Computing Careers and Irish Higher Education: A Labour Market Anomaly

Simon Stephens, David O'Donnell & Paul McCusker

Simon Stephens
Letterkenny Institute of Technology
Port Road, Letterkenny, Donegal County, Ireland
Tel: +353 (0)74 9186715
Fax: +353 (0)74 9186701
Email: simon.stephens@lyit.ie

David O'Donnell
Intellectual Capital Research Institute of Ireland
Ballyagran, Limerick County, Ireland
Tel: +353 (0)876821032 Email: david.odonnell@ireland.com

Paul McCusker
Letterkenny Institute of Technology
Port Road, Letterkenny, Donegal County, Ireland
Tel: +353 (0)74 9186520 Email: paul.mccusker@lyit.ie

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Abstract: This paper explores the impact of developments in the Irish economy and labour market on computing course development in the Irish Higher Education (HE) sector. Extant computing courses change, or new courses are introduced, in attempts to match labour market demands. The conclusion reached here, however, is that Irish HE is producing insufficient numbers of computing graduates notwithstanding the anomalous fact that the capacity to produce them is available in the Irish HE sector. Manpower planning is inefficient and IT skill shortages remain not as a result of poor industry/HE relations but because of a lack of understanding of Irish student perceptions, preferences and expectations. Pressures for radical institutional change are probably unlikely to emerge as skill gaps are being filled by immigrants with the requisite skills.

Keywords: computing; Irish higher education; manpower planning; skills shortages; student perceptions.

Introduction

For the purpose of this paper the term manpower planning refers to a governmental strategy that seeks to align output of the Higher Education (HE) sector with labour market demands. Computing careers, within the broad context of the Irish ICT sector, provides the context. The initial stage of this manpower planning process was the creation of the Expert Group on Future Skill Needs (EGFSN) in 1997. This group projected a large demand for computing graduates over a ten-year period in their

first report published in 1998. The Irish government proactively responded by prioritising funding for HE research, infrastructure, recruitment and course development in this area. This resulted in an expansion of computing departments in Irish HE in both the Universities and the Institutes of Technology (IoTs). Yet, supply of appropriately skilled computing graduates failed to meet demand. This is the 'gap' addressed in this paper which begs the following questions: What is the nature of links between the needs of the labour market and course development in Irish HE? What has the impact been on computing departments in HE? How have students responded to changes in course provision? Have changes in second level applications been matched by delivery of appropriately skilled graduates? Finally, what strategies are emerging to resolve current difficulties?

Context

The Irish HE system comprises the university sector, the IoTs and the colleges of education; all are substantially state funded. Since the 1960s the number of HE students has grown from 18,200 to almost 130,000. These rapid advances reflect the success of retention strategies at second level following the abolition of second level fees notwithstanding its continuing class-biased nature (see Clancy & Wall, 2000; O'Donnell et al., 2001), unique demographics, and higher transfer rates into HE. The last 40 years have witnessed significant changes in occupational structure. Traditionally power and status in Ireland were based primarily on property but are now rooted in educational competence and waged employment (Farnham, 1999; O'Donnell et al., 2001). The ability of educators, policymakers and business to persuade students of the value of a higher level education has significantly contributed to economic success.

The seven universities are autonomous and self-governing. The thirteen Institutes of Technology (IoT), in emergence since the 1970s, differ in that they are centrally managed by the Department of Education & Science but with autonomy in course provision introduced recently via 'delegated authority'. This allows each IoT to become a self awarding body in its own right. Acknowledging the landmark joint Government/OECD report *Investment in Education* (1966), the starting point for recent HE reforms is the white paper *Charting the Future of Education* (1995). The principles of this document address the role of HE in advancing social and economic well-being; rights, equality, pluralism, partnership, accountability and the importance of knowledge and skills for national competitiveness and development (Skillbeck, 2001).

Understandably, considering the very rapid rates of GDP and labour market growth, much concern is expressed with shortages in the labour market of highly trained personnel and the need for continual upgrading of knowledge and expertise. Targets have been set by government, industry bodies and HE, which include substantial enrolment increases, innovative course design, course redevelopment and the introduction of a variety of support measures, including allocations of substantial state finance to the HE sector.

