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Barriers and Stimulants to the Development of University-Industry Links: Perspectives from the Republic of Ireland

Volume II

(Two Volumes)

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January, 2004

CHAPTER 6

CHARACTERISTICS OF SURVEY FIRMS

6.1 INTRODUCTION

> *The management issues in high-tech companies, certainly if they are high growth companies, should be sophisticated, so again their need for connection with a relatively sophisticated knowledge base, all things being equal, should be higher than average. Those kinds of companies are the ones which in general one would reasonably hypothesise should have (a) the greatest need and (b) the greatest probability of having linkages; healthy, active, busy, productive linkages. It wouldn't be an inappropriate proposition to say if you are not getting linkages in that sector you are in bad shape (Interview with an academic from a university in Ireland, 2001, number one).*

The aim of this chapter is to offer a comparison of the profile and activities of firms with and without links to Irish HEIs. The key research question focuses on the degree to which the characteristics of firms engaging in links with HEIs differ from those that are not. This question is dominated by four categories: (1) the characteristics of the firms, (2) the R&D activities of the firms, (3) the perceptions of the firms towards the barriers and stimulants associated with the development of U-I links and (4) the role that EI and the HEIs should undertake in order to encourage firms without links to establish HEI links and to encourage the development of more successful links for firms with links.

Despite the implementation of a number of initiatives by the Irish government deliberately designed to promote U-I co-operation and the existence of a technology transfer infrastructure in Irish HEIs, they are under-utilised by indigenous high-tech firms as sources of knowledge and innovation (Jones-Evans, 1997a). In Ireland, a major obstacle to the development of a vibrant technological base within high-tech firms is the lack of co-operation in the exchange and absorption of knowledge with HEIs (Jones-Evans, 1997a; Jones-Evans *et al.*, 1998). Similarly, in other peripheral

regions in Europe, there is little evidence to suggest that there is substantial interaction between universities and the indigenous high-tech sector (Jones-Evans *et al.*, 1997b). That claim is reinforced by the results of this research, which indicate that 25%[1] (167 firms) of respondent firms from EI's indigenous high-tech client base have links with HEIs in Ireland (Chapter 3). However, in a random sample of 100 indigenous entrepreneurs in the Shannon Region, Shannon Development (2003) found that only 15% (13 respondents) engaged in interaction with HEIs and the purpose of this interaction was to acquire the R&D support from the HEIs (Chapter 4, Section 4.6.3). By way of comparison, the degree of HEI interaction for respondent firms in the Shannon Region is considerably lower than that recorded from respondents to this research which incorporated a national focus.

The survey data for this research revealed that only 8% of firms without HEI links had links with HEIs outside Ireland. For firms with links the corresponding result was 34%. The evidence suggests that there is a highly significant difference between the mean value in both samples ('prob-value'[2] = .00). Furthermore, a significantly higher proportion of firms with links to HEIs in Ireland also have links with HEIs located outside Ireland.

Before analysing the reasons for such low levels of co-operation with HEIs in Ireland from the perspective of industry, it is important to understand first the profile and activities of both samples of respondent firms, that is those with and without links to HEIs. This is to ascertain whether or not a certain type or profile of firm is more likely to engage in links with HEIs.

6.2 CHARACTERISTICS OF RESPONDENT FIRMS

Data pertaining to the date and size of establishment, firm origins, the high-tech sector(s) to which the firm belongs, firm activities, extent of R&D and product development activities and the attitudes of the firm towards the development of U-I links was collected in order to analyse the characteristics of respondent firms. This provided a comprehensive framework from which to analyse and compare the industrial profiles of firms with and without links to Irish HEIs.

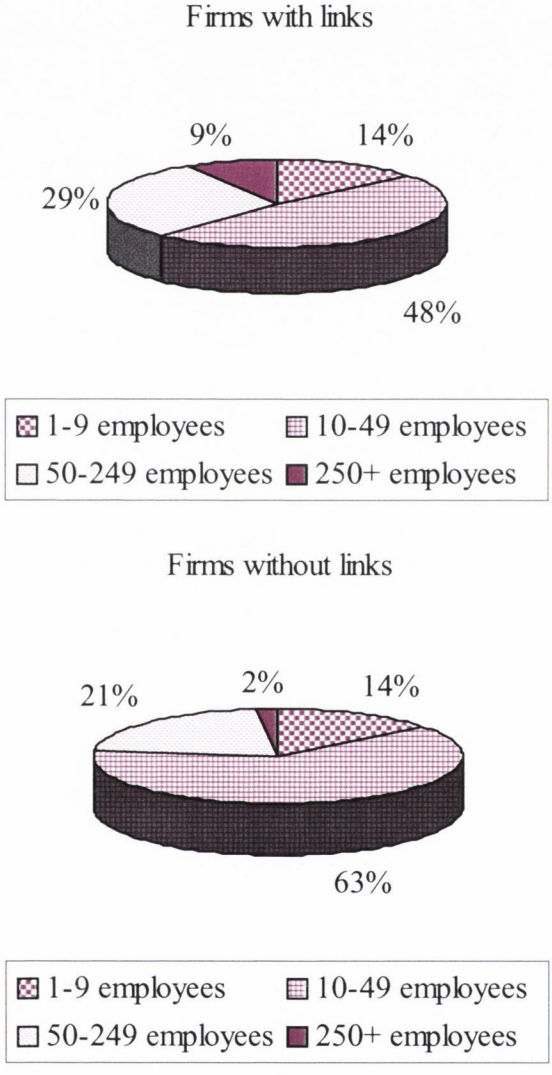
[1] In Scotland, System 3 (Chapter 2, Section 2.3.1.1) found that of all the Scottish companies questioned, 82% had links with academics (SE and RSE, 1996a). However, these companies were not all high-tech companies. The profile of the samples was as follows: manufacturing (35%); business services (35%); professional services (16%); financial services (7%); and others (7%).

[2] All the tests in this chapter which produced 'prob-values' are derived from a t-test comparing both samples (Chapter 3, Section 3.7.1.2). All probability values are expressed to two decimal places.

6.2.1 Firm age, size and origins

The average age of respondent firms in both samples was 23 years. A 'prob-value' of .98 indicates that there is no statistically significant difference in mean length of establishment for firms with and without links.

Figure 6.1 Firm size



Source: Industry questionnaire survey (2002)

There were significant differences between the two categories of firm in relation to size (Figure 6.1). The proportions of firms with 1-9 employees ('prob-value' = .72) were the same but a significant difference existed in the 10-49 employee category ('prob-value' = .00), in the 50-249 employee category ('prob-value' = .06) and in the 250+ employee category ('prob-value' = .00). More of the firms with links were in the larger size categories. In interviews with EI personnel, the principal reason offered was the fact that many larger-sized corporations have dedicated

personnel whose role is specifically focused on establishing and maintaining HEI links. In general, SMEs do not have sufficient personnel, time or resources to engage in the development and maintenance of HEI links.

Table 6.1 Origins of respondent firms

	Firms with links (%)	Firms without links (%)	Independent samples t-test 'Prob-value'
Corporate spin-off	9	12	.33
New independent start-up firm	77	88	.00
Spin-off from a university	12	0	.00
Spin-off from an IT	2	0	.19

Source: Industry questionnaire survey (2002)

In the sample of firms with links 77% of were new independent start-ups, while in the sample of firms without links 88% were of this origin (Table 6.1). In order to establish whether or not there was a significant variation in firm origins, an independent samples t-test was undertaken. The null hypothesis was that there was no difference in the proportion of firms of various origins between the two samples. The evidence suggests that a significantly higher proportion of firms without links are new independent start-ups when compared to firms with links. Of the firms with links, 12% were university spin-offs and only 2% were IT spin-offs. There are three reasons for this difference.

First, as already mentioned (Chapter 3, Section 3.4.1), ITs are not permitted to take equity in companies formed on campus. In interviews with ILOs, widespread confusion was evident in relation to ITs taking equity in companies established on campus.

Second, even if companies were formed on IT campuses, it is likely that the number of such companies would be very low. This is mainly due to the lack of research in ITs when compared to the long tradition of research in universities. Until 1992 and the introduction of the RTC Act, research was not a feature of IT activities. This barrier was cited in a number of interviews with ILOs:

> *Basically the ITs are further back along the food chain as well in terms of research and development and we had to build up that capacity. Remember up to 1992 they [the ITs] were not allowed do research in the sector. You could in theory have got sacked in 1991 for doing research. They were teaching institutions. That tension is still there (Interview with TecNet, 2002).*

Third, according to the ILO of each IT interviewed, a major barrier to the formation of spin-off companies is the lack of time academic staff in ITs allocate to research when compared to universities. The main reasons for this are heavy teaching workloads and demanding administrative responsibilities. In ITs academic staff are timetabled to provide an average of sixteen hours per week, in comparison with six hours for academics in universities. For example, one ILO commented:

> *Time of the staff, time available to the staff. They are motivated, they are talented, they have the expertise, but they just don't have the time (Interview with an ILO from an IT, 2002, number one).*

Furthermore, according to TecNet:

> *One of the big things is that they have a 16 hour week teaching load. Now there is a big disagreement on that. Some people will maintain people will do research anyway. I was talking to one director of an institute there lately who was saying to me that he always researched 16 hours or not. I actually think that that is a barrier I must admit. I think people will do it for a year or two years but they get burnt out. The result is you will find a lot of the research being done by people who are new into the system. But they reach a burnout stage. If you are teaching 16 hours, you well know having been a teacher, then you have at minimum, take it for the first three or four years take it that, you are working a 40-hour week. Then on top of that if you apply research to that. There is no doubt that is a barrier. There is no reward system in place either (Interview with TecNet, 2002).*

Table 6.2 Commercialisation outcomes in two ITs in Ireland, 2001

	CIT	IT Tralee
Volume of sponsored research (€M)	*	*
Number of technology disclosures	0	2
Number of patents filed	0	0
Number of licenses granted	0	0
Number of spin-offs	3	1
Number of start-up companies	12	2
Royalty income (€M)	*	*

Source: Interviews with the ILOs of CIT (2002) and IT Tralee (2002)

