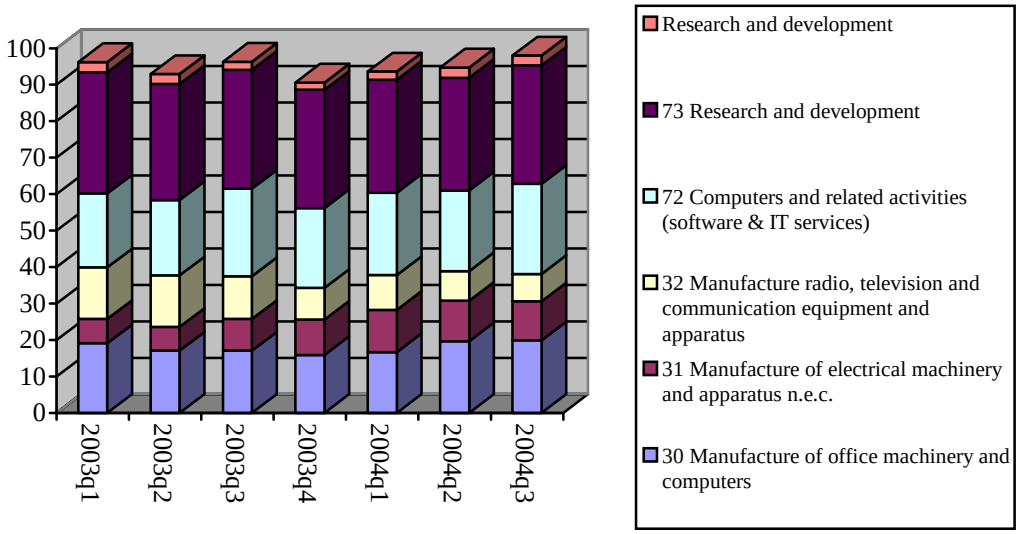


Source: Quarterly National Household Survey, CSO

These improvements became clear to the ICT sector as 2004 progressed. By December 2004, increased demand for ICT staff was being flagged by the business media[40].

QNHS data shows employment in the bottoming out late in 2003 or early in 2004, prior to an initially modest recovery, as can be seen in Figure 3.5.

Figure 3.5 Quarterly QNHS Data on ICT Sector Employment

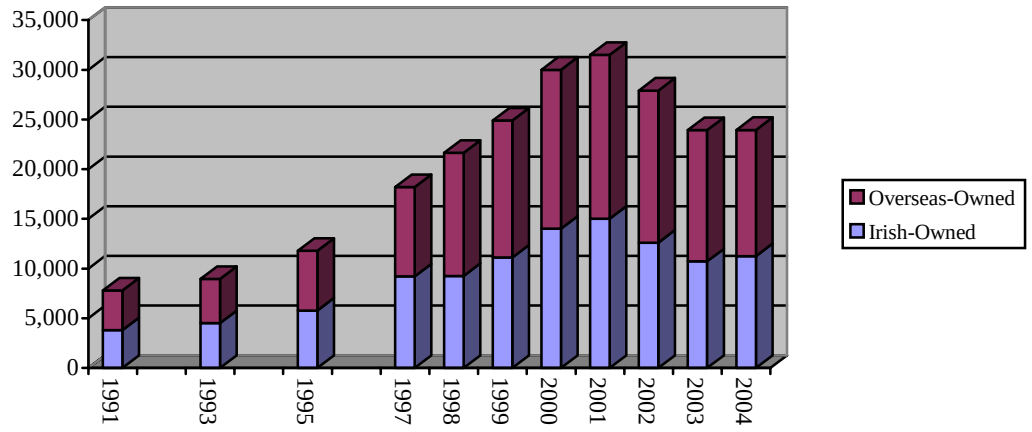


[40] See, for example headlines: “Experienced IT staff in demand once again”, Sunday Business Post, December 19, 2004; “Jobs gain signals an end to IT downturn”, Irish Times, December 17, 2004.

Source: Quarterly National Household Survey, CSO

The breakdown in employment between the software and hardware is examined in more detail in the following paragraphs. Figure 3.6 gives a breakdown for employment in the Software Sector. This highlights the rapid growth in employment in the course of the 1990s.

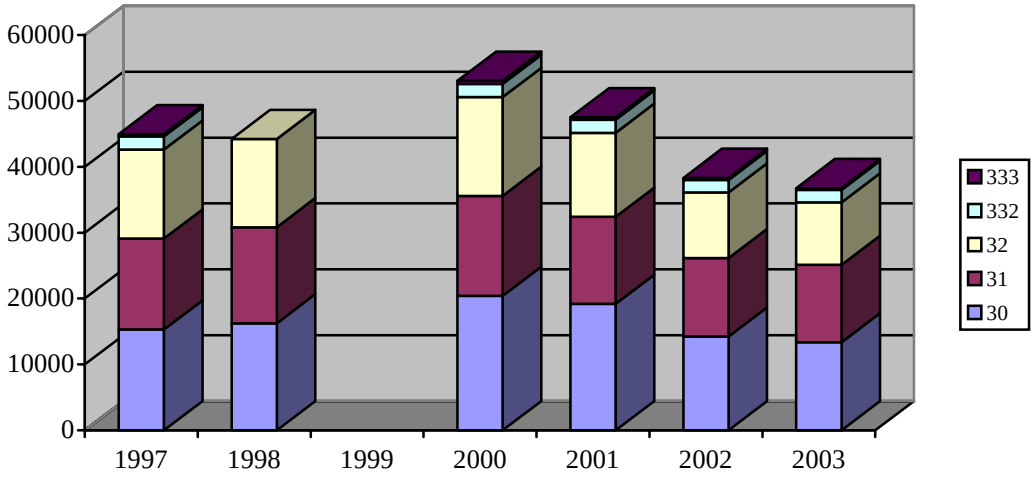
Figure 3.6 Enterprise Ireland Data on Software Sector Employment



Source: Enterprise Ireland

Employment in software peaked in 2001, with both overseas–owned and Irish owned firms subsequently experiencing a downturn in employment.

Figure 3.7 Employment in the Electronic Hardware Sector



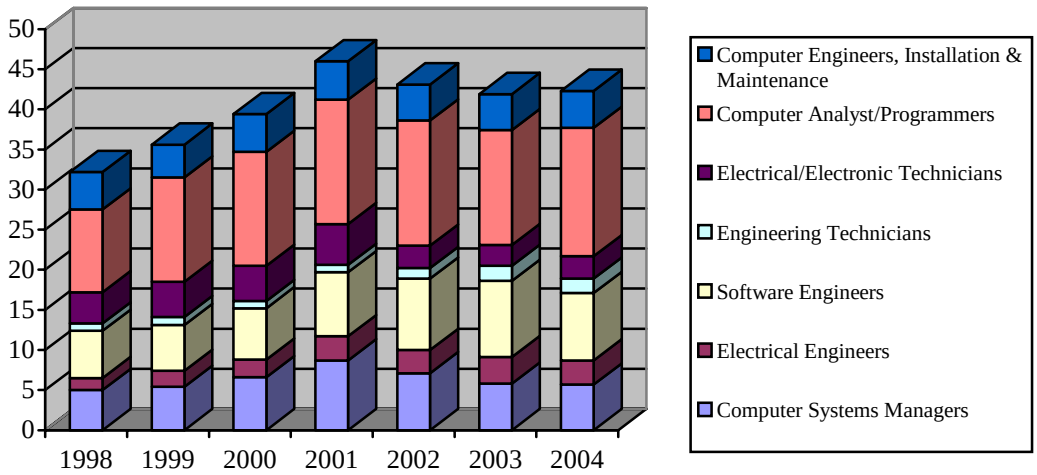
Source: Census of Industrial Production, CSO

The story in hardware is different, with employment peaking in 2000 and falling through 2003.

3.7 ICT Occupation Employment Trends in Ireland –2003/2004

Employment in ICT-related occupations also increased rapidly over the period to 2001, falling in 2002 and 2003, and recovering modestly in 2004. This is illustrated in Figure 3.8.