From the mid-1970s onwards planning to meet the training needs of technicians and other skilled workers was a matter for consultation with the Confederation of Irish Industry and the Irish Congress of Trade Unions (ICTU) in co-operation with the National Manpower service. The HE sector had taken on board the necessity of being responsive to the demands of a rapidly industrialising society, but industrial planners were far less aware of what was actually happening in the education system. The HE system was very much influenced by what had become industrial and economic policy with 'no reciprocation' (White, 2001). The formalisation of this linkage occurred with the creation of the Manpower Consultative Committee in 1978. This committee, in association with four universities, six regional technical colleges (RTCs; now Institutes of Technology) and a number of associate colleges, developed a programme which enhanced intake into twenty-two existing courses, brought additional options to five others, and introduced thirty new courses and fifteen short-term conversion courses for graduates (White, 2001). The resulting increase in graduates went some way towards alleviating skill shortages at that time. The relative success of this initiative marked a turning point in the way Irish Industry viewed HE and in the whole area of manpower planning and forecasting. The result was a pattern of course development designed to largely mirror the needs of a developing economy.

Demand for computing graduates is now driven by the very impressive growth of the Irish economy in more recent years where it is consistently at the top of the OECD growth table with an average GDP growth rate of 7.5% between 1995 and 2005 and the fourth highest GDP per capita in the world in 2005 (OECD, 2006). The unemployment rate has stabilised around 4%, in comparison to ~16% in 1993. Employment has increased from 1.1 million in 1991 to 1.9 million in 2005, an almost 40% increase in the past decade. Emigration has been replaced by immigration and the emergence of a more cosmopolitan society. While the increase in labour force participation rates to 62% by 2005, particularly for Irish women (from 47% in 1995 to 61% in 2005), was the

primary driver of the recent expansion in the Irish labour market, inflows of migrant workers (2.4% in 1994 to 8.2% in 2004; 70,000 in 2005 alone) also contributed generously, providing additional supply (EGFSN, 2006; OECD, 2006).

The information and communications technology (ICT) sector is one of the key drivers of such growth attracting massive inflows of foreign direct investment (FDI), in particular from the United States. US FDI now exceeds 70 billion US dollars and the 600+ US firms within the Irish economy export over €50 billion, pay €2.5 billion in corporation tax and over €17 billion in payroll and services annually, and employ over 100,000 workers. The key attractors of such FDI are the competitive corporate tax rate of 12.5% (in comparison to an EU average of 30%) and the availability of a very highly skilled subset of the Irish labour market in business, science, technology and ICT. The very high reliance on FDI in selected manufacturing sectors, particularly ICT and PharmaChem, and internationally traded services is the principal economic driver resulting in a major shift in investment, employment and population towards Dublin and, to a lesser extent, to the other major cities.

Since 1987 there has been increasing pressure on Irish HE to contribute directly to such growth. The neo-corporatist partnership agreements in place since 1987 project the view that all social partners, including HE, are expected to play an active role in sustaining Ireland's economic development. A major factor behind this pressure is the growing concern about future competitiveness and the changing nature of the Irish economy and labour market (Tansey, 2005). EU institutes and the World Bank now regularly put forward the argument that the output of higher education and training systems, in terms of both quantity and quality of skills at all levels, is a prime determinant of a country's level of industrial productivity and hence competitiveness. This is the neo-classical economic argument; but on its own, as the Irish situation with regard to the supply of computing graduates shows, it is insufficient as a guide to national skills policy. Evaluations tend to be dominated by economic models, but the Irish skill system can only be adequately understood with reference to the complex set of inter-relationships between the education system, industrial training system, the organisational structure of industry, the industrial relations system and the class and status relations of the wider society as reflected in its political system (O'Donnell et al., 2001; Maurice et al., 1986).

This new economic prosperity has led, inevitably, to increases in labour costs, and Ireland now faces significant competition from low-cost emerging economies (Crawley & O'Sullivan, 2006). Many lower value manufacturing activities are being lost

or outsourced to such lower labour cost locations. Companies such as Fruit of the Loom for example, which manufactured textiles in Donegal and at one stage employed thousands, have moved to Morocco. Many experts now advise a transition to an innovation driven knowledge economy through the uptake of high value-added activities. Sustainable job creation requires that Ireland provide a business environment that supports increasingly complex and skilled manufacturing, R&D, and service activities. It must also enable firms, both indigenous and foreign-owned, to develop and produce innovative new products, services and production processes. This scenario is dependent on flows of such enabling human capital from the education system. Policy makers now locate HE as central in their economic strategies as low-cost manufacturing, the first phase of Ireland's economic development, is no longer an option. It follows that the standard of educated manpower is a key economic determinant leading to the provision of new courses, up-skilling and life-long learning initiatives. As addressed in this paper, industrial and labour market demands are a catalyst for course changes in HE but with often unexpected results.