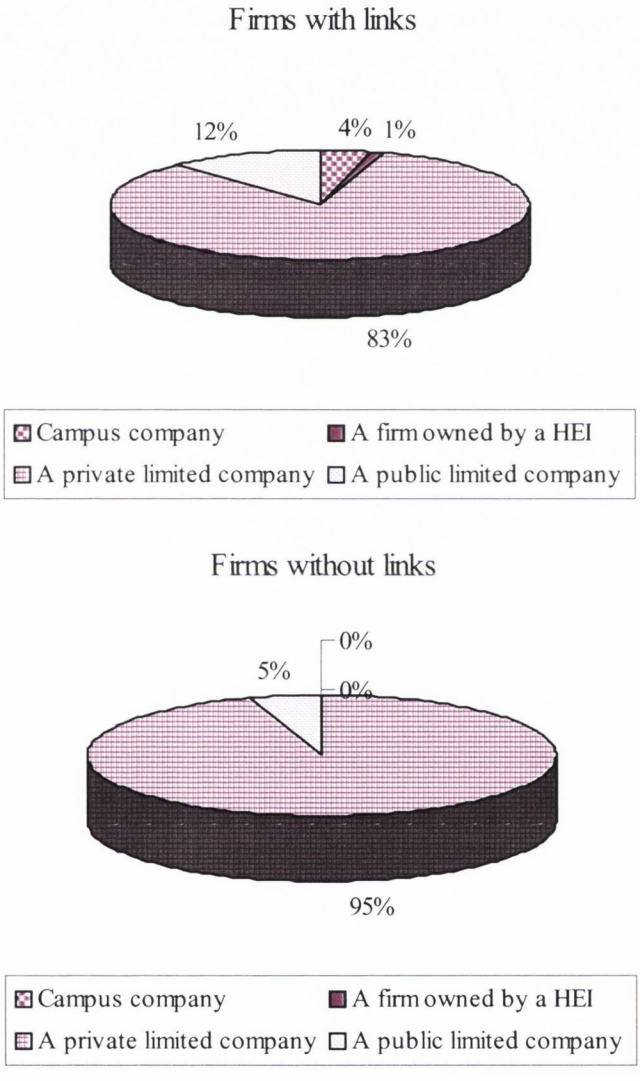
* Data not available

Each of these three factors plays an important role in the low number of spin-offs from ITs. Results provided by CIT and IT Tralee highlight a low number of spin-offs for the year 2001, only three from CIT and one from IT Tralee (Table 6.2). Unfortunately, no comparable data were provided by the remaining ITs or any of the universities. In general, ILOs were reluctant to release such figures.

6.2.2 Types of company

Despite the low proportions of respondent firms with links, only 4% of these firms with links were campus companies. As a caveat to this result it must be remembered that the total population of EI-assisted campus companies was not included in the target population of this research (Chapter 3, Section 3.4.1).

Figure 6.2 Types of company



Source: Industry questionnaire survey (2002)

Of firms with links, only 1% were owned by a HEI, 83% were private limited companies and 12% were public limited companies (Figure 6.2). Of the firms without links to HEIs, 95% were private limited companies and 5% were public limited companies, while none was a campus company or a firm owned by a HEI. In order to assess whether or not there was a significant difference in the proportions of each company type between the two samples, a t-test was undertaken. The null hypothesis

was that there was no difference in the proportions of companies comprising both samples.

In each of the company types: campus company ('prob-value' = .00), private limited company ('prob-value' = .00) and public limited company ('prob-value' = .00), the evidence suggested that there were statistically significant differences between the two samples. However, in the case of a firm owned by a HEI ('prob-value' = .15), there was not enough evidence to suggest that there was a significant difference. Only 1% of firms with links and none of the firms without links are owned by a HEI and the resulting 'prob-value' reflects the small sample size.

6.2.3 Sectoral composition of firms

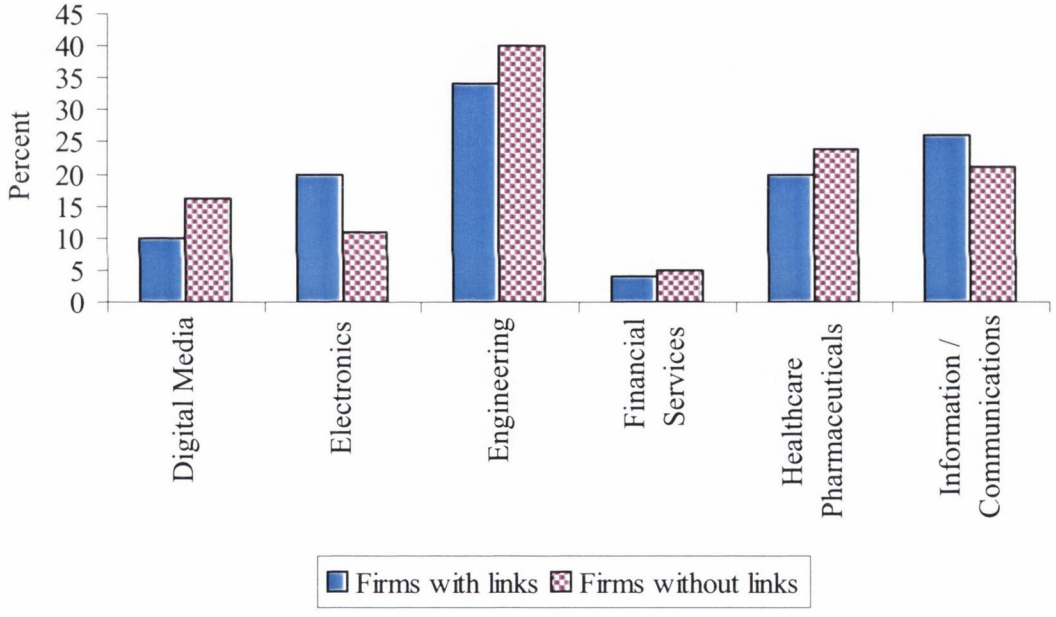
While statistically significant differences by type of firm were found between firms with and without HEI links, there were less significant differences in the sectoral composition of the companies. In the 1990s, Ireland's 'Celtic Tiger' economy was based predominantly on the attraction of high-tech multinational firms. Proximity to EU markets, access to IDA grants and a highly skilled labour force were key pull factors for foreign high-tech firms considering investment in Ireland. These incentives provided a favourable environment for the growth of indigenous high-tech industries through the provision of support services for the foreign sector or the identification of niche markets for company products both in Ireland and Europe. The profile of indigenous high-tech investment in Ireland became more diversified. In general, the tendency is for small-sized indigenous high-tech firms to act as suppliers to multinational companies; also they play a central role in the location investment decisions by foreign firms in Ireland. According to ISME:

> *...small companies really are service providers to the larger companies as well. If there weren't service providers like SMEs to provide services to the multinationals, the multinationals may not come into the area (Interview with ISME, 2002).*

The target population of firms for this research was categorised into six high-tech sectors specified by EI (Chapter 3, Table 3.2). In order to examine for each sector whether a significant difference existed in relation to the proportion of firms with and without links, a t-test was undertaken. The null hypothesis tested was that no difference existed between the proportions in both samples. The 'prob-values' indicated that there was enough evidence to suggest that there was a statistically

significant difference in sectoral composition in relation to digital media/E-commerce ('prob-value' = .02) and electronics ('prob-value' = .01). A significantly higher proportion of digital media/E-commerce firms (16%) did not have links compared to the percentage of firms (10%) with links to HEIs. The opposite is the case in the electronics sector, where a significantly higher proportion (20%) of firms had links compared to the firms (11%) without links. Given the nature of the digital media sector and its requirement for on-going R&D, it would be expected that a significantly higher proportion of firms in this sector would have links with HEIs. Instead, it is the electronics sector which had a higher proportion of firms with HEI links. This is surprising given the presumption that digital media would have a higher propensity to engage in links with HEIs when compared to electronics.

Figure 6.3 The sectoral composition of respondent firms



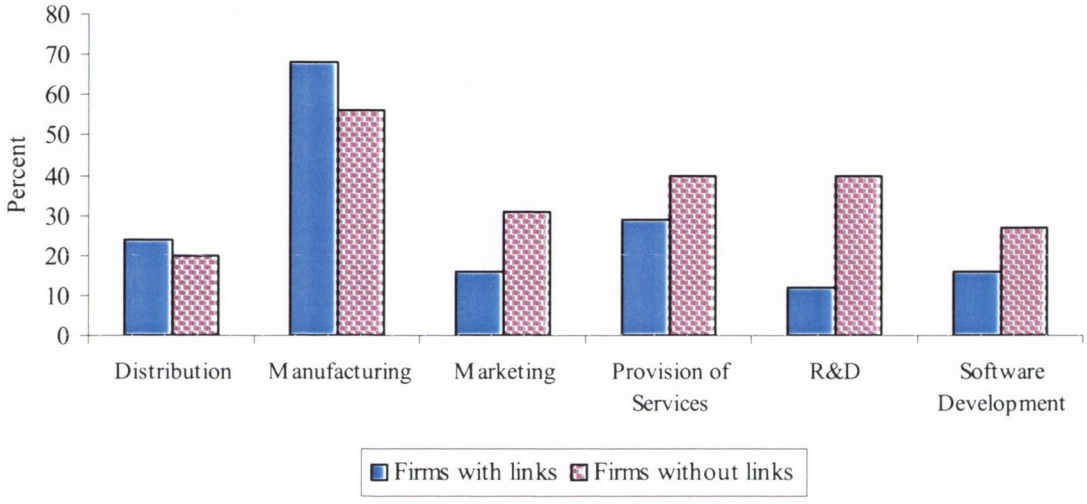
Source: Industry questionnaire survey (2002)

In the remaining sectors of engineering ('prob-value' = .18), financial services ('prob-value' = .69), healthcare pharmaceuticals ('prob-value' = .30) and information/communications ('prob-value' = .24), there was not enough evidence to suggest that a statistically significant difference existed between the proportion of firms with and without links (Figure 6.3). It is likely that due to the small sample sizes, it is difficult for statistically significant differences to occur. A more detailed assessment of the profile of respondent firms can be found in an analysis of their activities.

6.2.4 Firm activities

As noted in Chapter 3, definitions vary with respect to the term 'high-tech' (Section 3.2.2). It was decided to ask the firms whether or not they considered their firm to engage in high-tech activities, even though the population of firms was based on what EI defines as indigenous high-tech companies.

Figure 6.4 Activities of respondent firms



Source: Industry questionnaire survey (2002)

Of the firms that had links, 73% considered that they engaged in 'high-tech' activities compared with 45% of firms without links. A t-test yielded a 'prob-value' of .00 indicating a statistically significant difference between the two samples. This suggests that a higher proportion of firms with links to HEIs consider themselves high-tech compared to those without such links. While a higher proportion of firms with links consider that they engage in high-tech activities, this is not an indicator of engagement in higher order activities compared to firms without links; rather, the opposite seems to be the case.

In relation to the activities of respondent firms, a t-test was undertaken to establish whether or not a significant difference existed between the proportion with and without links engaging in link activity. The null hypothesis tested was that there was no difference in the proportions. The resultant 'prob-values' indicated that that there was enough evidence to suggest a significant difference in all but one of the activities. Distribution was engaged in by 20% of the firms with links and 24% of those without links (Figure 6.4). With a 'prob-value' of .27, this is the only activity in which there is no evidence to suggest a significant difference between both samples.