Figure 3.8 QNHS Data on Employment in ICT-Related Occupations



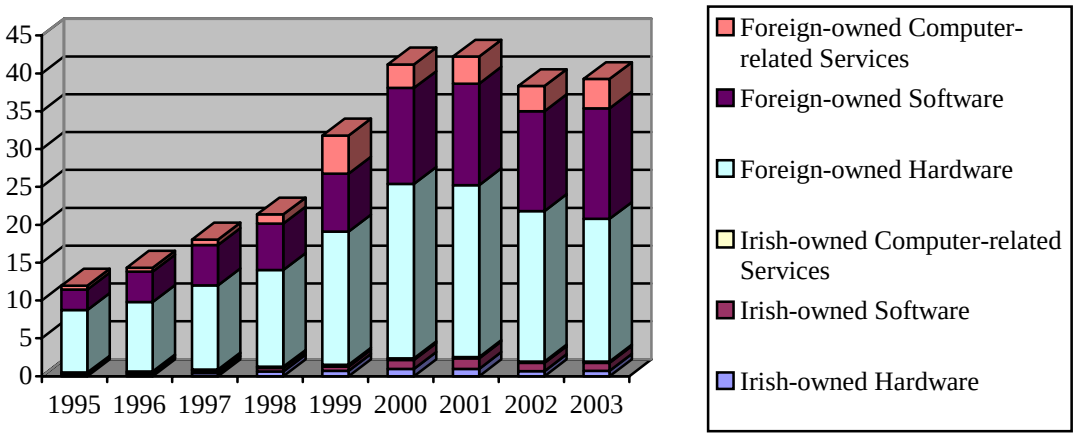
Source: Quarterly National Household Survey, CSO

A large part of this pattern simply reflects variations in employment levels in the ICT sector, which is the leading employer associated with ICT occupations. Other factors appear to include a significant increase in ICT-related employment in the broader economy over the period to 2001, and a progressive increase in the share of employment in the electronic hardware sector accounted for by ICT specialists relative to production operatives.

3.8 ICT Sector Sales and Value Added

Electronic hardware sales rose sharply between 1995 and 2000, peaked in 2001, fell in 2002, and recovered modestly in 2003. Software and IT services sales rose sharply to 2001, and then at a slower rate. This is illustrated in Figures 3.9 and 3.10.

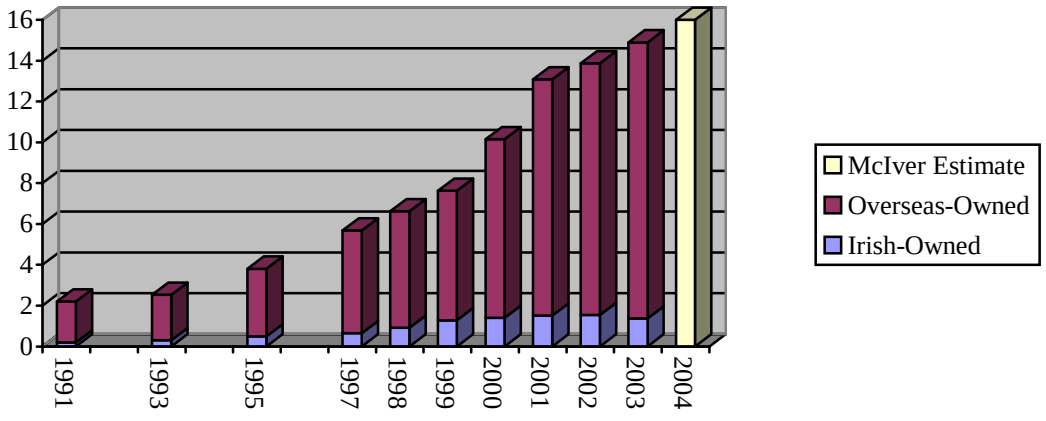
Figure 3.9 ABS Data on ICT Sector Sales (€bn)



Source: Forfás – Annual Business Survey of Economic Impact (2000-03); Irish Economy Expenditure Survey (1995-1999)

High rates of improvement in productivity, particularly in electronic hardware, have meant that sales have increased much faster than employment in times of growth, and have mostly increased (albeit more modestly) even when employment has been static or falling.

Figure 3.10 EI Data on Software Sector Sales (€bn)

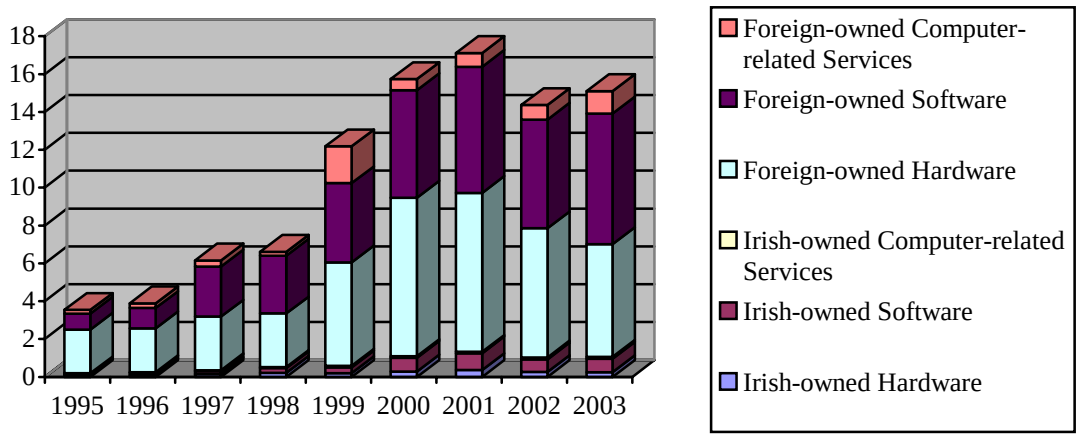


Source: Enterprise Ireland

As sales per employee are much higher, on average, for foreign-owned ICT industry than for Irish-owned ICT industry, overall sales trends for the sector primarily reflect the sales of foreign-owned industry.

Of more economic significance than sales is the level of value added by the Irish ICT sector. ABS data shows that value added grew rapidly to 2001, fell in 2002, and enjoyed a recovery in 2003.

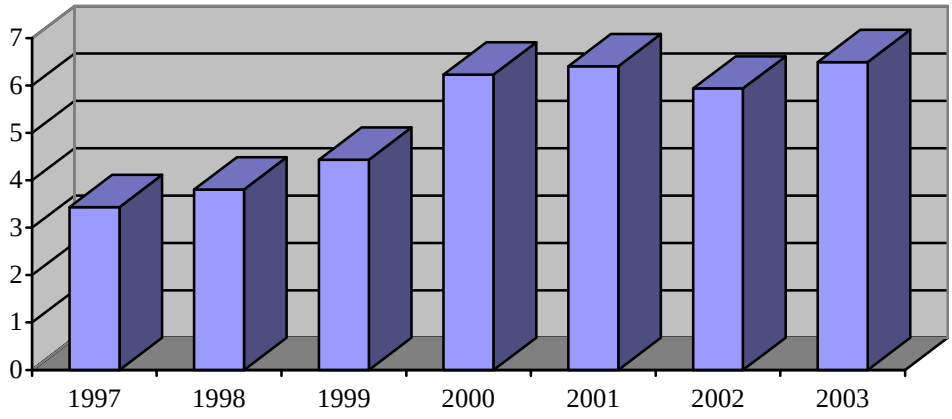
Figure 3.11 ABS Data on ICT Sector Value Added (€bn)



Source: Forfás – Annual Business Survey of Economic Impact (2000-03); Irish Economy Expenditure Survey (1995-1999)

As value added per employee is much higher, on average, for foreign-owned ICT industry than for Irish-owned ICT industry, overall value added trends for the sector primarily reflect trends for foreign-owned industry.

Figure 3.12 National Accounts Data on Gross Value Added at Constant (1995) Factor Cost – Computers (NACE 30) & Instrument Engineering (NACE 33) (€bn)



Source: CSO National Accounts Data

National accounts data (see Figure 3.12) show a somewhat more positive view at a more aggregated level with a dip in 2002 and a strong recovery in 2003.

3.9 The Study Context

The purpose of this section of the report has been to set the initiatives in the context of industry events – the period of rapid growth up to 2000 or 2001; the downturn in employment between 2002 and 2004, and in sales and value added in 2002; and the beginnings of a recovery that emerged in 2004, and appears to now be continuing. The interview evidence confirms that industry now has much more positive expectations for the immediate future than it did a year ago, during the first half of 2004.

The downturn has also masked significant changes, which are taking place within the industry, as the ICT sector moves to higher value added activities. This is reflected in the statistics for revenue, and, in particular, in the data for value added by the sector.