Methodology

For the purpose of this scoping piece the mixed methods approach of 'sequential explanatory strategy' (Creswell, 2003) is used. The method was employed as follows; data from a number of sources including policy documents, publications and the websites of FÁS (National Employment/Training agency), Economic & Social Research Institute (ESRI), Central Statistics Office (CSO), Central Applications Office (CAO) and the Higher Education Authority (HEA) were analysed. The views of the Heads of Computing Departments in the seven universities and thirteen Institutes of Technology (IoTs) were sought, and nine responded. Eight computing students were also interviewed. The purpose here was to explore why computing has experienced difficulties and to identify any approaches in emergence to dealing with them. This qualitative evidence was used to assist in interpreting the findings, the main one being that Irish HE is producing insufficient numbers of computing graduates notwithstanding the perplexing fact that the capacity to produce them is readily available within the Irish HE sector.

Developing HE computing courses to match labour market demand

Emerging trends in the Irish labour market are similar to those in most developed economies with an increasing demand for highly skilled professional and skilled service workers in parallel with a declining demand for unskilled manual and agricultural workers. This indicates an increasing value placed on HE as the primary supplier of a labour force capable of meeting the changing needs of a predominantly high-skill economy. The Expert Group on Future Skills Needs (EGFSN), set up in 1997, identified a skills shortage for professionals and technicians in engineering and computer science in their first report in 1998. The result was a government attempt at manpower planning. The primary emphasis of the Department of Education & Science, and the Department of Enterprise & Employment, has remained in these key economic areas of engineering, science and technology. To the extent that education is necessary to securing a vibrant economy, the state has an interest in maintaining forms of education that develop economic aims and thus a *prima facie* right to develop such forms of education (Winch, 2002). It is within this emerging more neoliberal context that HE institutions have developed courses in areas with identified skill shortages, such as computing.

Saunders (2000) outlines the various perspectives that have been used over the last thirty years to explain the nature of the relationship between HE and the labour market. A comprehensive review of the same period in Ireland is not feasible within this paper (see O'Donnell et al., 2001; Tansey, 2005), but a brief description of the change in philosophy is necessary to set the context. The original HE model in Ireland was based on a small number of 'elitist' universities with a predominantly liberal philosophy. The move to a more vocational approach first emerged in the late 1960s with the creation of Regional Technical Colleges (now IoTs) and the first efforts at widening participation. The present system projects a widening access agenda in place of the previous elitist ideal. Linkages to industry and labour market needs are prioritised. von Humboldt's (1969) republican ideal, with the state not looking to 'the universities for anything that directly concerns its own interest (but) rather cherish(ing) a conviction that in fulfilling their real function, the universities will not only serve the state's purposes, but serve them on an infinitely higher plane' is deemed to have passed its sell by date, albeit with some dissenting voices within Irish HE, as the neoliberal marketisation agenda grows ever stronger (see Lynch, 2006).

With the creation of EGFSN the needs of the labour market and economic and industrial concerns enter much more explicitly into HE course design, development and funding as an aspect of manpower planning. The effective role of HE is now to furnish entrepreneurial research prowess and educated labour for a knowledge economy. This is explicit in policy documents with a requirement to align HE curricula with the changing needs of the industrial and service sectors (EGFSN, 2004). This results in initiatives such as the Scientific & Technological Education Investment Fund Group (STEF):

> In the university sector, €43 million was allocated towards the creation of 3,900 additional places to meet the skills needs of high technology industry. This investment enabled the commencement of seven major capital projects across the sector, all of which are designed to increase the throughput of computer and electronics graduates to keep pace with industry needs. (STEF, 2005)

The paper now proceeds to present some statistics on course provision, applications, and graduates. The research scopes to see if Irish HE provided new courses in areas specified by economic pressure and how and if students reacted to such changes in provision. The entire range of university degree courses available to students was analysed by systematically working through the yearly lists and recording the changes that occurred. In all twenty seven degree courses were removed from the CAO system between 1998 and 2006. Surprisingly the area of science and computing accounts for a third of these courses. Further analysis showed that the pattern of removal is similar to those in the commerce/business group, namely - courses removed are those that include a language stream. One possible explanation is that immigration is filling the language gap, with employers using immigrant native speakers rather than Irish language graduates. The ready availability of such ‘languages’, for example, was noted in Google’s recent decision to expand its Dublin operation by over 700 employees.