Figure 6.5 Firms with HEI links

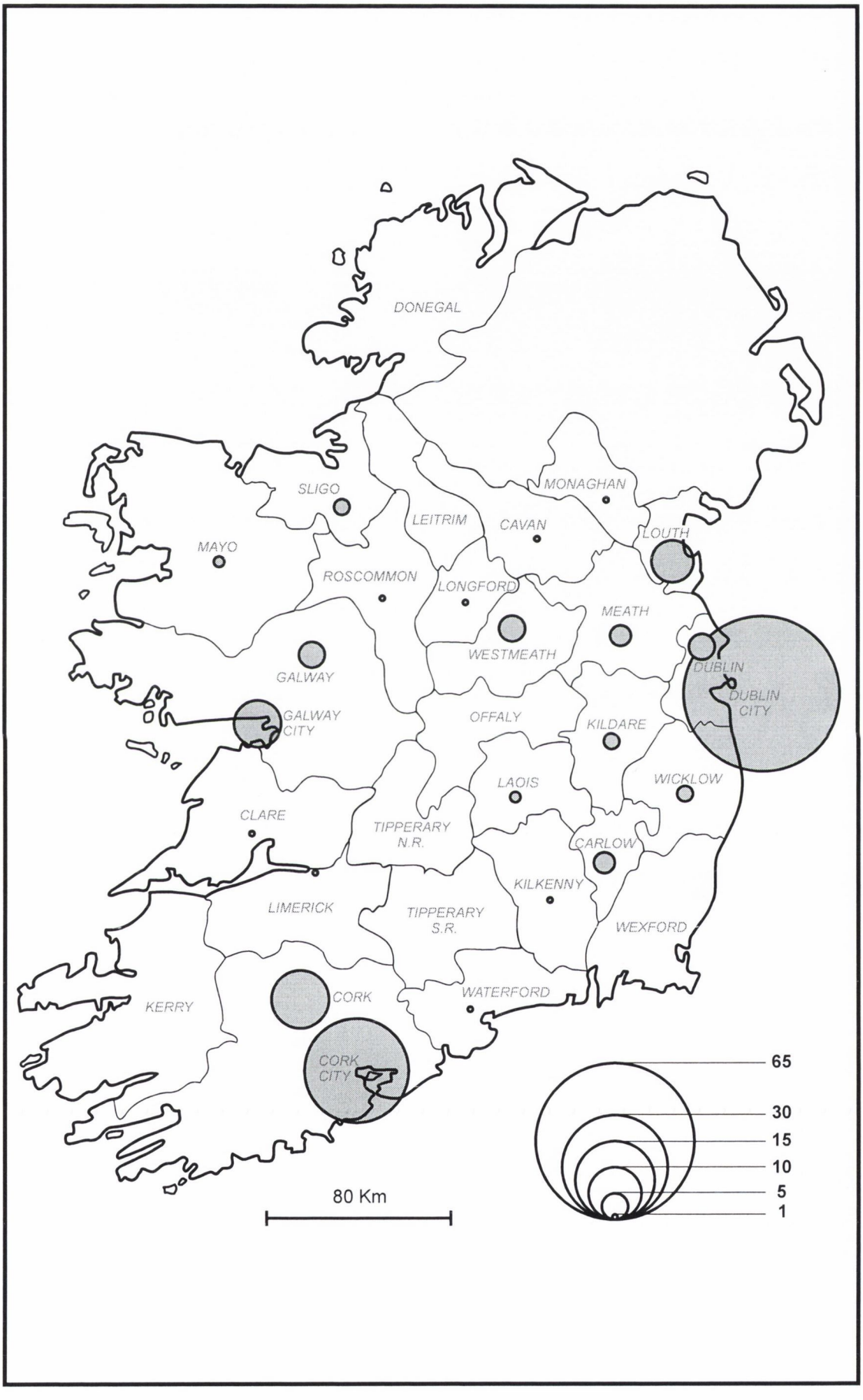
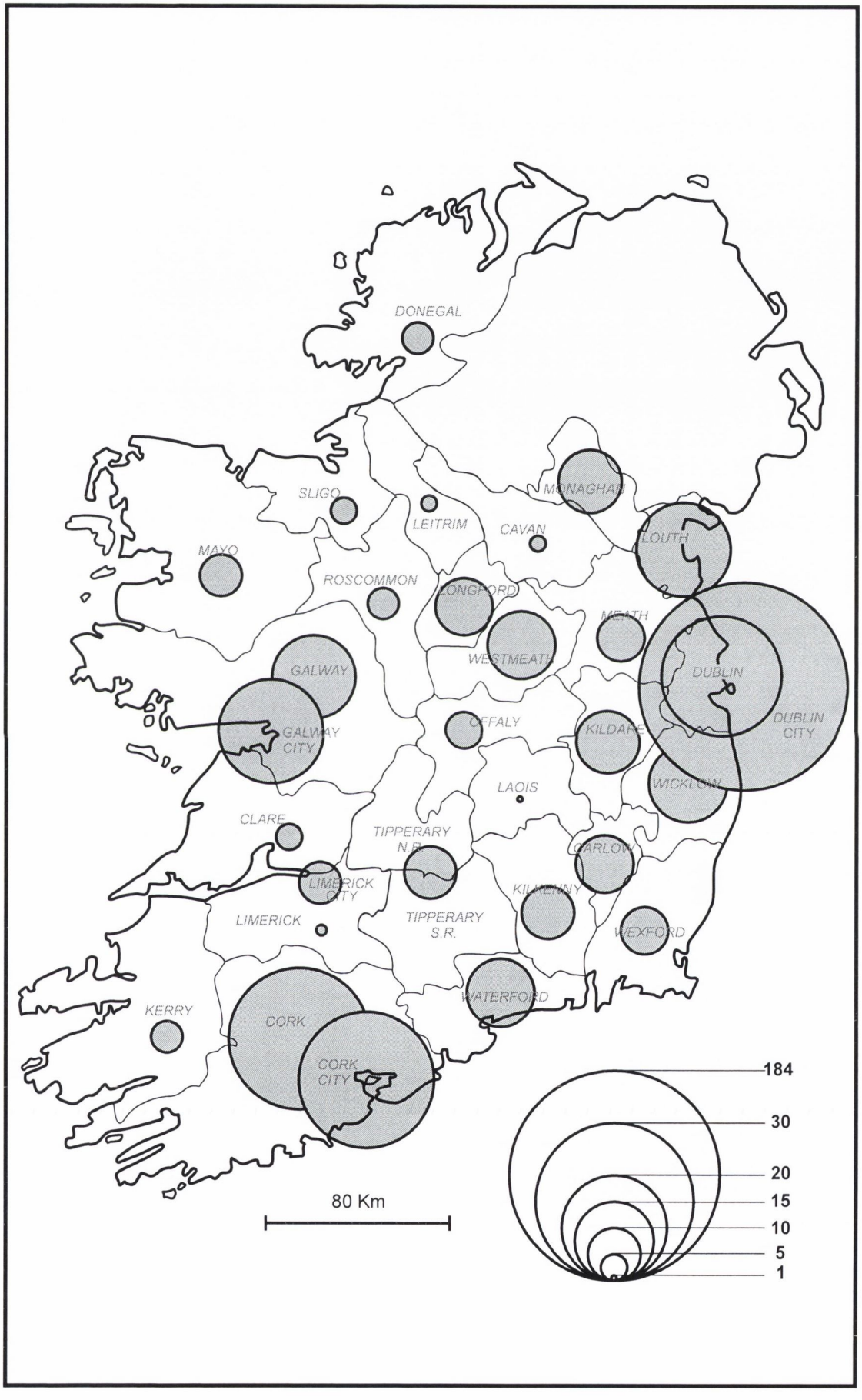


Figure 6.6 Firms without HEI links



In each other case, the resultant t-test produced a 'prob-value' of .00, indicating a statistically significant difference between samples.

While a significantly higher proportion ('prob-value' = .00) of firms without links (68%) engaged in manufacturing compared to firms with links (56%), in each of the remaining activities - marketing, provision of services, R&D and software development - statistically significant differences were found. In particular, a significantly higher proportion of firms without links engaged in these activities when compared to firms with links.

While it is difficult to ascertain why firms without links engage in higher order activities and do not engage in links with HEIs, two possible reasons are suggested. First, they do not see HEIs as compatible partners in terms of marketing, R&D and software development. Second, firms with links do not have the resources or in-house personnel to engage in such activities. Consequently, they outsource such functions to HEIs or consider HEIs to be compatible partners in such activities.

6.2.5 Geographical proximity of firms to HEIs

There is an urban bias in the location of EI-assisted firms. The majority of respondent firms in each of the six high-tech sectors were located in Dublin City and in the GDA (Figures 6.5 and 6.6). In general, firms locate in Dublin in order to benefit from economies of scope associated with proximity to a range of services in the capital, access to markets and a transport infrastructure facilitating the movement of goods and personnel to mainland Europe. In particular, the growth of both indigenous and foreign high-tech sectors in Ireland has enhanced Dublin as a prime location from which high-tech investment can serve national and international markets. The concentration of high-tech investment in the capital highlights the advantages of major urban-based regions for such investment and reflects the inability of both EI and the IDA to decentralise such sectors to Ireland's alternative planning regions.

However, an urban location is not in itself a prerequisite to engaging in links with HEIs. In rural areas, advances in telecommunications also facilitate such links. In order to assess whether or not geographical proximity plays a role in the development of links between firms and HEIs, the respondents were asked to specify whether or not they felt it facilitated the establishment of such links. The hypothesis is that the greater the geographical proximity between the industrial firm and HEI, the more likely the firm will have a link. In relation to firms with links, 62% considered

geographical proximity as an important factor, as compared with 49% of those without links. A t-test yielded a 'prob-value' of .00, indicating that firms with links appreciate more the benefits of geographical proximity. These findings support much of current literature on the important role of geographical proximity between the firm and the HEI with respect to the development of U-I links (for example, Mansfield, 1995; Vedovello, 1997). Furthermore, according to Santoro (2000), the industrial firm's proximity to the university research centre is not only crucial in terms of establishing a partnership, but it also plays a consequential role with respect to the intensity of the U-I relationship and generates greater levels of tangible outcomes. Thus, despite advances in new information and communication technologies, geographical location remains a crucial strategic consideration for firms seeking to engage in links with HEIs (Santoro, 2000).

The perceptions of firms as to the importance of geographical proximity were emphasised by the data that emerged in relation to the mean distance of firms from universities and ITs. The mean distance was 19.5 miles for firms with links to the nearest university and 28.0 miles for firms without such links. A t-test, yielding a resultant 'prob-value' of .00 indicated a statistically significant difference between both samples.

Similarly, in relation to distance from the ITs, firms with links were on average located 9.5 miles from the nearest IT. The corresponding figure for firms without links was 13.0 miles. Again, a t-test yielding a 'prob-value' of .00 showed that there was a significant difference between samples in relation to distance from the nearest IT. This suggests that geographical proximity may facilitate the establishment of links between industry and ITs.