Section 4
Impact on Attraction and Retention of Overseas Industry

4.1 Introduction

The first question posed by the terms of reference for the research is as follows:

> *"Have the Department's ICT Skills Initiatives resulted in attracting and retaining overseas industry into Ireland because of the availability of sufficient numbers of suitably qualified ICT graduates?"*

This section of the report sets out the findings of the research on this question, which are broadly in the affirmative.

4.2 IDA Ireland Client Survey Data

IDA Ireland commissions a survey of its clients annually, which it drew to the consultants' attention in the course of an interview undertaken as a part of the research. While there have subsequently been changes to the set of questions asked, there is a series of data available on the threats perceived by the Irish operations of its clients between 1996 and 2000. As shown in Figure 4.1, IDA's ICT and engineering clients[41] saw difficulty in attracting skills, and in the related issue of rising wage costs, becoming rapidly more significant through the latter half of the 1990s. Despite this, the threat they perceived from competition from other countries fell sharply over the same period.

Figure 4.1 Views of IDA ICT & Engineering Clients as to the Main Potential Threats Likely to Impact on Irish Operations

	1996	1997	1998	1999	2000
Difficulty in Attracting Skills	18%	30%	51%	69%	63%
Rising Wage Rates / Cost Base	30%	38%	51%	48%	90%
Competition from Other Countries	45%	35%	19%	17%	22%
Deterioration in Infrastructure	-	-	-	-	17%

Source: Annual surveys of IDA Ireland clients, provided by IDA Ireland

The explanation for this paradoxical set of views appears to be as follows:

[41] This category was dominated by ICT.

- Even with the various skills interventions undertaken, IDA client companies faced significant issues with recruiting sufficient people, and faced significant wage inflation.
- However,
  - Over the period, many succeeded in meeting or exceeding corporate performance expectations;
  - ICT manpower availability issues were more severe in most other developed countries; and
  - Ireland was seen as having responded more effectively than other countries to the shortage, through the undergraduate skills initiatives and other related initiatives.

4.3 Attraction of Investment

4.3.1 Electronic Hardware

There was a substantial volume of inward investment by electronic hardware companies over the period 1997 to 2000, the impact of which on employment and turnover can be seen in many of the Figures in Section 3 of this report.

The interview evidence, from companies that made some of the largest investments over the period, indicates that the undergraduate ICT skills programmes were influential in the decision-making.

It was not possible for any interviewee to state categorically that the investments would not have taken place without the skills programmes.

- However, in cases where detailed corporate assessments were made prior to major investments, the interview evidence is that skills availability was among the top two or three issues under consideration[42], and that the existence of the programmes had a major impact on Ireland's credibility on skills supply. The impression of decisive State action on ICT skills was possibly as influential as the detail of what was done.

  The specific actions that were most influential were those undertaken to increase the output of engineering technicians. Measures to increase the supply of graduates in computing and in electronic engineering were also seen positively. A small number of interviewees also commented positively on increases in the output of degree graduates in the broad area of production and manufacturing engineering over the period, despite the fact that these increases were outside the scope of the undergraduate ICT initiatives.

  The positive impacts were of two sorts.

  1. Visibility of a strong future supply of graduates gave investors confidence about the medium to long-term viability of investments, even where, as in the case of plans to increase degree graduate numbers, the actual anticipated increase in graduate output might be four or five years into the future. In the event, initiatives focused on degree programmes only started to produce significant numbers of additional graduates around 2001, just as the industry downturn struck, but this did not take away from the impact that the initiatives had on decisions made between 1997 and 2000.
  2. Initiatives undertaken at technician level had an impact on investor confidence in the medium to long-term viability of investments, but also had

[42] Ireland's corporation tax regime was also mentioned by most interviewees from overseas-owned operations.

a direct impact on the supply of graduates available within the timeframe of the high growth period. The Accelerated Technician Programme produced certificate level graduates, who already had six months work experience, most often with their eventual employer, in 1998 *(check this – might have been 1999*), and continued to produce significant numbers of good quality graduates through the remainder of the high growth period.

- In the case of more incremental investments, the record of the Irish operation in meeting and exceeding its commitments was typically the main factor directly relevant to decisions by international management. In many cases, the over-riding consideration among decision-makers was which of their operations globally could be best trusted to ramp up production quickly, efficiently and without problems, so as to meet fast-growing market demand in a timely manner. The Irish operations we interviewed mostly took on whatever they were offered, but were only able to continue to meet their commitments because the technician level undergraduate skills initiatives, supplemented by inward migration, allowed them to recruit sufficient technicians.

  Without sufficient technicians their performance would have been slower, less efficient and more prone to technical and operational problems. Thus, if Irish operations had taken on incremental investments without having sufficient access to technicians, the trust and confidence of international management would likely have been undermined, limiting future investment potential.

It is not possible to point to any individual investment, and say with certainty that it would not have gone ahead without the undergraduate ICT skills initiatives. However, the initiatives played such a big direct, and indirect, role in so many investment decisions, that it is reasonable to assert that that the overall impact must have been substantial.

4.3.2 Software

1996-2001

There was a substantial volume of inward investment in software over the period from 1996 to 2001. Its impact on employment and industry turnover can be seen in the data on the foreign-owned part of the software sector presented in Section 3 of this report. The interview evidence is that the undergraduate skills initiatives were influential in the decision-making that led to these investments.

Ireland was already a major player in attracting inward investment from the US, and indeed from other European countries, but evidence of shortages started to become apparent around 1996. However, over this period, demand for software professionals increased sharply, leading to tight labour market conditions, and to difficulties for employers in recruiting high quality staff in virtually all developed countries, not just in Ireland.

The announcement in 1996 and 1997 of plans for substantial increases in the intake into Irish computing courses, particularly at degree level, and subsequent increases in college intake, appear to have had the effect of distinguishing Ireland from other possible European locations for inward investment, whose responses were slower and more incremental. IDA data shows that Ireland had a market share of 42% of mobile software development investment in Europe over the period 1999-2001, a share which could only have been achieved if Ireland was seen as an attractive location for inward investment in software.

The interview evidence indicates that the undergraduate ICT skills programmes were influential in allowing Ireland to achieve this high market share for software inward investment. Skills availability was one of the main factors considered by ICT corporations deciding whether to locate a software operation in Ireland or elsewhere. Indeed, the

interview evidence is that, in some cases, the idea that a small country such as Ireland would have difficulty in supplying enough people was the key objection to locating a substantial investment in Ireland put forward internally.

The interview evidence is that visibility of a strong future supply of computing graduates gave investors confidence about the medium to long-term viability of investments, even though, at degree level, the actual anticipated increase in graduate output was four or five years into the future. Related skills initiatives were seen as going some way towards bridging this delay, including increases in the number of places on graduate diploma courses, increases in numbers studying computing at certificate and diploma level, and increases in FÁS's training activity in ICT skills.

In the event the degree programmes started to produce significant numbers of additional graduates around 2001, just as demand for computing graduates was turning down, but this did not take away from the impact that the initiatives had on decisions made between 1996 and 2001.

As with electronic hardware, it is not possible to point to any individual investment, and say with certainty that it would not have gone ahead without the undergraduate ICT skills initiatives. However, the future supply of software professionals was such a high profile issue for industry over the period that the initiatives must have made the difference in a significant proportion of cases.

2001 to 2004

While new inward investment in software slowed from 2001, it did not cease. As demand for software skills slowed, the immediate outlook for software skills supply was no longer as crucial to investment decisions as it had been previously. Competition for mobile investment from Eastern Europe, India and the Philippines became a bigger issue.

The interview evidence is that the significance of the undergraduate ICT skills programmes for decisions on inward investment was reduced, but not eliminated. Ireland's reputation as a good location for inward investment continued to be influential. This continued reputation was rooted, in part, in the fact that Ireland had always been responsive to the priority needs of the ICT sector. An effective response to skills needs over the period from 1996 to 2001 had been a necessary link in this chain. If Ireland had not responded decisively to the sector's manpower supply problems over this period, it would have damaged the country's reputation, reducing the volume of inward investment even after 2001.

The increase in the software manpower supply that occurred from around 2001, arising from the undergraduate ICT skills initiatives, probably also had some more direct benefits, helping to limit salary inflation that threatened Ireland's competitiveness as a location for software inward investment, and giving companies confidence that they would be able to recruit sufficient staff once the market for software and other ICT products swung upwards.

4.3.3 Electronics Design / Integrated Circuit Design

The electronics design sector is mainly concerned with design of integrated circuits. It is a small part of the sector, accounting for perhaps a couple of thousand people, but it is particularly highly skilled. Its primary requirement is for primary and higher degree graduates in electronic engineering. At primary degree level its main interest is in graduates from the top 10% of 20% of their classes.