Analysis of new degree courses shows evidence that university HE has introduced over 50% of new courses in the key areas of science and computing. The same level of analysis was not undertaken on courses delivered by the Institutes of Technology, but a preliminary review also indicates a strong pattern of increased course provision in the areas of science and computing. Student demand for courses can be measured by first preference CAO applications. Entry to all HE courses in Ireland is based on a common points system. All applicants for a particular course are ranked based on the results of the Leaving Certificate – the final second level examination. Students are awarded between 100 points for an A1 in a higher level subject to 5 points for a D3 in an ordinary

level subject; the total points score is based on the six best results. HE places are offered from the top of the ranking downwards, until all of the places on a course are filled. The points achieved by the student who obtains the last available place represents the points requirement to gain a place on a course in any given year. The points required to get a place in a particular course change, depending on the number of applicants, the standard of results nationally, and most significantly the demand for particular courses.

But what do these new courses and changes in application patterns mean in terms of an end product, that is, graduates? Table 1 shows the changes in university graduate numbers in different academic areas between 2000 and 2004. This expansion in course numbers coincides with a period of manpower planning as prescribed by the EGFSN. The result is evident in Table 1. The decline in science graduates is continuing while the engineering area remains reasonably stable. The increase in computing graduates (+120%) demonstrates the initial success of the manpower planning initiative emanating from the initial work of the EGFSN, government support, and the HE response. However, following this first rush, the number of applications to, and graduations from, university computing departments went into serious decline.

Table 1. Changes in the number of Irish University Graduates, 2000-2004.

Degree Courses	2000	2001	2002	2003	2004	% Change 2000-2004
Education	732	883	1096	1153	1198	+ 64%
Humanities & Arts	4281	4361	4721	4761	4028	- 6%
Social Sci., Business & Law	3473	2571	3529	3629	4080	+ 17%
Science	2408	2198	2147	1799	1879	- 22%
Engineering, Manufacturing & Construction	1436	1496	1382	1499	1351	- 6%
Agriculture & Veterinary	295	188	193	242	272	- 8%
Health & Welfare	938	867	852	1149	1307	+ 39%
Computing	**481**	**732**	**860**	**740**	**1058**	**+ 120%**

***Source**: Adapted from http://www.hea.ie/uploads/excel/AwardsFTUGDegField05.xls*

Computing was an area specifically targeted by government in the late 1990s as a result of perceived skill shortages and increasing demand. The CAO system requires students to formally accept the course that they are offered. In terms of degree acceptances by discipline (Table 2.), it is clear that computing is not now attracting new entrants at a level sufficient to meet Irish labour market demands. Between 2000 and 2005 the number of acceptances into university computing departments declined from

1,809 in 2000 to 995 in 2005. Government efforts at manpower planning have been ineffective in attracting substantially greater numbers of student entrants into computing departments.

Table 2. Total Acceptances by Discipline for University Degree Courses, 2000-2005.

Degree Courses	2000	2004	2005	% Change 2000-2005
Computing	**1,809**	**889**	**995**	**- 45%**
Technology/Engineering	6,577	5,685	5,982	- 9%
Health, Veterinary & Agriculture	1,163	3,551	3,650	+ 214%
Other	12,988	15,574	15,352	+ 18%

Source: *Adapted from SLMRU (2006, p. 43).*

With this combination of ever diminishing applications to, and graduations from, computing departments it is unsurprising that the EGFSN and others will continue to report skill shortages in a range of computing professions. The supply-demand gap is negative and this will continue to widen over the next four years (Table 3.).

Table 3. Demand-Supply Gap for Computing Graduates, 2006-2009.

Year	2006	2007	2008	2009
Supply Gap	- 941	- 1511	- 1854	- 2242

Source: *EGFSN 4th Report presented to Government (2003)*

Something strange is obviously going on here. This decline is happening at a time when computing careers are readily available, HE has the resources to produce many more computing graduates, and projections for the future of the Irish ICT sector, and economy in general, are very positive. The simple supply-demand curves of the neoclassical economists do not appear to work here. We tease out some insights on this anomaly in the following section.