Overall, firms with links considered geographical proximity as an important factor facilitating the establishment of U-I links more so than firms without links. Furthermore, firms with links are closer to universities and ITs than firms without links. While geographical proximity to universities or ITs may play a role in the establishment of links with HEIs, it is also important to consider what factors encouraged firms to locate in a certain region.

6.2.6 Factors influencing location choice

Presumably, locational factors differ from region to region, from sector to sector and even by individual firm. According to the Commission of the European Communities

(CEC) (1993), there is no one single overriding location factor. Rather companies seek to locate in a region which satisfies a number of factors which the company considers to be most important. For the purpose of this study, an assessment of location factors was included in order to evaluate the significance of two HEI factors (*i.e.* proximity to R&D at HEIs and access to skilled labour force/graduates from a HEI) relative to other locational influences. Respondents were asked to rate the importance of eight factors which influenced the choice of location on a scale from 1 to 5, 1 being very important and 5 being not a factor (Chapter 3, Section 3.2.1). This section focuses on the answers to a question concerning the factors influencing a firm's location choice.

Table 6.3 Factors of the location decision

	Firms with links		Firms without links	
Factor	Mean Score	Std. Dev.	Mean Score	Std. Dev.
Proximity to markets/customers/suppliers	2.76	1.55	2.57	1.54
Good infrastructure (transport/telecommun.)	2.57	1.32	2.80	1.42
Higher regional grant incentives	3.96	1.26	4.07	1.25
Existence of strong subcontracting networks	3.70	1.30	3.77	1.28
Access to good business services	3.09	1.29	3.19	1.31
Proximity to R&D at a HEI	3.82	1.27	4.46	1.00
Access to skilled graduates from a HEI	2.76	1.38	3.35	1.39

Source: Industry questionnaire survey (2002)

The question presented the respondent with seven factors (Table 6.3). Respondents were asked to score each factor on a scale from 1 to 5 in order of importance. The selection of the factors was based on a broad reading of the germane literature (for example: CEC, 1993; Harrison, 1994a; IDA, 1996; Krumme, 1969; Massey, 1995). In-depth analyses of these factors was provided by KPMG (1997) in the Irish context and by Hayter (1997) in the international context.

The mean and standard deviation of each factor are given in Table 6.3. The 'Other' category was not included as a scored variable as it comprises a mix of factors. It was listed by 17% of firms with U-I links and 15% of those without links. While a variety of reasons were provided under 'Other', the most cited factor was proximity to the home of the firm's managing director (MD). In all, 44% of the total replies under 'Other' by the firms with links and 41% of those without cited proximity to the home of the MD to be the most important factor. This is not surprising considering that these firms are indigenous enterprises, often established in the home

of or in close geographical proximity to the home of the MD or entrepreneur and they are often run by that person alone. Of the remaining factors, there was little variation between firms with links and those without links. In both samples, the crucial factors that encouraged firms to locate were proximity to markets/customers/suppliers and good infrastructure (transport/telecommunications technology). For the remainder of this section, the factors listed in Table 6.3 are discussed in turn.

6.2.6.1 Proximity to markets/customers/suppliers

One of the key factors which influenced individual firm locational decisions was proximity to markets/customers/suppliers. This factor was the most important factor rated by firms without links and the second most important factor scored by firms with links (the factor 'access to skilled graduates from a HEI' was also rated in joint second place with a mean score of 2.76) (Table 6.3). In order to access and serve markets, firms benefit from being close to their client base. Increasingly, the products and services that firms provide are tailored to meet customer demands. Therefore, despite advances in telecommunications and e-commerce, firms still benefit from close physical proximity to their customer base. Furthermore, in the national context of Ireland, proximity to markets/customers/suppliers would necessitate proximity to large urban centres. This may help to explain the high concentration of firms in urban centres or in close proximity to urban centres.

6.2.6.2 Good infrastructure (transport/telecommunications technology)

Limitations associated with Ireland's spatial peripherality have diminished through the emergence of industrial networks in the cyberspace economy. Increased broadband connectivity and improved road, rail and air transport systems are important components that have impacted upon the location decisions of firms. Firms with links scored this factor highest of all influences and those without links rated it as being the second most important factor (Table 6.3).

6.2.6.3 Higher regional grant incentives

EI offer higher grants in an attempt to entice firms to locate outside Dublin. It also provides financial incentives enticing firms to locate in less developed areas such as the BMW region. Yet, this factor was scored last of the seven location factors by firms with links and second last by firms without links (Table 6.3). The similar mean

and standard deviation values indicate that there was little variation in the answers of both samples. This highlights the fact that firms consider urban locations to be more important than receiving financial grants for locating in less well-developed regions. Furthermore, it is reflective of the government's failure to redirect investment away from urban centres and, in particular, away from Dublin and the GDA.

6.2.6.4 Existence of strong subcontracting networks in the region

The geographical clustering of firms, their suppliers and buyers within the regional economy has become a crucial factor in achieving competitive advantage (Clancy *et al.*, 1998). Very often, the location of these clusters is an important strategic factor in influencing the location decision-making process.

For the firms surveyed in this research, the cluster concept and the resultant availability of subcontracting networks was not considered an important factor in the location decision-making process (Table 6.3). This factor was rated fifth for firms with and without links. In explaining this result it is relevant that many firms located in these areas prior to the development of an environment conducive to the creation of subcontracting networks. In addition, the majority of the firms researched were small enterprises employing less than 50 employees. Therefore, it is highly likely that these firms provide services for larger-sized indigenous and foreign entities.

6.2.6.5 Access to good business services and growth opportunities

A good service infrastructure for industry refers to the availability of specialised training, education, research, technical and business support services within a particular region. This factor was rated fourth for firms with links and third for those without links (Table 6.3). Firms are increasingly locating in urban centres in order to gain access to their client base and also to a wide range of business support services. Cities are experiencing a spatial agglomeration of high-tech firms seeking to embed themselves within industry-specific high-tech clusters and benefit from economies of scope. By locating in urban areas, firms not only gain access to customers and suppliers, but also benefit from easy access to a variety of business, financial and information services. The evidence suggests that firms recognise the need for access to a specialised service infrastructure and this factor emerged as being relatively important within the overall location decision-making process of both independent sample populations.

6.2.6.6 Proximity to R&D at HEIs

Despite the increasing focus of industry on the need to access sources of product and process innovation, it seems surprising that proximity to R&D rated quite low. For firms with links, it scored second last and last of the seven factors for firms without links. The difference in mean values and standard deviations suggest distinct differences between both samples in relation to the relative importance each assigned to proximity to R&D at HEIs. The data suggest that R&D at HEIs is more important for firms with links, as would be expected. Firms without links do not consider proximity to R&D at HEIs to be an important factor and relegate it as the least important factor.

6.2.6.7 Access to skilled labour force/graduates from HEIs

While access to R&D facilities was not an important factor, access to a well-educated, highly skilled labour force was more significant. This factor was rated joint second with the factor 'proximity to markets/customers/suppliers' for firms with links and fourth for those without links (Table 6.3). The results reflect the increasing emphasis firms place on accessing highly skilled knowledge workers. In terms of the geography of indigenous high-tech development in Ireland, it is highly probable that regions possessing third-level educational institutions are more likely to be favoured as locations for investment by new start-up firms.

6.2.6.8 Conclusion on the factors influencing location choice

Locational factors differ not only from region to region but also by sector (*e.g.* high-tech manufacturing) and the particular period in which an investment decision is finalised. Above all, it is a particular combination of spatial fixes that ultimately influence a firm's location decision (Hayter, 1997).

The analysis provided a perspective on the relative importance of the factors that conditioned the locational decision of firms. There was little difference between samples with respect to the relative importance of factors affecting locational decision-making. Of particular importance were good infrastructure (transport/telecommunications technology) and proximity to markets/customers/suppliers. Proximity to R&D at HEIs scored as the second lowest for firms with links and as the lowest for firms without links.

6.3 INNOVATIVE ACTIVITIES OF FIRMS

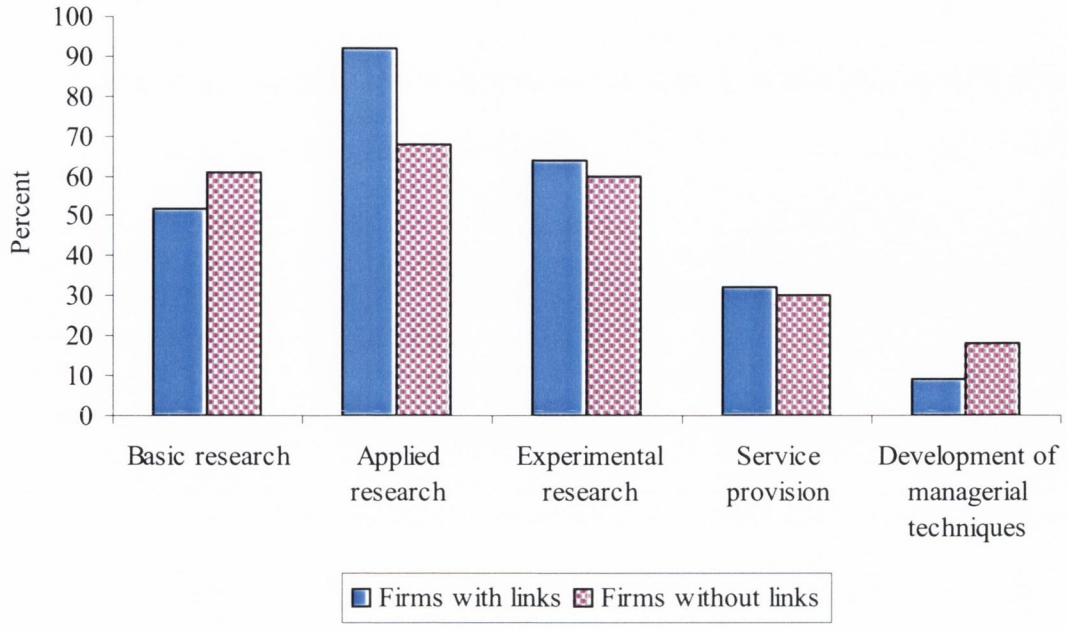
> *Because the high technology demands...access to advanced knowledge about the technologies involved, which will typically be university and research institute based as well as maybe the large corporation R&D unit based. If it is high-tech indigenous, very few of them are going to have sizeable R&D facilities of their own. So all things being equal there should be a need to reach out and plug into the development in the technology and maybe support for anything to do with managing/improving the technology, whether in product or process side (Interview with an academic from a university in Ireland, 2001, number one).*

Within the current corporate climate of flexible specialisation, one of the main dimensions of competitive success derives from an ability to accelerate product innovation. This should be reflected in the increasing orientation of firms towards the implementation of in-house R&D.