The sector grew substantially over the period up to 2001, and then contracted over the period to 2004.

The interview evidence is that the undergraduate skills initiatives had only a limited impact on inward investment decisions, which were driven more by knowledge of the existing supply of electronic engineering graduates than by plans for increases to the supply. In the

event, plans under the undergraduate skills initiatives to increase substantially the number of graduates in electronic engineering had only a limited impact on graduate numbers in any case.

4.3.4 e-Business

Since the late 1990s, IDA Ireland has succeeded in attracting a substantial share of all investment into the EU by major e-Business companies. The interview evidence is that the undergraduate skills initiatives had a modest positive impact on these decisions. The impact has been modest because quite a broad mix of skills has been required (not just technology skills, but also skills a variety of other areas such as editorial and advertising), and because many of the decisions have, in any case, been made since demand for software professionals slackened around 1991.

Even so, Ireland's position as the first choice location for inward ICT investment into the EU through the latter half of the 1990s does appear to have been influential. This position was partly a function of the existence of the undergraduate skills initiatives.

4.4 Retention of Inward Investment

A significant volume of past inward ICT investment has been lost since 2000, particularly in electronic hardware, but also in software. The impact of these losses is reflected in the employment data presented in section 3 of this report.

However, a substantial proportion of these losses is attributable to the closure or downsizing of relatively low value-added activities that were present in Ireland prior to the establishment of the undergraduate ICT skills initiatives. This continued trends that were apparent even in the high-growth years, of migration overseas by low value added manufacturing operations, and closure of inward investment operations by companies that were losing out in global competition.

On the whole, overseas-owned ICT operations established or attracting substantial reinvestment during the latter half of the 1990s have survived, and have maintained employment at levels not drastically different to the levels achieved around 2001. While this looks like stability at a macro level, the interview evidence is of very considerable change at the level of the individual operation. Almost every overseas owned operation interviewed had a history of migrating low value added operations overseas, compensated by adding or growing higher value added activities.

- Where many electronic hardware operations were focused mainly on carrying out manufacturing operations to standards specified elsewhere, they have increasingly taken on responsibility for improving production processes, for development work, for product management, and for a wide range of business functions, such as marketing, procurement and finance. In many cases, they retain responsibility for the management of production activities that have been migrated overseas.
- Many software development operations have changed their focus within the corporate value chain, away from routine coding work, towards higher level development work and towards work that involves a strong functional understanding of the purpose for which the software will be used. Consistent with this, companies increasingly wish to employ computing graduates with postgraduate degrees or with high levels of experience and expertise. In many cases, more routine work has been migrated overseas.

These changes have been influenced by increased international competition for inward ICT investment, particularly from Central/Eastern Europe, India, China and the Philippines. With higher costs, local managers of international companies have had no choice but to develop higher value activities if their operations are to survive.

Without the undergraduate ICT skills initiatives, it appears likely that the retention performance of the sector would have been significantly poorer. With less inward investment in the latter half of the 1990s, the resilience of the sector would have been much poorer.

- The longer established, lower value added, operations that actually closed would have closed anyway.
- The high value added operations that have survived would, in many cases, not have existed, either because the inward investment had never occurred, or because the original operations from which they developed were constrained from moving to higher value added activities by shortages (or anticipated shortages) of high skilled staff.
- Industry would have had more difficulty in sourcing people with higher degrees. The number of people graduating with higher degrees in computing and electronic engineering has risen in recent years, driven by several factors, which include the increase in primary degree graduate numbers, increases in funding for postgraduate research and the reduced opportunities in industry for primary degree graduates since 2001.

Without the developments facilitated in the electronic hardware sector by the undergraduate skills initiatives, there is every possibility that this sector would now be no more than a rump, rather than a still-strong industry. The overseas-owned software sector would have been more resilient than the hardware sector, but would have entered the downturn weaker, and almost certainly have suffered more through the downturn as a result.

Section 5
Impact on Expansion and Growth

5.1 Introduction

The second question posed by the terms of reference for the research is as follows:

> *"Has the ICT Industry in Ireland experienced expansion/growth due to the availability of suitably qualified graduates?"*

This section of the report sets out the findings of the research on this question, which are broadly in the affirmative. It should be read in conjunction with Section 4, as we have refrained from recapitulating all the relevant material from that section.

5.2 History of Growth

The history of the sector's growth since the announcement of the first of the undergraduate ICT skills initiatives is outlined in some detail in Section 3 of this report.

The main points are as follows:

- The sector grew rapidly by all measures from before the announcement of the first of the initiatives until 2001[43].
- Employment, turnover and value added fell significantly in 2002, denting gains made up to 2001, but stopping far short of eliminating them.
- Employment fell again in 2003, while turnover and value added resumed growth.
- The fall in employment bottomed out in 2004, at up to 20,000 below the 2000/01 peak for the ICT sector as a whole, and employment growth appears to have resumed at a modest rate.

5.3 Links Between Skills Initiatives and Growth

5.3.1 Overseas-owned Sector Through Growth Period and Downturn

The ICT skills initiatives appear, as outlined in Section 4.3, to have made a substantial contribution to the expansion of the overseas-owned parts of the ICT sector over the period from 1996 to 2001. They also appear, as outlined in Section 4.4, to have limited the severity of the downturn of 2002/2003 for overseas-owned operations.

5.3.2 Irish-owned Sector Through Growth Period and Downturn

They appear to have had a more limited impact on growth in the Irish-owned parts of the sector, which are dominated by software and IT services. While the growth of overseas-owned software operations over the period to 2001 was influenced strongly by the expectation of future increases in graduate numbers, arising from the initiatives, Irish-

[43] The downturn started during 2001. The year in which it appears to start, based on annual data, depends on the data series used, reflecting differences in survey dates.

owned software companies lived more in the present. Where they could staff their operations effectively from within Ireland, or by recruiting inward migrants, they did so. Where the available supply of people was not adequate within Ireland, many looked abroad, establishing development operations in locations as diverse as India, Australia and the US. Increases in ICT student numbers at graduate diploma level, which are outside the scope of this review, had a positive impact on graduate supply from around 1998, but significant increases at degree level under the undergraduate skills initiatives only cut in around 2001, just as the downturn was starting.

The initiatives appear to have had a modest positive impact through the downturn, limiting pay inflation, which threatened the sector's competitiveness, and adding to the available supply of people.

5.3.3 ICT Ireland's Graduate Placement Programme

ICT Ireland, the IBEC organisation representing the ICT sector responded to the downturn in demand for new graduates by launching a programme to place graduates in industry, in association with the Institution of Engineers of Engineers of Ireland. The programme gives graduates in electronic engineering and computing six to twelve months work experience, which leaves them much better prepared to take up regular employment in the sector. Indeed, many of those undertaking paid placements under the programme have taken up regular employment with the host company at the end of the placement period.

The existence and scale of the programme can be attributed partly to the undergraduate skills initiatives. Having asked for graduate numbers to be increased, the ICT sector felt a responsibility to offset the problems faced by graduates when industry demand fell. It also had an interest in maximising the likelihood that those graduating during the downturn would continue to be available to the sector, and in generating positive news about employment in the sector that might encourage future college applicants to apply for courses in disciplines relevant to the sector.

This programme has gone some way towards maintaining the flow of graduates into the sector through the downturn, limiting the numbers being lost to employment in other sectors, and smoothing out the sector's experience profile. Now that demand for people has turned up, many companies are finding that they are short of the people with two to five years' experience that they need for well-balanced teams. By boosting the flow of graduates into the sector, the Graduate Placement Programme has reduced the extent of this problem.

5.3.4 2004 and 2005

The initiatives appear to still be playing a positive role in 2005.

The evidence, from interviews and other sources, is that demand for software and electronic engineering professionals has been picking up since the latter half of 2004. Labour markets are tightening. Demand for contractors is increasing. Advertisements for positions in ICT are again prominent in the printed media. Radio advertising for the recruitment of ICT professionals has appeared[44]. Some organisations interviewed report already having difficulty in recruiting sufficient people with around three to five years experience.

[44] Accenture, week ending 13 May, 2005.

Under these circumstances, the existence of a strong supply of graduates in computing in the current year, and from recent years, is likely to be delaying the onset of significant shortages, and is likely to also be limiting the scope for pay inflation beyond the level present in the rest of the economy. Both of these outcomes are positive for the sector as a whole, and particularly for the software sector.