Perceptions and misconceptions

This section of the paper provides a snapshot of the experiences and perceptions of HE computing heads and some computing students during this period. The focus is on identifying some preliminary insights on why applicant and graduate numbers appear unresponsive to manpower planning and to identify what strategies, if any, are emerging to deal with this anomaly. The Heads of Computing departments in the seven

universities and thirteen IoTs were requested to describe the changes that have occurred in their departments since the first EGFSN report in 1998 and to offer some explanations for these changes. In addition eight students who applied for degree courses in computing in 1999/2000 were interviewed to understand their motives for entrance and their experience during their studies. The eight students interviewed had very different experiences. Three are now successfully working as computing professionals, three dropped out of a degree programme in computing in the first year, one left a job in computing to start a Law degree and the final interviewee transferred from computing after two years into a Business degree. The recent cycle of computing in Irish HE is succinctly captured as follows:

> 'Student numbers have dropped significantly. Just one example - for the former National Diploma in computing - in 2000/01 there were 193 CAO 1st preferences and 1845 mentions (listed in a students top ten preferences) compared to this year (2005) with only 4 CAO 1st preferences and 221 mentions'. (Head A)

Student numbers have fluctuated significantly, rapid increases between 1996/2001 and decreases since. The emergence of computing as a new and exciting career alternative with excellent job prospects meant that large numbers of students enrolled initially. But the reality for many students did not match their expectations; as one student who dropped out in the first year put it:

> 'Sounds cool and with a job guaranteed it was 'for me' - but by March I had enough. The course was so boring and there was tons of maths … I don't know, I thought it would be more hands on'. (Student D: dropped out in first year and now works in administration)

The challenge of mathematics is a constant theme among the responses of students, especially those students who did not complete their computing courses. This parallels the issue at second level where CAO statistics show that in the period 2000–2006 an average of only 15% of students sat the higher level mathematics paper in the leaving certificate. The emphasis on mathematics in conjunction with hours of theory and thought programming left certain students disappointed:

> 'Of course the promise of a job was a factor but it was more the fantasy of being am … like a hacker … I know that's the wrong term but saying you could do stuff like that' (Student C: transferred into a business degree after two years on a computing course)

The experience of family members and friends suggests that potential students have now become wary of selecting computing courses especially in light of poor publicity regarding the future of IT surrounding the demise of the dot.coms which resulted in a loss of confidence in career prospects in computing. Yet the Irish ICT sector continued to grow throughout this period and resiliently weathered the global downturn (O'Donnell et al., 2004). It now continues to grow vibrantly. Yet, HE institutions have struggled to reverse this trend, tackle the negative perceptions, and remove the

> '… misconception that computing is a subject for nerds and that the course is all programming … in fact, it is only twenty percent'. (Head D)

This perceived misconception is not borne out when speaking to students who changed from computing to other courses;

> 'Guys I knew were getting companies to sponsor them and getting free laptops so they were students with money and promises of jobs … so I thought I would try it. But changing to doing arts was way better … (the) work load was better and more interesting so I was motivated more than when I thought there was a job in it'. (Student F: dropped out in first year; after a 'year out' this student went back into HE and completed an MA in History)

The message is somewhat different when computing students who 'stuck it out' reflect on what they have achieved and where they are now:

> 'I am really glad I stuck out the maths … the job is great, loads of travel and it's great when you arrive somewhere and the system is a total mess and then you sort it out. Loads of people hate technical stuff so you kind of get a status when you're the guy who can fix it'. (Student A: obtained a position as a programmer immediately after graduation. He has recently completed a Masters degree with the aid of sponsorship from his employer)

The data presented above shows that there was an initial rapid rise in students undertaking computing courses but that this quickly dropped—a phenomenon noted over and over again by the heads of Irish computing departments:

> 'In the late 1990s there was huge demand for graduates. We could fill our courses three times over. Eight years later we cannot meet the demands of industry. Students very much follow fashion and very much have a collective rush to what is popular and trendy'. (Head B)

> 'We have seen fewer students, year on year, in the last five years. I think the perception is that the computer industry is in trouble but the reality is

> that very few computer companies have closed in the last year. We know that there have been closures and redundancies in computer manufacturing but it is not the same in the high skills area where a lot of the vacancies exist. High tech knowledge is difficult to move'. (Head F)

The rapid drop off in applications can be explained, if in part, by fashion, lessons learnt, and an erroneous belief that there were no jobs, despite one head citing statistics such as 'last year we had 145 graduates—143 are now working and only two are between jobs' (Head D). The consequence of this period of perceived depression is that computing departments are undertaking reviews and revisions in attempts to reverse the trend of falling numbers.