6.3.1 In-house R&D

With regard to EI-assisted companies, 46% (78 firms) of firms with links had an in-house R&D facility while the corresponding figure for firms without links was 22% (114 firms). A t-test was undertaken to examine whether or not a significant difference existed in relation to the existence of in-house R&D facilities. A 'prob-value' of .00 indicates that a significantly higher proportion of firms with links have in-house R&D facilities. On average, firms with links had established in-house R&D facilities eleven years previously (1991); the corresponding figure for those without HEI links was eight years (1994). Again, having completed a t-test, the resulting 'prob-value' of .06 indicates that a significantly higher proportion of firms without links established in-house R&D facilities more recently when compared to firms with links. This suggests a growing awareness amongst the firms without links of the importance of establishing in-house R&D facilities.

Figure 6.7 Types of R&D conducted by respondent firms



Source: Industry questionnaire survey (2002)

For firms that have established an in-house R&D department, with the exception of applied research (*i.e.* prototype development), there is not enough evidence to suggest that there is a significant difference in relation to the types of R&D being conducted by firms with and without HEI links. In relation to basic research (*i.e.* creative stage/initial phase of development), 61% of firms without HEI links and 52% of firms with HEI links engaged in this type of R&D (Figure 6.7). A 'prob-value' of .22 indicates that there is not enough evidence to suggest that a significant difference exists between the proportion of firms with links and those without links in terms of implementing basic in-house research.

Two important points must be noted in relation to the results on basic research. First, indigenous firms in Ireland have not had a reputation for engaging in any type of R&D activity, least of all basic research; yet, the data reveals that a high proportion of firms from both samples are engaging in basic research. Traditionally, indigenous SMEs were reluctant to engage in basic research because they did not possess the finance, expertise or resources to create new products and technologies. While SMEs have the dynamism and flexibility required for championing a product, they tend to lack the finance, technology and market experience to introduce new technologies (Manimala, 2002). The results from this research suggest that indigenous high-tech firms in Ireland have gained the confidence to become the market creators of new products and technologies, based on their endeavor to conduct basic in-house

research. Second, for firms without HEI links, a slightly higher proportion of this sample conducted basic in-house research. Either these firms do not consider HEIs as compatible partners in terms of establishing R&D links in basic research or firms consider that they have the appropriate personnel and resources to conduct basic in-house research independent of external stimuli and influences.

Sixty-eight percent of firms without links which have established an in-house R&D department engaged in applied research while the corresponding figure for firms with links was 92%. A t-test 'prob-value' of .00 indicates that a significantly higher proportion of firms with links engaged in applied research. This is not surprising given that the majority of R&D links between firms and HEIs is in applied research (Chapter 7). Furthermore, the relatively high proportions in both samples are to be expected, as applied research was the most common form of R&D practiced by firms. The high proportion of firms engaging in applied research is also indicative of a current drive in the indigenous high-tech sector towards a culture of providing customised products on a just-in-time (JIT) basis in order to satisfy increasingly fickle national and international markets. The same factors play a role in the relatively high proportions of firms that engage in experimental research (*i.e.* adaptation and fine-tuning of products), which is somewhat similar to applied research. In all, 60% of firms without links and 64% of firms with links who have in-house R&D facilities engaged in experimental research. Having completed a t-test, the resultant 'prob-value' of .53 indicates the lack of difference in a statistical sense between proportions of firms in the two samples.

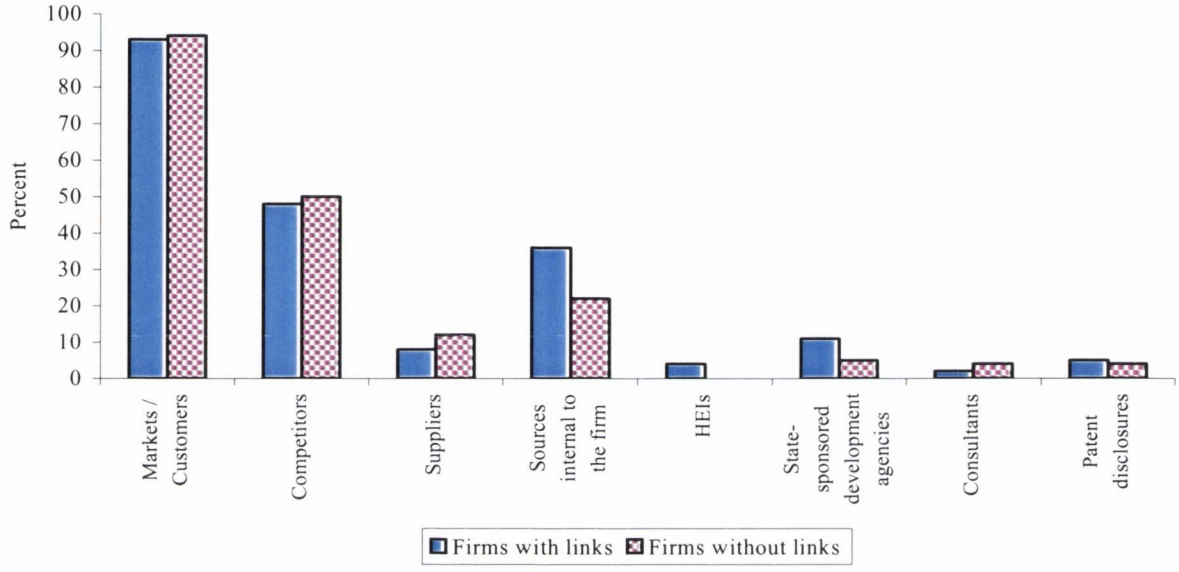
The remaining types of R&D activity (service provision and development of managerial techniques) were not as common as basic, applied and experimental research. As the forthcoming section highlights, firms were more focused on the development of new products rather than on the provision of R&D services or the development of managerial techniques.

6.3.2 New product development activities

The questionnaire survey asked firms to specify whether or not they engaged in new product development activities. In all, 65% (330 firms) of firms without links and 80% (134 firms) of firms with links developed new products. A t-test was undertaken to examine if a significant difference existed between both samples in relation to the proportion of firms engaging in new product development activities. The resulting

'prob-value' of .00 indicates that a large proportion of firms with links focus on new product development activities. However, the evidence suggests that HEIs are not the key source of innovation for new product development activities.

Figure 6.8 Factors that encourage respondent firms to engage in new product development activities



Source: Industry questionnaire survey (2002)

Firms which engage in new product development activities were asked to indicate the main factors which encouraged such activities. The two key factors were markets/customers and competitors (Figure 6.8). Markets/customers were considered to be the most important stimulant by 93% of firms with links and 94% of those without links. Having completed a t-test, the resultant 'prob-value' of .70 indicates no statistically significant difference in the proportion of firms in both samples citing this factor. According to the OECD (1999a), increasing market forces are the main catalyst encouraging firms to engage in product innovation. This stems from globalisation, deregulation and changing patterns of consumption.

In the case of competitors, the second most important factor, 50% of firms without links which were engaging in new product development activities considered competitors an important factor, while the corresponding figure for firms with links was 48%. Having completed a t-test, the resultant 'prob-value' of .64 indicates no statistically significant difference between the proportion of firms in both samples citing this factor.

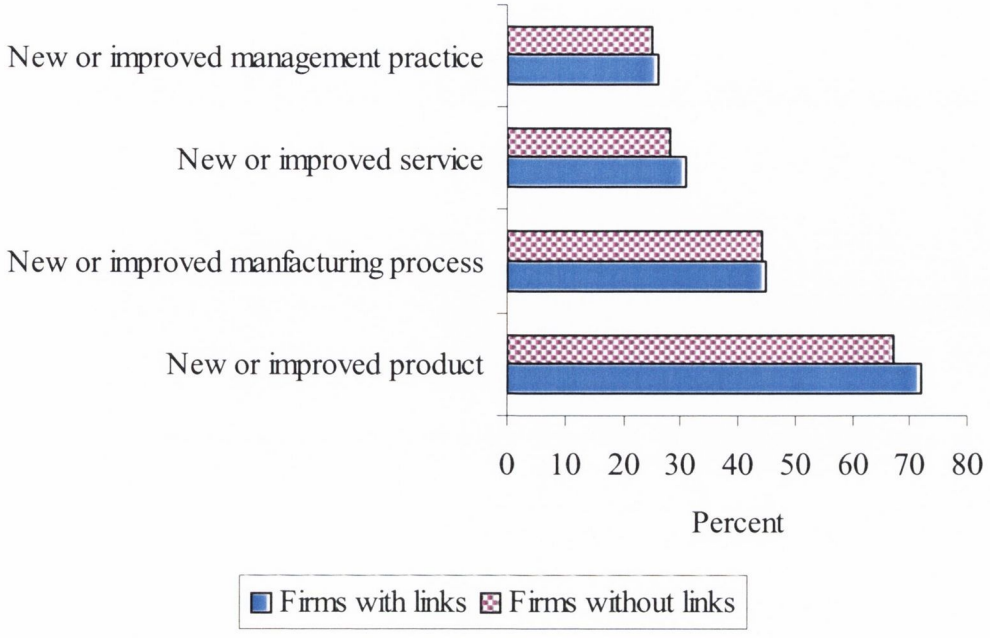
Of the other listed factors, sources internal to the firm was rated as relatively important, while the remaining factors had relatively low proportions in both samples and were considered unimportant. In particular, the universities and ITs rated as the least important factor. Not surprisingly, none of the firms without links cited HEIs to be a factor. Of the firms with links which engage in new product development activities, just 4% cited HEIs to be a factor.

6.3.3 Introduction of new technologies since 1999

An increasing emphasis on product customisation has encouraged firms to introduce new technologies in order to enhance both product and process innovation. In particular, shorter product life cycles and increased international competition have encouraged this adjustment. The introduction of new technology enhances strategic decision-making in relation to changes within markets and allows firms to achieve limited downtime, unparalleled precision and superior quality (Gertler, 1995). Essentially, new technology introduces greater flexibility into manufacturing in two ways. First, new process technologies increase a firm's ability to adjust its production systems to meet new and specific product requirements. Second, new product technologies enable firms to design new products. Thus, a combination of both product and process technologies allows firms to manufacture a variety of specialised products specifically designed to meet the demands of niche markets.

The increasing orientation of firms towards the introduction of new technologies has resulted in the emergence of Flexible Manufacturing Systems (FMS). In particular, FMS enables firms to adjust their internal production systems in order to produce a variety of specialised products and enhance their competitive position within niche markets. However, one effect of such flexibility is that it creates a demand for continuous R&D capacity in terms of product and process innovation. In response to this, firms have established independent in-house R&D departments. However, according to Cooke (1996), the problems associated with achieving flexible specialisation require a greater input of advanced technological knowledge. This involves developing links with external bodies such as HEIs and/or specialist R&D institutes. Therefore, the assumption is that firms which introduce new technologies are more likely to establish links with HEIs.