The increased output of graduates with higher degrees is likely to also be positive for the future growth of the sector, as it moves into higher value added activities, and places an increasing emphasis on research.

Section 6
Impact on ICT Sector's Viability

6.1 Introduction

The third question posed by the terms of reference for the research is as follows:

> *"Have the ICT Undergraduate Skills Initiatives contributed to the viability of the ICT sector in the short, medium and long term*?"

This section of the report sets out the findings of the research on this question, which are in the affirmative.

6.2 Transformation of Sector

The ICT sector has undergone a transformation since the first of the undergraduate ICT skills programmes was announced in 1997, making it less vulnerable to the low cost competition that has emerged in the meantime.

- The electronic hardware sector has shed most of its lower value added manufacturing work, through a mix of closures, and progressive replacement of existing activities. It has replaced the low value added work with higher value added activities, including higher value added manufacturing, development work, marketing, product management, and a wide range of business functions, such as marketing, procurement and finance. Irish operations interviewed have, in many cases, taken a global lead within their organisations, in improving manufacturing processes, more than offsetting higher costs in Ireland through higher productivity. These developments have had the effect of maintaining the sector's viability in the past, and underpinning it for the short-term future. As there is scope for Irish operations to continue to take on higher value added work, the developments have the potential to underpin the sector's viability over the medium term and long term too.
- In the mid-1990s, much of what the software sector in Ireland had to offer was access, directly or indirectly, to a strong supply of skilled software professionals at a modest cost. This was one of the major attractions for inward investors. It was also the core of a significant software services export industry. And it was important to the viability of Irish-owned software products businesses. However, it is essentially the same as what Eastern Europe, India and the Philippines can now offer at significantly lower cost.

  The sector has survived, and shows signs of starting to thrive again, because it has moved away from the low value positioning that much of it occupied in the mid-1990s. The Irish owned part of the sector has become better at developing and exploiting software products, and the Irish operations of software multinationals have become progressively more focused on activities based on high levels of intellectual content and business knowledge.

The undergraduate ICT skills initiatives have played a significant role in this, through the following main mechanisms;

- Encouraging inward investment, and re-investment, by overseas-owned ICT companies;
- Providing many of the technicians required by the electronic hardware to upgrade its capabilities, particularly over the period to 2000;
- Contributing to boosting the supply of graduates in computing with higher degrees;
- Boosting the supply of graduates available in the current year, from among new graduates and from among the underutilised supply of graduates from previous years, to fuel renewed growth over the immediate future; and
- Boosting graduate recruitment to some extent during the downturn in demand of 2002 and 2003.

6.3 Maintenance of Ireland's Reputation as a Location for ICT Industries

The undergraduate ICT skills initiatives maintained and reinforced Ireland's reputation as a location with a Government responsive to ICT industry needs. This reputation is one of Ireland's key advantages in attracting inward investment.

There is some evidence from interviews, however, that the sector feels that Government has become a little less flexible and responsive since the undergraduate skills initiatives were put in place.

6.4 Future Adequacy of Manpower Supply

While the undergraduate ICT skills initiatives did much to boost the supply of new graduates in ICT disciplines, that impact is now close to being dissipated. Recruitment into ICT-related programmes in the higher education system fell a little in 2001, and more sharply in 2002, 2003 and again in 2004. The fall appears to have been a response to bad news from the ICT sector, at a time when news from other sectors was more positive. The preliminary evidence from CAO college applications data is that recruitment in 2005 will be quite similar to that achieved in 2004.

These student intake changes mean that degree graduate numbers in computing and electronic engineering will fall in the current year, and are likely to continue falling up to 2008. A number of those interviewed said that they had observed a decline in the average quality of final years in computing presenting for interview this year, which would be consistent with falling CAO points requirements. Others said that they did not perceive any shift in quality among graduates, or among students coming to work with them on internships.

A number of those interviewed expressed concerns about the adequacy of the future supply of graduates in computing and electronic engineering, both in terms of the number and the quality of graduates. As the sector moves to higher value added activities, graduate quality is becoming more, rather than less, important. Electronics design companies expressed the most urgent concerns about the adequacy of the supply of new graduates in electronic engineering into the future.

6.5 Synthesis

The undergraduate ICT skills initiatives have had a significant positive impact on the viability of the sector over the short, medium and long terms. However, this is being compromised by the fact that the intake into relevant courses has fallen from 2001 to 2004, which will cause graduate numbers to decrease over the period to 2008.

Section 7
Economic Impact

7.1 Introduction

The fourth question posed by the terms of reference for the research is as follows:

> *"What has been the overall economic impact for Ireland of the ICT skills initiatives*?"

This section of the report sets out the findings of the research on this question, drawing both on interview evidence and on broader economic evidence. It finds that the economic impact of the ICT skills initiatives is strongly positive, despite the downturn in labour market demand experienced between 2001 and mid-2004.

The main factors that support the view that the economic impact of the initiatives was positive are as follows.

- Graduates of courses supported who completed their studies prior to 2001 (mainly technicians) were in strong demand, and were very successful in the employment marketplace;
- The evidence is that graduates of the courses supported were quite successful in the employment market after graduation during the period of reduced demand that affected graduates of 2001 to 2003;
- There is a good case that the initiatives boosted overall economic growth significantly in Celtic Tiger years;
- The initiatives appear to have had a strong positive impact on Business Expenditure on R&D;
- The initiatives appear to have boosted tax take significantly directly, as well as through their broader impact on economic growth;
- The initiatives appear to have contributed to underpinning significant increases in per capita income throughout the economy;
- Recruitment of technology graduates by the broader economy, particularly since 2001, has the potential to boost productivity growth generally, through improved use of ICTs;
- The Undergraduate Skills Measure is funded under the National Development Plan, and part funded by the European Commission under the Community Support Framework 2000-2006; and
- On average, higher education courses provide attractive economic returns to society, and the factors described above suggest that the economic returns provided by the ICT skills initiatives are higher than average.

These factors are described in more detail in the paragraphs that follow.

7.2 Employment Performance Immediately after Graduation

For college leaving cohorts in computing and electronic engineering at degree level, and in engineering at certificate and diploma level, up to the class of 2000, employment rates were high, as can be seen in Figure 7.1.

Figure 7.1 Situations of Graduates after Graduation for Graduates of 1996, 1998 and 2000

		1996	1998	2000
Computer Science Degree	Research or Further Study	6.7%	7.1%	8.7%
	Not Available for Employment or Study	0.9%	2.3%	1.9%
	Seeking Employment	0.6%	1.1%	3.4%
	Gained Employment	91.9%	89.5%	85.9%
Electronic / Electrical Engineering Degree	Research or Further Study	16.4%	13.2%	12.8%
	Not Available for Employment or Study	2.6%	2.4%	5.7%
	Seeking Employment	2.3%	2.8%	1.7%
	Gained Employment	78.7%	81.7%	79.8%
Engineering Certificate and Diploma	Research or Further Study	57.7%	52.6%	58.6%
	Not Available for Employment or Study	1.0%	1.1%	1.9%
	Seeking Employment	3.3%	1.6%	1.0%
	Gained Employment	38.0%	44.7%	38.4%

Notes: (1) There was a change in survey methodology for graduates of 2001, after which comparable numbers were not prepared. (2) The "Research or Further Study" category has had the small numbers going into "Other Vocational and Professional Education and Training" and state "Work Experience" programmes added to it, to reduce the level of detail in the Table. (3) Separate data was not published on computing certificates and diplomas.

Source: Annual First Destination of Award Recipients in Higher Education Reports, HEA

Since then, despite the downturn in demand for new graduates, graduate unemployment rates have continued to be modest, in part because the propensity of graduates to continue their studies has risen. This can be seen in Figures 7.2 and 7.3, which present data on the situation of degree graduates and certificate/diploma graduates respectively from courses supported under the undergraduate skills initiatives, when surveyed in the spring and early summer after graduation.

Figure 7.2 Situation of Graduates of 2001 to 2003 from Degree Courses Supported Under Undergraduate ICT Skills Initiatives

		2001	2002	2003
Gained Employment	Ireland	58%	45%	49%
	Overseas	10%	9%	7%
Further Study or Training	Ireland	18%	27%	29%
	Overseas	1%	2%	1%
Seeking employment		9%	9%	6%
Not Available for Employment or Study		5%	9%	9%
Total		100%	100%	100%

Source: HEA

Figure 7.3 Situation of Graduates of 2003 from Certificate and Diploma Courses Supported Under Undergraduate ICT Skills Initiatives

	Situation of Graduates of 2003 When Surveyed
Gained Employed	18%
In Further Study	76%
Seeking Employment	4%
Not Available for Employment or Study	2%

Source: McIver Consulting Analysis of HETAC First Destination of Award Recipients Data for graduates of 2003 (Relevant response rate is approximately 41%.)