> 'Staff numbers originally rose to match student numbers but as student numbers dropped any staff who left were replaced with part-timers. Since 2000 we have redeployed many of our lecturing staff to IT courses in our business school'. (Head E)

These anomalous developments have tarnished reputations, damaged the morale of students and staff and created an atmosphere of negativity in HE computing departments. Despite claims by the various Heads that computing is misunderstood, the students interviewed, albeit a small sample, consistently referred to negative personal, peer and family experiences. As noted above, extra course and infrastructural provision in HE did not result in sustained increases in student demand or sufficient growth in graduates. This is reflected in low completion rates and falling points thresholds for entry. The students interviewed applied based on two key factors. Firstly, they conceived computing to be 'hands on' and were unaware of the emphasis on mathematics. Secondly, the promise of a job in a country just emerging from twenty five years of large scale emigration was a major incentive in the mid to late 1990s and pressure from family, second level teachers and peers who knew the value of employment encouraged participation in computing degree programmes offering job opportunities. But this did not last; student perceptions changed and thus far have not morphed back to match the reality of a vibrant ICT sector and booming economy and the opportunities that both unquestionably provide for computing graduates. As Pat O'Connor, head of the ICT skills project group at the Higher Education Authority (HEA), put it in 2004:

> 'Now we have the prospect in the coming years of not just core companies such as IBM, Microsoft and Oracle, but also our key industries such as Financial Services, looking at a supply of (computing) graduates that will fall far short of their requirements. So, if nothing is done to alter perceptions,

> Irish industry faces a return to recruiting overseas to fill its needs for computer professionals'. (www.hea.ie)

Dramatic media headlines on some closures and job losses in, for instance, personal computer assembly operations over the past few years have led to a sharp fall-off in the numbers of school-leavers applying for HE computing courses; yet the demand for computing graduates from the Irish ICT sector and the broader economy is robust and these job losses relate mainly to semi-skilled assembly operators. O'Connor's group produced a DVD for distribution to second level career programmes with the message that (i) jobs will be plentiful, (ii) one doesn't need to be a mathematics genius, (iii) jobs are varied, rewarding and people centred, and (iv), jobs are and will be available in all sectors, not just in hardware manufacturing or software design. In light of diminishing applications and fewer graduations, the fact that the numbers of female applicants is also decreasing, and the view among computing educators that a reduction in the points threshold for entry is resulting in unmotivated students and a drop in the overall skill level of cohorts - a review process commenced. This review at the various HE institutions resulted in a range of initiatives:

- Increase in the range of subjects in response to skills shortages.
- Introduction of new undergraduate levels.
- Introduction of postgraduates to facilitate student progression.
- Refinement due to a fall in demand.
- Diversification of cohorts.
- Extra postgraduate and progression courses.
- New streams (e.g., games).
- School liaison officers.
- IT Tutors to aid student performance.
- Industry advisory panels & guest lecturers.
- Computing staff sabbaticals.

This is a comprehensive range of proposals. A tutoring system should aid the progression of students who may struggle with mathematics in the early stages. Advisory panels and guest lecturers should make courses more relevant to the working world but whether this affects the level of 'hands on' work is unclear. The introduction of new streams, especially gaming, in conjunction with the introduction of school liaison

officers may help to reverse the perception of computing students as ‘nerds’ and should provide applicants with a more realistic idea of what ‘doing’ computing at HE level entails.

Some students choose computing because it was an area that they were interested in and others were drawn away from their original choices by the promises of good jobs and high earnings. The failure of initial increases in applicants to produce graduates in sufficient numbers can be attributed to student misconceptions about what a degree course in computing involves. The initial wave of applicants tended to have somewhat negative experiences; coupled with the demise of the dot.coms there is now a perception among potential applicants that computing is ‘boring’, for ‘nerds’ and has poor job prospects; all mis-conceptions at variance with Irish economic realities.