Figure 6.9 Types of new technologies introduced since 1999



Source: Industry questionnaire survey (2002)

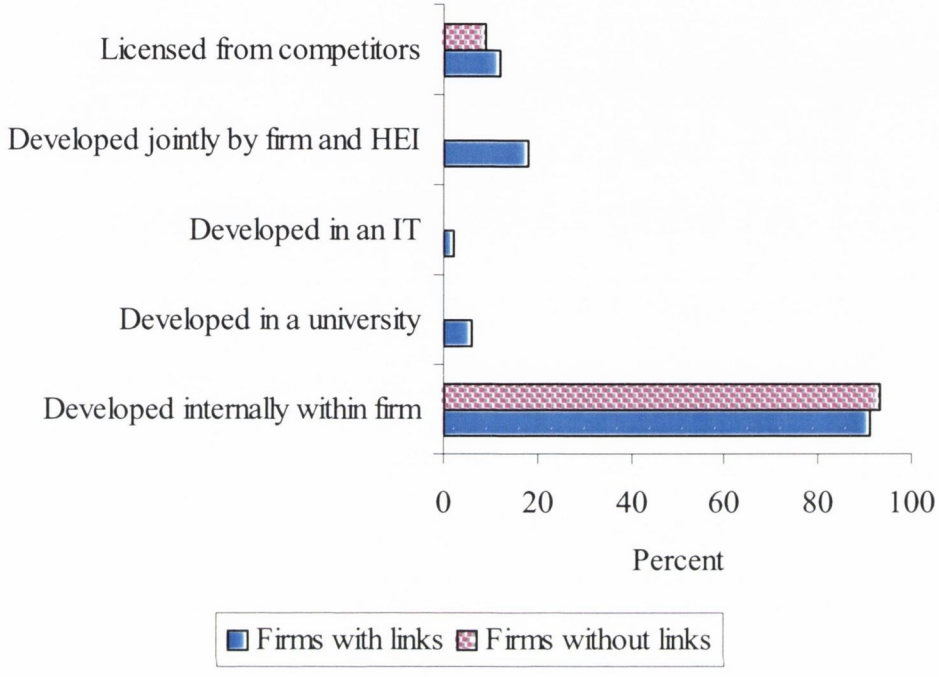
Since 1999, 84% (141 firms) of firms with links but only 65% (327 firms) of those without links have introduced new technologies. A t-test showed a statistically significant difference ('prob-value' of .00) between the samples in relation to the introduction of new technologies.

In relation to the type of new technology introduced, the most common for firms with and without links was a new or improved product (Figure 6.9). Of the 141 firms with links to HEIs who had introduced new technologies since 1999, 72% had introduced a new or improved product. Of the 327 comparable firms without links, 67% had introduced a new or improved product. Having undertaken a t-test, the resultant 'prob-value' of .27 indicates that there is no statistically significant difference between samples in this respect.

The second most important type of new technology introduced was a new or improved manufacturing process. Of the 141 firms with links, 45% had introduced this type of new technology compared to 44% for firms without links. Again, having completed a t-test, the resultant 'prob-value' of .88 indicates no statistically significant difference between the samples. Similarly, there is not enough evidence to suggest that there were statistically significant differences in the two remaining types of new technology: new or improved service ('prob-value' = .59) and new or improved management practice ('prob-value' = .84). However, both types of new technologies have not been introduced to the same degree as new or improved product

or new or improved manufacturing process. These results suggest that firms from both samples were largely manufacturing units with new product and process technologies being integrated into their manufacturing activities.

Figure 6.10 Sources of innovation for the introduction of new technologies since 1999



Source: Industry questionnaire survey (2002)

Firms were asked to highlight the source of innovation for new technologies introduced since 1999. The results overwhelmingly indicated that the main source of innovation emerged from within firms. In total, 91% of firms with links and 93% of those without cited internal sources as crucial to the introduction of new technologies (Figure 6.10). Having conducted a t-test, the resultant 'prob-value' of .44 indicated that there was not enough evidence to suggest a statistically significant difference between samples in terms of the proportion of firms citing sources internal to the firm in relation to the introduction of new technologies.

The most important feature to emerge from the data on sources of innovation relates to firms with HEI links. The second most important source of innovation for firms with HEI links was that 'developed jointly by firm and HEI'. Only 6% cited the source to be a university, 2% cited an IT and 18% cited the source of innovation to be development jointly by the firm and a third-level institute. Evidently, despite this sample of firms establishing links and engaging in the introduction of new technologies, they did not consider universities and ITs to be the most important

sources of innovation. While the results suggest that firms who have introduced new technologies are more likely to have HEI links, this does not mean that HEIs are the only source of innovation for firms. Similar research in Scotland found that few companies are receptive to the idea that the universities may represent sources of expertise or technology which could contribute significantly to their competitiveness (Downes and Eadie, 1998).

6.3.4 Conclusion on innovative activities of firms

The key theme emerging in analysing the innovative activities of firms is that engaging in links with HEIs or utilising the expertise and resources of HEIs as sources of innovation is not necessarily a prerequisite to engaging in innovation. In the sample of 167 firms with links, 46% had established in-house R&D facilities while 22% of the firms without links had such facilities. In light of the increasing focus on product and process innovation, the expectation was that these figures would be significantly higher. In terms of the type of R&D being conducted by firms, one surprising feature was the relatively high level of basic research being conducted by firms from both samples. Up until recently, the presumption was that basic research was not an activity conducted by firms (particularly indigenous firms) and that it was the preserve of industrial R&D units in HEIs and publicly-funded research laboratories. Despite the relatively low number of firms with in-house R&D facilities and the high degree to which basic research was being practiced by firms, HEIs were not the key source of innovation. Overall, the results suggest that while R&D and new product development activities are being conducted by firms there is little or no input from HEIs. Despite the fact that indigenous manufacturing enterprises in Ireland have become more intensely involved in R&D activities, they lack the absorptive capacity to recognise, adopt and process new knowledge and technologies produced in public science (European Commission, 2001). Similarly, despite their engagement in a broad and sophisticated spectrum of innovative activities, firms analysed in this research do not regard HEIs to be an equal partner in the process of industrial innovation; instead they prefer to remain autonomous or somewhat withdrawn from HEIs in this regard. An analysis of the barriers and stimulants to the development of U-I links from the perspectives of firms with links and those without links may shed some light on the reasons for these patterns.

6.4 BARRIERS AND STIMULANTS TO THE DEVELOPMENT OF U-I LINKS

> *The culture in universities has to change from one of 'funds to do work' that the academics want to do versus industry's needs. Many small companies cannot afford to do R&D but may suffer at the hands of university goals. There is a conflict between a teaching culture and industry's exploitation of ideas. There is also a lack of knowledge in universities on how business operates. Universities operate a 'cost centre' approach geared to 'when will the money dry out?'. Industry is a profit-centred culture. 'How fast can we get this to market'. However, organisation and structure are key to improving things. This is why further investment by the universities and government is crucial [Science Park Firm, firm with HEI links, number 48 (Underline is respondent's own)].*

As the above quotation highlights, a variety of cultural differences pervade the interface of U-I relationships. While a variety of barriers play a crucial role in preventing the establishment of U-I links equally there exists a number of stimulants that facilitate the development of industry-academic partnerships.

Firms were presented with lists of seven barriers and seven stimulants for establishing U-I links and were asked to select the barriers and stimulants relevant to them. These variables were selected based on a broad reading of the germane literature (for example, Geisler and Rubenstein, 1989; Canadian Research Management Association, 1991; Warda, 1995; PREST, 1998; Lee, 2000; Business-Higher Education Forum, 2001; CURDS, 2001).

6.4.1 Barriers

> *SMEs tend not to know where university knowledge relevant to them is available, where the points of contact are to be found, what support is available, on what terms and on what time frame. Universities have limited understanding of the needs of SMEs, and may be concerned about the degree of engagement needed to develop effective working relations if little new intellectual capital is likely to be created, and about clients with limited ability to pay (SHEFC and SE, 2001, 12).*

In relation to the barriers to establishing U-I links, it is not surprising that a significantly higher proportion of firms with links (50%) considered that collaboration is problematic due to industry's short-term product development focus versus the HEI's longer-term research objectives. This figure contrasts starkly when compared to just 27% of firms without links which considered the different time frames of industry and academia as a barrier. The reason for such a difference between both

samples is that firms with U-I links have experienced this barrier to be the case, suggesting that it has real validity. It is important to note that this barrier was cited as the most important barrier by firms with links.

Compiled from data using open questions, PREST (1998) analysed the views of the ILOs in relation to the problems and successes encountered by HEIs in maintaining existing relationships with industry. The ILOs cited seven barriers preventing the maintenance of research and consultancy links. At the top of the list was the divergence of objectives between industry and academic partners. Therefore, cultural differences between the two partners are not only significant in terms of establishing links but are also relevant in terms of maintaining the link.

Table 6.4 Perceptions of barriers to establishing U-I links in the two independent samples

	Firms with links (%)	Firms without links (%)	Independent samples t-test 'Prob-value'
Collaboration is problematic due to industry's short-term product development focus versus the HEI's longer-term research objectives	50	27	.00
Cost of research and consultancy links is expensive	42	43	.82
Lack of knowledge of the capabilities of HEIs	44	68	.00
Perception of the HEI as an 'Ivory Tower' by industry	27	21	.11
The equipment base/facilities of HEIs are insufficient	17	5	.00
The work completed by HEIs is not always relevant	42	41	.93
HEIs are too slow to respond to the demands of industry	46	28	.00

Source: Industry questionnaire survey (2002)

The most important barrier cited by firms without links was the lack of knowledge of the capabilities of HEIs (Table 6.4). While 68% of firms without links cited this factor as a barrier, the corresponding figure for firms with links was 44%. A t-test was undertaken and the resultant 'prob-value' of .00 indicated that a higher proportion of firms without links are more acutely aware that a lack of knowledge of the capabilities of HEIs is a significant barrier to the establishment of U-I links.

The remaining two barriers for which there was enough evidence to suggest that a statistically significant difference existed between both samples were the 'equipment base/facilities of HEIs are insufficient' and 'HEIs are too slow to respond to the demands of industry'. It is significant, in relation to the latter, that 46% of firms with links considered that HEIs are too slow to respond to the demands of industry while 28% of those without links considered this to be the case. The 'prob-

value' of .00 is a very significant result as it indicates that firms with links are more acutely aware of the inability of the HEI sector to meet the demands of industry on time.