Anecdotal evidence regarding graduates of 2004 is of a dramatic improvement in industry demand for graduates in ICT disciplines.

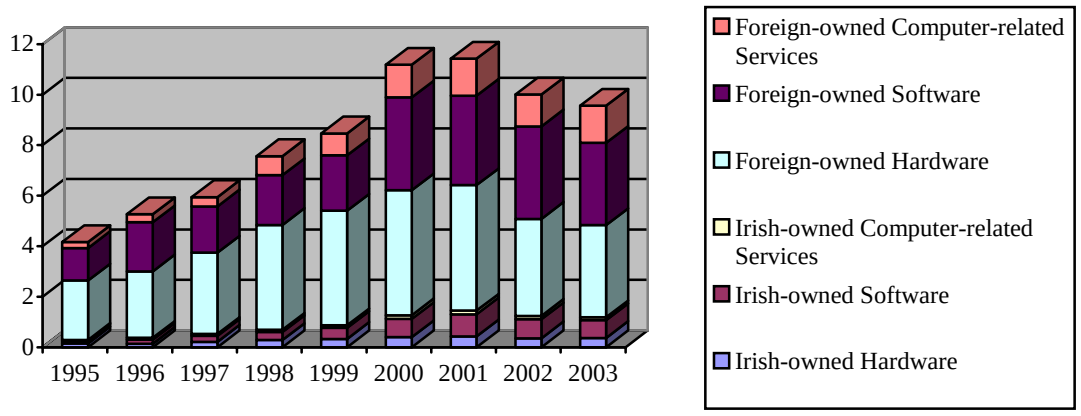
7.3 Impact on National Economic Growth

7.3.1 ICT Sector's Irish Economy Expenditure

The ICT sector impacts on the Irish economy, not just directly, through its own performance, but also indirectly through the money it pumps into the wider economy, through paying its employees and purchasing goods and services domestically.

Consistent with other indicators, the sector's Irish economy expenditure rose rapidly from 1995 to 2000, levelled off in 2001, and fell in 2002 and 2003, as can be seen in Figure 7.4.

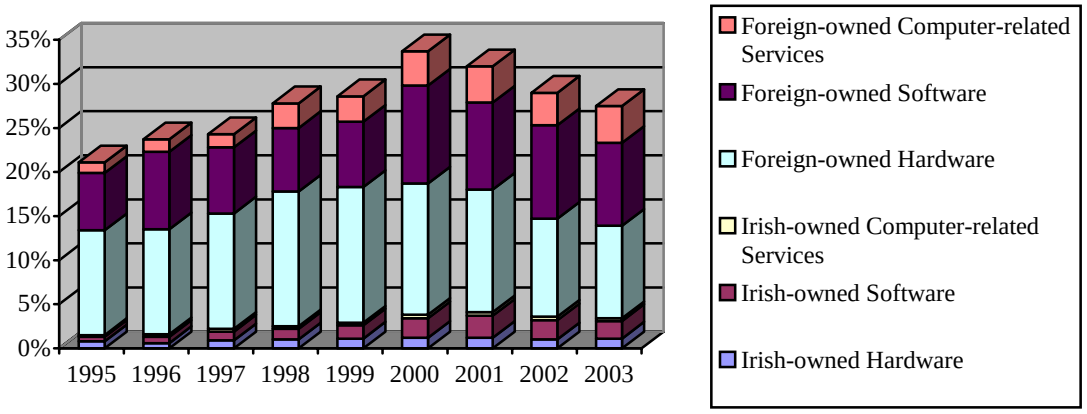
Figure 7.4 ABS Data on Irish Economy Expenditure of ICT Sector (€bn)



Source: Forfás – Annual Business Survey of Economic Impact (2000-03); Irish Economy Expenditure Survey (1995-1999)

Between 1995 and 2000, this brought the ICT sector's share of all Irish economy expenditure by manufacturing and internationally-traded service industry from 21% to 34%. However, by 2003, it was back down to 28%, arising from both the sector's own weakness and strong growth in activity in other sectors (prominently pharmaceuticals).

Figure 7.5 ABS Data on Irish Economy Expenditure of ICT Sector as % of Irish Economy Expenditure of All Manufacturing and Internationally-Traded Services Sectors (€bn)



Source: Forfás – Annual Business Survey of Economic Impact (2000-03); Irish Economy Expenditure Survey (1995-1999)

7.3.2 ICT Sector and the "Celtic Tiger"

The period of rapid growth in the ICT sector, and in the sector's Irish economy expenditure, coincided with the "Celtic Tiger" years of real GDP and GNP growth rates in excess of 7% per annum. It is generally acknowledged that this growth was underpinned by favourable corporation tax rates, a favourable regulatory approach and a stable industrial relations environment. However, these factors applied for a significant time before the period of rapid growth, and have continued to apply since. It is necessary to look for other

factors to explain the cause of the above-trend growth experienced by the economy between 1995 and 2001.

While views differ as to the extent to which the ICT sector's growth was at the root of the rapid growth in the economy, a strong case can be made to the effect that a large part of the above-trend growth experienced by the economy was related to the sector's growth.

Two components appear to have been important:

- The direct impact of ICT sector growth on overall growth in the economy; and
- The indirect impact of the growth in the sector's Irish economy expenditure on activity in the non-traded and weakly traded sectors of the economy.

Based on ABS data, the value added directly by the sector increased by €13.6bn between 1995 and 2001 (€9.6bn at 1995 prices[45]). As an order-of-magnitude indicator of its significance (although they are not strictly comparable[46]) this is equivalent to 27% of the growth in real GDP over the same period.

Of probably greater significance for economic growth was the downstream impact of the sector's Irish economy expenditure. Growth in the Irish economy expenditure[47] of traded sectors is one of the principal drivers of growth in the non-traded and weakly traded sectors of the economy. Between 1995 and 2000, ABS data indicates that the ICT sector accounted for 69% of the real growth in Irish economy expenditures by manufacturing and internationally traded service industries[48]. Together, these industries form a reasonable proxy for the traded sector. (See Appendix A for calculations.)

Taken together, these factors suggest that ICT sector growth was the leading short-to-medium term accelerator of economic growth over the latter half of the 1990s.

7.3.3 Contribution of Undergraduate ICT Skills Initiatives

While it is not possible to quantify with certainty what contribution the undergraduate ICT skills initiatives made to this growth, it seems clear that it would have been significantly less without them. We hypothesise that it could have been cut by as much as half of the 33% (€20.8bn[49]) real growth in GDP actually experienced through 1998, 1999 and 2000. The electronic hardware sector and the foreign-owned part of the software sector relied heavily on expectations as to the future supply of graduates in relevant disciplines, that were based on the skills initiatives, when making inward investment decisions from 1996 to 2001, and the hardware sector relied on the initiatives to produce a viable domestic supply of technicians over the high growth period between 1998 and 2000.

If the sector's growth had been cut in half, this would have had a major impact on the overall rate of growth experienced by the economy. Between the direct impact of lower growth in the sector, and the indirect effects of lower Irish economy expenditure, it could have cut the rate of growth in GDP by a number of percentage points each year.