The changing nature of skill demands is highlighted by the EGFSN, and given the strong linkages between economic needs and course design many key actors continue to express confidence that this challenge will be met. We are not convinced. The numbers do not support such confidence and an increasing number of vacancies are being filled by immigrants (FÁS/EGFSN, 2006) – the probable safety valve in unquestionable emergence to cope with present anomalies. No matter how successfully HE provides training and education tailored to the needs of the labour market the absence of student applicants continues to undermine the rationale behind extant manpower planning initiatives. One must move beyond simple economic ideas of supply-demand, and investigate broader societal influences, to unpack this anomalous uptake of computing courses in a country with one of the most vibrant ICT sectors in the world. It is probable that this needs to take place at second level.

Conclusion

Ireland has one of the most vibrant ICT sectors in the world. In 2005 over 30,000 IT professionals were employed in Ireland, an increase of 6% on 2004. Half are associate professionals (computer analysts/programmers) with software engineers and managers accounting for 25% each. All three experienced employment growth in the 2000-2005 period; numbers employed as software engineers, computer systems managers and computer analyst/programmers increasing at annual average rates of 5.0%, 3.7% and 2.4% respectively. There is a current shortage of software engineers, computer analysts/programmers and computer systems managers. A significant number

of work permits/visas were issued to non-EU nationals for these occupations in 2005. Demand for these occupations is expected to be relatively high in the future due to the gradual upturn of the ICT sector in recent years and the resumption of stronger growth in the long-term. As the evidence presented in this paper suggests, it is probable that the level of graduate output from the Irish HE system will not match future demand requirements. This trend is underpinned by the decline in the level of student intake to computing courses since 2000: as noted above the level of student enrolment in computing courses in both 2004 and 2005 was less than half that of 2000.

Note that the term 'shortage' refers only to the situation where the supply of computing professionals within the Irish workforce is insufficient to meet demand. There *is* a sufficient supply within the EU and globally and the number of non-Irish nationals in all three occupational areas is increasing (FAS/EGFSN, 2006). There are very high levels of educational attainment (~50% at degree level) among immigrants relative to the native population (~33% at degree level) (see Barrett & McCarthy, 2006; ESRI, 2005; Tansey, 2005). It is probable, therefore, that skill-gaps in the computing area will be filled from outside the Irish state as Irish salary levels and working conditions are attractive. Immigration thus relieves the pressure from key actors to initiate the radical initiatives that the anomalous take-up of computing careers in Irish HE probably demands and which remains incompletely understood.

To a large extent, Irish HE policy is now dictated by industrial development policy. HE is expected more strongly than in the past to enhance its contribution to technology, innovation and economic growth (Teichler & Kehm, 1995) and the neoliberal model of marketised HE is increasingly dominant (Lynch, 2006). Manpower planning, however, is somewhat more complex than simplistic supply-demand economic models suggest and questions remain on whether HE can develop employability as governments suppose (Atkins, 1999). Broader societal analyses need to be incorporated in future labour market and HE policy making as the anomaly of Irish computing presented here suggests. Irish HE has responded positively to recent manpower challenges and is both ready and able to act quickly and comprehensively within a policy framework that is supported by targeted funding. Government has targeted the key high value areas of computing, engineering and science and has been successful in persuading HE to develop these 'vocational' courses; but the underlying problem is that insufficient numbers of students avail of the opportunities on offer and there are significant weaknesses at second level in science, technology, mathematics and ICT.

Failure to substantively engage with students, particularly potential second level applicants, has undermined extant manpower strategy in the computing area. The substantial challenge is to persuade potential students of the value of science, engineering, technology and computing. The focus must now shift to improving student liaison and support, exploring the role of ICT in second level education across the curriculum, the probable influence of low broadband availability and uptake, and the ICT skills and perceptions of second level teachers themselves. Much has been written about how student preferences are shaped by expectations, peers, family, the media, educators, HE representatives, and so on (Silver & Brennan, 1988; James, 2000; Yorke, 2000; Karns, 2005). A strategy that liaises with applicants and students in a manner that supports and facilitates the transition from applicant to a member of the computing labour force is a pressing requirement. One recent attempt by the HEA to influence attitudes, change perceptions and boost interest in computer science careers among second-level students is the ChooseIT initiative (www.ChooseIT.ie). The initiative aims to promote a better understanding of the career of a computing professional and allows students explore their aptitudes for a variety of careers that a qualification in computing could lead to. Further similar initiatives are certainly now in order.

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