In relation to the barrier of work completed by the HEIs not always being relevant, 42% of firms with links cited this as a barrier and 41% of firms without links. The resultant 'prob-value' of .93 indicates no statistically significant difference between both samples in relation to the proportion citing this barrier as being important. It is significant that such a high proportion of firms without links cited this variable as a barrier. Again, it is likely that such a result is based on the poor perception the firms have of the HEI sector as a potential industrial partner.

In relation to the barrier of the perception of HEIs as an 'ivory tower' by industry, 27% of firms with links and 21% of firms without links considered this as a barrier. A t-test was undertaken and the resultant 'prob-value' of .11 indicates that there was not enough evidence to suggest that a significant difference between both samples. What is significant about this barrier is that it is rated as the second lowest barrier by both samples. Yet, the 'ivory tower' stereotype of academics as inefficient and out of touch with the real world has been found to exist in many firms (Jones-Evans *et al.*, 1998). The least important barrier for both samples was that the equipment base/facilities of HEIs are insufficient.

The final barrier to be discussed pertains to the cost of research and consultancy links. In the sample of firms with links, 42% considered research and consultancy links expensive while 43% of firms without links considered the same to be true. A 'prob-value' of .82 indicates that there is no statistically significant difference between these values. It is very significant that such a high proportion of both samples considered cost as a barrier to the creation of U-I links. Furthermore, firms have a number of related issues associated with the cost of R&D links. For example:

> *A key problem area that has not been addressed in this questionnaire is that HEIs seem to have an increasing desire to use R&D or industry support as an income source that has to be maximised. This gives rise to problems of cost – e.g. hourly rates – more hours = more income, IP ownership of IP and risk sharing. HEIs want to have cost of gain with no risk. They expect industry to carry the cost <u>and</u> the risks [Firm with HEI links, number 24 (Underline respondent's own)].*

During interviews with EI, one of the main barriers to U-I links cited was a perception by firms without links of the high costs associated with establishing and maintaining links with HEIs. Amongst the population of EI-assisted companies without links, there is a perception that high R&D and consultancy costs are incurred through interaction with HEIs. According to Mowery (1998), small-sized firms often face serious problems with R&D collaboration due to the significant financial investment that participants must make in technology absorption. In addition, small firms often need much more than technological assistance in order to improve their competitive performance. Industry's perception of excessive cost remains a barrier despite the fact that the direct beneficiary of the results of R&D and consultancy links is industry. The application of R&D results can lead to reduced costs through improved processes and to value-added products and technologies that industry can direct onto the marketplace (Canadian Research Management Association, 1991).

In interviews during this research, the most frequently cited barrier by HEIs to the development of U-I links was the reluctance of industry to pay economic rates for the services provided by HEIs, particularly universities. For example, one ILO stated that:

> *First of all, complaints that we [ILOs] interfere as an institution in the dialogue between the academic and industry is perfectly true, because industry would prefer to come to the university and get it for nothing. OK, value from the professors or other people on the basis that knowledge is a public good and they're entitled to take this and make money out of it, and what has emerged is that all universities are organised to value such transactions and to require to place a high price on them. If they are giving a value to industry, they want it to be paid for, and any economist will tell you that under-pricing a good, OK, and so on, is a mistake for society, that if industry is getting some good from the universities, it ought to pay some fraction of the price of the development of that. I believe that they're correct and I believe that most of the complaints you get from industry come from people who will pay an enormous amount for information or for services from professionals outside, but don't want to make any contribution to the university for precisely the same information or services (Interview with an ILO from a university in Ireland, 2002, number two).*

However, from an IT perspective, a number of respondents revealed a reluctance on the part of some academics in ITs to charge for the services they provide for industry. For example, according to one academic from an IT:

> *A suggestion on my part would be that you look for evidence of a significant difference in responses regarding research and consultancy earnings from University respondents as opposed to those from the Institutes of Technology sector.*
>
> *My experience of University lecturers is one of them always charging a proper and* ***professional*** *fee for external research and consultancy work. On the other hand, my experience of IT personnel, with a few noteworthy exceptions, is one of them feeling infatuated with the idea of doing external 'research and consultancy work' for no gain whatsoever to themselves.*
>
> *After leaving University, I worked for close to ten years in a very large chemical plant before going to one of the RTCs.*
>
> *My family background is in the engineering service and maintenance area. To make the price of one's breakfast it was the practice to charge customers for materials used, for time spent, plus a reasonable margin of profit after all of that. It is for this reason I feel that IT lecturers who work for nothing to be a rather unique group! [Academic without industrial links, number 206 (Bold text, respondent's own)].*

The barriers to the development of U-I links pertain to the different objectives and aspirations of the two partners (PREST, 1998). While a number of practical obstacles exist for firms, it is important to note that the perception firms have of the HEIs is a crucial factor creating further obstacles which overshadow the practical obstacles. This is particularly the case for the firms without links to HEIs. The purpose of the forthcoming section is to analyse the stimulants to the development of U-I links.

6.4.2 Stimulants

The most important stimulant for firms with links was good working relationships with individual academics (Table 6.5). In total, 83% of firms with links cited this as a factor compared to 30% of firms without links. A t-test was undertaken and the resultant 'prob-value' of .00 indicates that a significantly larger proportion of firms with links cited this factor as a stimulant. Furthermore, it is significant that a relatively high proportion of firms without links cite the role of individual academics as important even though the same firms have no experience of engaging in partnerships with individual academics.

Table 6.5 Stimulants that facilitate the development of U-I links in the two independent samples

	Firms with links (%)	Firms without links (%)	Independent samples t-test 'Prob-value'
Good working relationships with individual academics	83	30	.00
Dynamic academic entrepreneurial climate of HEIs	12	11	.81
Excellence in academic research	20	14	.05
Increased commercialisation of HEI research	38	34	.32
Increased government funding in HEI research	27	24	.45
Rapidly evolving technology incubation facilities in HEIs	17	15	.53
Support schemes provided by EI to encourage collaboration between industry and HEIs	37	34	.55

Source: Industry questionnaire survey (2002)

In relation to the factor excellence in academic research, 20% of firms with links considered this as a stimulant compared to 14% for firms without links. Again, a t-test was undertaken and the resultant 'prob-value' of .05 indicated that a large proportion of firms with links cited this factor as a stimulant. Evidently, this view held by firms with links is based on their knowledge of research activities derived from interaction with the HEI sector.

Due to the fact that there is not enough evidence to suggest that significant differences exist in the remaining factors (Table 6.5), these factors will be discussed in terms of the importance assigned to them by individual firms.

The most important of the remaining factors was 'increased commercialisation of HEI research', which was considered a stimulant by over one-third of firms. HEIs are gaining a reputation as centres which engage in the commercialisation of research activity. Despite the existence of a variety of barriers to the process of commercialisation (Jones-Evans *et al.*, 1998; Pandya and Cunningham, 2000; ICSTI, 2001; Pandya *et al.*, 2001), the increasing number of campus companies and spin-offs from HEIs are playing a crucial role in promoting HEIs as entrepreneurial entities. This has had the effect of changing the perception of industry especially in terms of the role played by HEIs in economic development.

This is likely to be linked to the support schemes provided by EI which encourage collaboration between industry and HEIs. In total, 37% of firms with links and 34% of firms without links considered EI support schemes as a stimulant. Due to the fact that the firms under investigation were all EI-assisted, the expectation was

that the proportions in both samples for this factor would have been higher, given that EI has a range of programmes focused on the development of U-I links. However a number of firms from both samples indicated they were unaware of the support schemes provided by EI or that they did not receive support from EI to engage in such interaction. While is it the function of EI to develop and market such support schemes to its client base, it is not within the remit of EI to develop strategic links between its client companies and HEIs. The initiative must come from companies wanting to engage in links with HEIs. This must also be matched by the initiative of academics in HEIs to market their capabilities to industry supported by the ILOs who manage the interface. Universities have a responsibility to market their services better and also to be more sympathetic to potential industrial partners (Jones-Evans *et al.*, 1998). For universities to adopt a proactive approach to the development of industrial links they must provide incentives for academics to engage in technology transfer activities and make knowledge transfer a key mission in conjunction with teaching and research (SHEFC and SE, 2001).

Lower down the order of importance as a stimulant was increased government funding in HEI research. Only 27% of firms with links and 24% of firms without links cited this as a factor. As already discussed (Chapter 4, Section 4.4), the Irish Government have up until recently been very pro-active in terms of providing finance for research for third-level educational institutions. The purpose of such funding has been to develop a research infrastructure in science and innovation in Ireland. While firms are aware of such expenditure, they are more concerned with the end results rather than financial supports which facilitate the research process.

Lower down in terms of importance was the factor rapidly evolving technology incubation facilities in HEIs. Only 17% of firms with links and 15% of firms without links cited this as a factor. HEIs, and in particular ITs, in conjunction with financial support from EI's Regional Incubation Space programme for third-level colleges, have been instrumental in developing campus-based incubator units (Chapter 4, Section 4.4.1.1). However, the respondent firms were either unaware that incubator units exist in HEIs or, if they had knowledge of the existence of these units, they did not consider them relevant to the development of HEI links. Furthermore, the focus of incubator units in HEIs is more on the creation and development of academic-based entrepreneurial enterprises and, therefore, is not directly linked to established enterprises outside HEIs. In any case, firms are not concerned with the

internal structure and support systems which promote the development of U-I links within HEIs. They are more concerned with the results HEIs can produce and the time-frame in which HEIs can bring the results to industry.

This is further reflected in the final and least important stimulant of dynamic academic entrepreneurial climate of HEIs. Only 12% of firms with links and 11% of firms without links considered this as a stimulant. Firms did not consider HEIs as entrepreneurial entities with potential to become partners with industry. While this may be one explanation for the relatively low proportions in both samples, there is evidence to suggest that increasingly, universities are taking a pro-active approach to establishing links with industry and are adopting a direct entrepreneurial role in collaborating with industry (Jones-Evans, 1997a; Jones-Evans *et al.*, 1999). This is particularly the case in relation to the licensing of patents to industry and the creation of spin-offs based on technology developed within university laboratories (Klofsten and Jones-Evans, 1996; Jones-Evans and Klofsten, 1997).