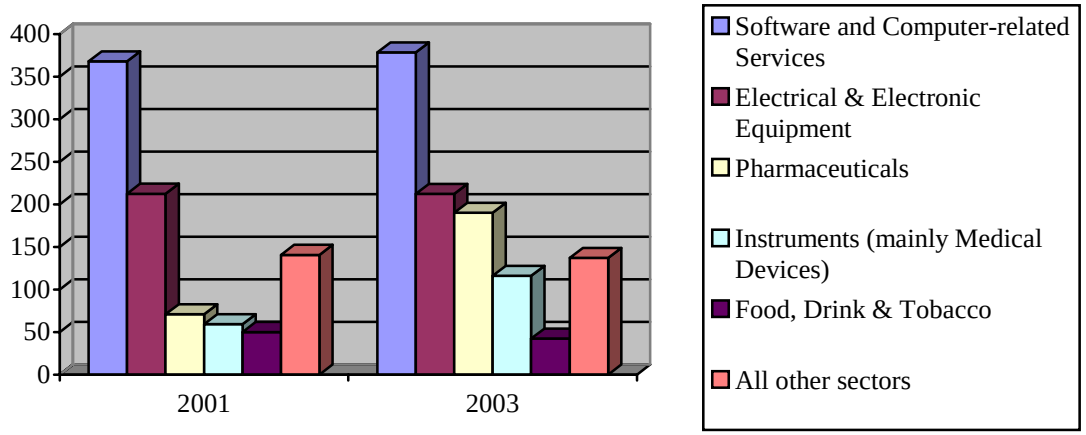
7.4 Impact on Business Expenditure on R&D (BERD)

[45] Using the CSO's GDP deflator.
[46] "Value added" is not perfectly comparable to GDP, as an industry's contribution to GDP is calculated on the basis of value added, less net royalties, and the ICT sector pays significant royalties overseas.
[47] Irish economy expenditure is made up of wages and salaries, purchases of Irish goods and purchases of Irish services.
[48] See Appendix A for calculations.
[49] At 1995 prices. Based on data from National Income and Expenditure 2003, CSO, July 2004.

Increasing Business Expenditure on Research and Development (BERD) is one of the Government's major economic development policy objectives. The Irish Research and Development Action Plan envisages BERD increasing from €917m in 2001 to €2.5bn in 2010, supported by an increase in higher education and public spending on R&D from €422 million to €1.1bn per annum over the same period.

What is often not realised is the extent to which existing business spending on R&D is in the ICT sector, and the extent to which the potential for future growth in R&D spending is also in the ICT sector. The sector accounted for 55% of BERD in 2003 (see Figure 7.6). Along with biotechnology, it is the main focus of new business R&D investment into Ireland.

Figure 7.6 Business Expenditure on R&D (BERD) by Sector (€m)



Source: Forfás – Reports on Business Expenditure on R&D for 2001 and 2003 (published 2003 and 2005)

The undergraduate ICT skills programmes played an important role in allowing BERD to reach €917m in 2001. If there had been lower growth in the sector, it is inevitable that R&D expenditure would have been less. In the electronic hardware sector, the development of R&D has, in many cases, been built on the base of a manufacturing operation. With fewer, smaller and weaker manufacturing operations, as a consequence of an inadequate supply of technicians, it is almost inevitable that there would have been significantly less R&D activity.

Growth in R&D in the software sector would almost certainly have been substantially less without the initiatives. Much of the development work done by the sector is recorded as R&D. Without visibility of a strong future supply of graduates, inward investment would have been less, limiting growth in the development work recorded as R&D.

The increase in the number of students taking higher degrees in computing, which is partly a consequence of the undergraduate skills initiatives, is positive for the expansion of R&D.

7.5 Taxation

The initiatives appear to have boosted the tax take significantly through allowing activity in the sector to increase, particularly in terms of corporation tax and payroll taxes, and through the boost that Irish economy expenditure by the sector gave to other industries.

IDA Ireland indicated in an interview that it estimates its ICT clients pay approximately €500m per year in corporation tax.

7.6 Productivity Growth

According to the OECD, productivity growth in ICT manufacturing contributed 0.9% per annum to average Irish labour productivity growth over the period 1995 to 2001[50]. Thus, the ICT manufacturing sector was one of the main contributors to Irish productivity growth during the Celtic Tiger years. As the undergraduate ICT skills programmes contributed to the growth of the sector, it follows that most likely they made a significant contribution to national productivity growth through the period, directly through the ICT sector.

Capital deepening through ICT investment in the broader economy would also have contributed to productivity growth over the period. According to the OECD, "capital deepening due to ICT investment accounted for between 0.3 and 0.8 percentage points of growth in labour productivity" among its members over the period 1995 to 2001[51]. The undergraduate ICT skills initiatives would have made some contribution to this growth in productivity through technician-level programmes in computing (including the Accelerated Technician Programme), which provided the economy beyond the ICT sector with operationally oriented ICT professionals.

Since the onset of the downturn in demand for graduates in ICT discipline from the ICT sector, the share of graduates entering employment other sectors has increased sharply. Some of these are going into technology roles, some not. But all have the potential to contribute to the more effective adoption of ICTs by the wider economy, potentially boosting the rate of productivity growth attributable to deepening of capital investment in ICTs. Many of the challenges in achieving productivity growth through ICTs combine organisational and technical aspects, and are potentially best addressed by people who combine a strong grounding in technology with broad organisational experience.

7.7 EU Funding

[50] Meeting of the OECD Council at Ministerial Level 2003 – Seizing the Benefits of ICT in a Digital Economy.

[51] The source referenced does not provide data on this for Ireland, but does indicate that Irish spending on ICTs is relatively low in comparison with other developed economies, which suggests that Irish productivity growth attributable to ICT capital deepening may be towards the bottom end of the range.

The Undergraduate Skills Measure is funded under the National Development Plan and part funded by the European Commission under the Community Support Framework 2000-2006. Funding is being drawn down from the European Commission under the European Social Fund (ESF).

Under the 2000-2006 round of funding, the Undergraduate Skills measure funds the provision of third-level places to meet the identified skills needs of the high-technology sector, with particular emphasis on Information and Communication Technologies (ICTs). The programmes supported under this measure include the undergraduate ICT skills initiatives.

The Undergraduate Skills Measure funded under the NDP/CSF 2000-2006 also makes provision for some non-ICT undergraduate courses also approved by the Expert Group on Future Skills Needs.

7.8 Economic Returns to Higher Education

The main economic justification for investment in higher education is based on the expectation that it will produce an attractive rate of return on investment to the individual choosing to study (i.e. the private return), and to society as a whole, including the individual (i.e. the social return).

The economic return to the individual comes through higher income over their lifetime. The economic return to society comes mainly through higher productivity, less risk of unemployment and fiscal benefits over the student's lifetime. Even where wider society absorbs the cost of higher education provision through free fees and grants, the individual makes an investment in terms of income foregone while studying, and expenditure on books, educational materials and college service charges.

Thus, even in the absence of an intent to address specific bottlenecks in an economy, spending on higher education is best analysed as an investment by the individual and by society, rather than an expense.

The OECD publishes figures for both the social and private return on tertiary education, which show strong social rates of return in most countries, particularly in the US, France and the UK (Figure 7.7). However, the figures do not cover Ireland.

Figure 7.7 OECD Data on Rates of Return to Tertiary Education 1999-2000

	Social return on tertiary education %		Private Return on Tertiary Education %	
	Males	Females	Males	Females
Canada	6.8	7.9	8.1	9.4
Denmark	6.3	4.2	13.9	10.1
France	13.2	13.1	12.2	11.7
Germany	6.5	6.9	9.0	8.3
Italy	7.0	-	6.5	-
Japan	6.7	5.7	7.5	6.7
Netherlands	10.0	6.3	12.0	12.3
Sweden	7.5	5.7	11.4	10.8
United Kingdom	15.2	13.6	17.3	15.2
United States	13.7	12.3	14.9	14.7
Country mean			**11.8**	**11.3**

According to OECD, the sample for female graduates in Italy was too small.

Source: Education at a Glance 2004, OECD

The European PURE ("Public funding and private rates of return to education") project, published in 2000, found that the private return to higher education for women in Ireland was the highest among the 15 participating countries, at almost 14%. It found that the private return for men was lower (9%), but still among the leaders, being less than 1% behind the UK and Portugal, and similar to Switzerland.

Given this, and that fact that most Irish students (and their families) cover their own living expenses while at college, we suggest that the likelihood is that Ireland's public return to education is, like that of the UK, towards the higher end of the range visible in Figure 7.7.

It seems reasonable that an assessment of the economic impact of the undergraduate ICT skills initiatives should take account of the return that would be anticipated from any untargeted programme. If untargeted programmes produce attractive returns for the economy, then a targeted programme with similar costs and a similar expected graduate lifetime employment profile, will be expected to produce similar attractive returns.

Then, a relevant question to ask is: "How is lifetime social return per student from the undergraduate ICT skills initiatives likely to differ from that on other higher education programmes?" The evidence presented through this section suggests that the return is likely to be significantly higher than average, despite the downturn in labour market demand experienced between 2001 and mid-2004.

Section 8
Recommendations for Alternative Approaches

8.1 Introduction

The fifth, and final, question posed by the terms of reference for the research is as follows:

> *"What recommendations can you put forward in relation to alternative approaches to the provision of qualified ICT graduates?"*

The content of this chapter is based both on points raised by people interviewed for the research, and on conclusions drawn by the consultants.

8.2 Need for Attention to ICT Skills Supply

The near-universal view of companies consulted is that it is important for the State to take an interest in the supply of graduates in disciplines relevant to the ICT sector, particularly in computing and in electronic engineering. The sector forms a substantial part of the economy, and depends for its success on being able to recruit sufficient highly skilled professionals.

The period of strong demand for technicians is probably over. Those companies that still need to source technicians can mostly source enough from the pool of experienced people in Ireland and overseas, by upskilling operatives, and from the decreasing number of graduates in relevant disciplines who complete their studies below honours bachelor degree level.

The need for the future is to assure the supply of people with qualifications in computing and electronic engineering at primary degree level and higher degree level.

8.3 Focus on Graduate Quality

Many of those interviewed feel that there is a need to focus more on producing very high quality graduates. They see this as being competitively necessary if the ICT sector is to continue to thrive.

They argue that there should be at least some courses in computing and electronic engineering positioned, and resourced, so as to be competitive with world leading courses, such as in Cambridge, Stanford or MIT. They argue that these courses should be taught by people doing research at an internationally competitive level. They argue that such courses will have the indirect benefit of attracting people to study these disciplines.

More generally, they argue that there is a need to maintain the focus on graduate quality through all programmes in these disciplines. While boosting the supply of graduates is important, it is even more important to make those who take up places on courses in these disciplines into the best graduates possible. The Government must continue to invest, particularly at primary degree and higher degree levels.

These interviewees see improved resourcing and, where it is not already part of a course, well structured industry internships, as forming a critical part of the package of reforms that is required.

8.4 Funding as a Lever

The consultants believe that the Department of Education and Science and the HEA should reward higher education institutions that are successful in recruiting students to study in ICT disciplines, and are successful in ultimately graduating them. While the relevant departments, schools and faculties have a financial stake in achieving this, taken as a whole the financial incentives for educational institutions are fairly neutral between disciplines. If institutions had a clearer financial stake in producing graduates in computing and electronic engineering, this would be likely to boost the prospects for success in restoring student intake and graduate numbers considerably.

It could also be used as a basis for resourcing the focus on graduate quality described in the preceding point.

It is understood that the Minister for Education & Science envisages that the Incentive Fund for Third Level Institutions, currently in planning, will give consideration to outputs of graduates from disciplines of key national priority. This may be an effective way to reward institutions appropriately.

8.5 Postgraduate Degrees

There is an increased need for people with postgraduate technology degrees. Some organisations that previously recruited mainly people with primary degrees now recruit mainly people with Masters degrees, and increased numbers with both Masters and PhD degrees are required for research.

While the various research programmes operated by Science Foundation Ireland, the HEA and IRCSET are doing a lot to boost research degrees, there is also a need to maintain and increase Masters level provision, both full time and part time, with a mix of taught provision, research provision based on the needs of the students' employer, and more mainstream research provision based on research funding programmes.

Interviewees from number of major companies stressed the importance of investment in research, particularly through Science Foundation Ireland, as a driver of PhD supply and high quality undergraduate teaching.

8.6 Schools as Drivers of Interest in Studying Discipline Relevant to ICT

Many of those interviewed are very concerned about the expected decline in the number of graduates from courses in computing and electronic engineering. Predominantly, they have focused on a need for reforms in the school system as the basis for addressing the problem over the long run.

The main points made are as follows.

- That the Department should help Guidance Counsellors to be knowledgeable of the ICT sector, so as to allow them to advise students effectively.
- That existing efforts to promote careers in the sector are disjointed, and are resourced inadequately.
- That the school system is moving too slowly to exploit ICTs, and learning based on solving unstructured problems, in the classroom, and that this will

compromise students' capability to operate effectively in the workplace of the future, and distance them from technology industry.

- That there is still a need for problems with the take-up of physical sciences and higher-level mathematics at second level to be addressed.

The consultants suggest that there is a need for a renewed focus on reform in these areas at second level. It seems likely that a new shortage of ICT graduates is on the way, given the steep fall in student numbers in computing and electronic engineering that has already occurred. This may inspire the sense of urgency that will be needed if the barriers to reform are to be overcome.

The recent announcement of new Guidance Counsellor positions may present the best opportunity in many years to do something about the problems with career advice.

8.7 Immigration

Most interviewees stress that **overseas recruitment** already plays an important part in their recruitment strategy, and that they expect it to continue to be important.

- Most ICT companies rely on recruitment of overseas nationals for a significant proportion of their experienced hires.
- Companies looking for high-end graduates (PhDs and 1st/2:1 honours primary degrees from top academic programmes) rely on recruiting from overseas institutions for a significant part of their requirements.
- However, if too many are recruited from overseas, this starts to raise questions about whether Ireland is the right place for an operation.
- Even since the expansion of the EU in 2004, immigration policy remains an issue. Some companies report sometimes having difficulty in getting timely permission for temporary transfers from operations outside the EU, for training or project purposes. Some companies have an interest in recruiting from outside the EU, to get access to skills that are in short supply within the EU. One example mentioned is that of experienced COBOL programmers. Another is that of top graduates in electronic engineering, who can probably be sourced in Eastern Europe now, but who will be less available to Ireland once Germany and France open up to immigration from the 2004 accession states.

8.8 Alternative Approaches to Degree Graduate Supply

It appears likely that a significant mismatch between demand and supply for honours degree graduates in computing and electronic engineering is emerging, with demand growing, as graduate output falls. While it will be important for degree providers to respond to any increase in demand for places on degree courses, it will take four to five years for this to have an impact on graduate supply. An approach with a lower lead-time will also be required.

The likelihood is that demand from students for relevant courses will rise as demand from industry rises.

In computing, graduate diploma conversion courses are well established as a means of producing additional graduates who can substitute for computing degree graduates in some,

but not all, positions. It will be important that colleges do not face funding constraints in adding places on these courses as demand rises.

Some suggestions emerged in interviews that colleges should consider providing more specialised graduate diploma courses, that offer less breadth, but develop a significant level of skill in a specific area.

There will be a need to consider other innovative ways of responding to demand quickly. These could include:

- Add-on ordinary bachelors and honours bachelors degrees in business information systems (half business, half computing) for business students;
- New third year and final year options in electronics design for engineering students from a range of disciplines and for computing students; and
- Graduate diplomas and taught masters degrees in electronics design for engineering graduates from a range of disciplines, computing graduates and graduates in physics.

It will be important that colleges do not face funding constraints in providing such courses as demand rises.

Looking to the longer term, there is a need for a greater diversity of course provision at degree level, with mores cross-disciplinary courses combining, for example:

- Business with computing (business information systems);
- Biological sciences with computing (bioinformatics); and
- Electronic engineering design with software engineering.

8.9 Course Design

Issues relating to degree level **course design** that interviewees tended to highlight include the following:

- Co-op / work placement / intern programmes, which are part of most computing and electronic engineering degree programmes, are seen as being highly valuable in preparing students to operate in a working environment. Many interviewees were of the view that they should form a part of all degree level ICT programmes. While the primary reasons for providing placements are to do with maintaining close relationships with the education system, some interviewees indicated that students "on co-op" make a significant contribution to their companies.
- Interpersonal/teamworking/communications skills of graduates have generally improved, but the need for strong skills in this area is also increasing, and there is room for further improvement on many courses.
- Some interviewees suggest that there is a need for an increased focus on project management skills
- Interviewees suggest that some courses need more practical project work, so as to ensure that graduates have useful skills as well as a good education when they enter the labour market.

8.10 Continuing Education and Training

A number of interviewees highlighted a need for substantially more activity in continuing education and training of graduates, particularly in indigenous ICT companies, many of which are weak in this area. The problem appears to be linked to the small size of many companies.

Appendix A

Figure A.1 Change in Irish Economy Expenditure (€000) by ICT Sectors and by All Manufacturing and Internationally-Traded Services Sectors, 1995 to 2000

	1995	2000		Change 1995 to 2000	As % of Change Across All Manufacturing and Internationally Traded Sectors
		Nominal	(1995 prices, using GDP deflator - 1.231)		
ICT Sectors	4,159,050	11,182,699	9,084,240	4,925,189	69%
All Mfg. & Int'l Traded Sectors	19,837,686	33,242,944	27,004,828	7,167,142	100%

Source: Based on Forfás ABS data, and on CSO GDP deflator