While the university sector may have become more entrepreneurial in its attitude to U-I links, there is still the crucial issue of the poor reputation of the HEI sector in terms of working with existing indigenous enterprise. According to Jones-Evans *et al.*, (1997b), there is little evidence to suggest that the university sector plays a significant role in the development of indigenous small firms throughout Europe. The HEI sector may have the potential to do so but it does not have the reputation of engaging in such activities to the extent that the indigenous industrial community will take notice. In the industry questionnaire survey, a number of firms stated that their status as an indigenous SME was a barrier to establishing links with universities. For example, one firm stated:

> *Universities have no time to spend with the indigenous sector, they have more to gain from the large projects from the multinationals. There needs to be a forum set up interfacing the college to the indigenous sector. This forum should be government funded (Firm without HEI links, number 270).*

While it is clear that Irish universities recognise the value of commercially exploiting research and have become more entrepreneurial in terms of the creation of campus companies and spin-offs, this research has found that Irish universities have failed to include the development of existing SME-based indigenous enterprises into their portfolio of entrepreneurial activities. According to Jones-Evans (1997a), the

reason for this lack of co-operation with small-sized indigenous firms is a culture within academia which fails to encourage the development of links with small-scale industry and this in turn may be associated with a poor enterprise culture within the Irish economy. Equally, there may also be a cultural barrier from the perspective of personnel in SMEs who may not have a third-level educational qualification. Typically SMEs have staff with relatively low levels of educational attainment from HEIs and very often this makes contact with academics more difficult (Waagø *et al.*, 2001). Co-operation is very dependent upon personal relationships, and personnel in SMEs with academic backgrounds are more likely to know the strengths and limitations of HEIs. Therefore, they are more likely to communicate effectively with academic personnel.

While similar attitudes emerged in interviews in Scotland, the general consensus was that Scottish universities have failed to develop an entrepreneurial culture which includes all firms regardless of type, size, sector and nationality. The main reason for such a bias is based on the ability of large-sized enterprises to provide the finance and personnel to engage in links with the university sector. For example, one interviewee in Scotland indicated that:

> *Universities are very good at working with big industries, big industries have the money, they want a task done, they can throw money at the problem and the academic will set his mind to it. Small businesses don't have that kind of money. They have much smaller projects that are not hugely appealing to some of the academics. They can't put the whole team onto it, maybe just a one-man or two-man project, therefore the relationship between SMEs and universities is still not brilliant (Interview with a Scottish university incubator, 2001).*

In Ireland, this point was reiterated by a research centre in a university and also by a Dean of Research in a university.

> *In Ireland, the multinational firms are better organised to take advantage of the NMRC. I think a lot of small companies haven't got the staff or time, haven't got the background to appreciate new breakthroughs in technology and haven't got the money up-front to exploit it quickly (Interview with a research centre in an Irish university, 2001, number one).*
>
> *I would say that the multinational companies are far more likely to consider sitting down with you to talk about some sort of partnership, be it a research partnership, a regulatory affairs partnership or what have you, than the domestic Irish companies. I*

> *know, for example, in the food sector, in the last ten years for every one activity with an Irish food company, I would probably have 100 with multinational blue chip companies. I think it would probably be the same across many sectors, that most of the people here who deal with, say, sophisticated computing will be dealing with the multinationals, whereas there are Irish companies who don't seem to want to get involved, unfortunately (Interview with a Dean of Research in a university, 2002, number one).*

The different infrastructure and financial capability of indigenous SMEs in comparison with that of large multinational corporations affects a firm's acquisition and commercialisation of technology through links forged with HEIs. While this in itself is not problematic, HEIs have an important role to play in the development of the indigenous high-tech industrial base. This is significant given the recent downturn in the Irish economy and the decline in government expenditure, allied with the exodus of FDI from Ireland. It would be far more effective if HEIs assumed a more pro-active role in encouraging indigenous SMEs to deepen their technological capacity by engaging in the commercial exploitation of university R&D and by participating in a wide range of partnerships with the HEI sector. Such a move would generate positive developments towards the creation of sustainable economic growth in the Irish economy. According to Jones-Evans *et al.*, (1997b), HEIs are important engines of economic growth and play a crucial role in facilitating the growth of indigenous high-tech industry, thereby, enhancing national competitive advantage in peripheral EU countries such as Ireland. In order to lever the multiple resources of HEIs to benefit the development of indigenous high-tech enterprise in Ireland, it is important to remove all barriers to effective collaboration and to enhance effective government-funded programmes, with the aim of making linkage opportunities more accessible to indigenous high-tech companies.

6.4.3 Conclusion on the barriers and stimulants to the development of U-I links

For firms with links, the most frequently cited barrier was that collaboration is problematic due to industry's short-term product development focus as opposed to the HEI's longer-term research objectives. The evidence suggests that there are significant cultural differences between firms and universities in relation to what and when they expect their deliverables to be provided by HEIs. In relation to firms without links, the most frequently cited barrier was 'lack of knowledge of the capabilities of HEIs'. The evidence suggests that the firms are unaware of what HEIs

can provide them with in terms of deliverables. Furthermore, this highlights the failure of the HEI sector to effectively market its capabilities to indigenous industry and the failure of indigenous industry to proactively seek collaboration with HEIs.

The most frequently cited stimulant facilitating the development of U-I links from the perspective of firms with HEI links was 'good working relationships with individual academics'. This factor was significantly more important than any of the other factors. Essentially, the experience of dealing with individual academics has been positive for firms with links and clearly points to the crucial role played by individual academics in the development of links with industry. In addition, this result highlights the need for the academic community to market their capabilities to industry. The evidence suggests that the majority of firms value close interaction with an individual academic partner. Therefore, in order to foster effective U-I interaction, the onus is on academics from S&T backgrounds in universities and ITs to market their capabilities to industry and become one of the key forces in instigating and developing effective, fruitful and sustainable interactions with industry.

Two factors were cited by firms without links as the most important stimulants facilitating the development of U-I links: 'increased commercialisation of HEI research' and the availability of 'support schemes provided by EI to encourage collaboration between industry and HEIs'. The same level of importance was attached to each factor.

Increased commercialisation of HEI research may play an important role in terms of creating campus companies and spin-offs and it may also play a role in providing firms with a more positive image of HEIs as organisations focused on the development of entrepreneurship. However, it is not a stimulant which would directly encourage an indigenous SME to form a link with a HEI. This is in contrast to the other stimulant of the support schemes provided by EI that was given equal weighting in terms of importance. It is interesting that while firms without links are aware of the availability of such EI support schemes, they are generally not availing of such schemes; nor are they seeking to forge links with academia.

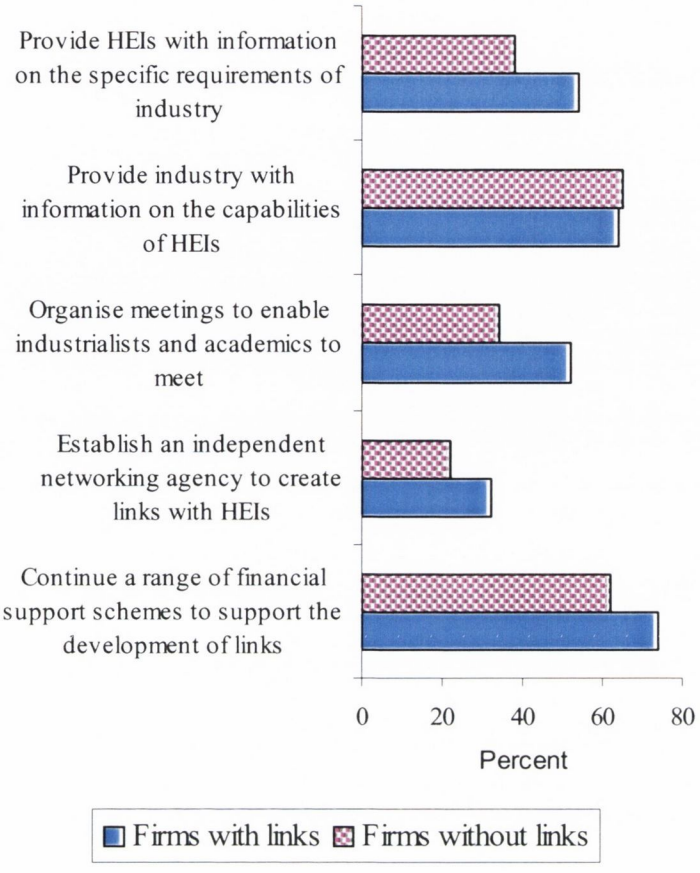
6.5 ROLE OF ENTERPRISE IRELAND IN DEVELOPING U-I LINKS

In this section an attempt is made to explain the above enigma by analysing the role of EI from a company perspective. For firms without HEI links, it offers suggestions as

to what EI can do to encourage firms to establish links with HEIs. The same is done for firms with HEI links.

EI, in partnership with the third-level educational sector, has introduced a number of measures and initiatives designed to harness the expertise and resources of HEIs in relation to R&D and innovation in an attempt to promote technology transfer to indigenous industry in Ireland (Chapter 4). EI's strategic intervention to promote greater use of Ireland's HEI knowledge base in order to enhance economic development has placed it firmly at the interface of U-I interaction in relation to indigenous EI-assisted enterprise in Ireland. In light of this, and due to the fact that all firms in this research were EI-assisted, firms were asked to offer suggestions as to what EI should do in order to develop U-I links in Ireland. While the response categories were the same both for firms with and without links, there was a slight variation in the way the question was phrased in each questionnaire (questionnaire 1, question 11; questionnaire 2, question 7). Firms with links were asked what they thought EI should do in order to encourage the development of more successful relationships between industry and HEIs, while firms without links were asked what they thought EI should do in order to encourage the establishment of links with HEIs. The remainder of this section will compare the responses from the two samples.

Figure 6.11 Role of EI in developing U-I links



Source: Industry questionnaire survey (2002)

Seventy-four percent of firms with links indicated that EI should continue a range of financial schemes to support the development of U-I links (Figure 6.11). The comparative result was 62% for firms without links. A t-test was undertaken and the resultant 'prob-value' of .00 indicated that a significantly higher proportion of firms with links cited this policy option. This evidence suggests that firms with links are not only content with the financial support schemes provided by EI but, more importantly, that they consider such support to be the most important activity that EI should engage in to encourage the development of the U-I interface in the future. For firms without links, a high proportion indicated that the continuance of EI's financial support schemes would encourage the establishment of links.

In an effort to explore how the process by which industry and HEIs interact with each other might be facilitated, firms were asked to indicate whether or not EI should establish an independent networking agency which would enable industry to create links to HEIs. The purpose of including this variable was to assess whether or not firms would value the introduction of a Connect Ireland initiative (Chapter 5,

Section 5.4.5). Only 32% of the firms with links and 22% of the firms without links indicated that such a measure would encourage the development of more successful relationships between industry and HEIs. A t-test 'prob-value' of .01 indicates that there is a significant difference. A significantly larger proportion of firms with links cited this policy option.

Given the lack of knowledge of firms on the capabilities of HEIs (already discussed, section 6.4.1) and the problems experienced by firms in terms of sourcing access points to HEIs, it would have been expected that a higher proportion of firms from both samples would have attributed more importance to the availability of an independent networking agency to foster links between HEIs and industry. One reason for the relatively low proportions from both samples may be that the firms were unaware of the potential benefits that an independent networking agency could provide for the indigenous high-tech industrial base at both regional and national levels. In Ireland, unlike Scotland, there are no network-based initiatives such as Connect Scotland or TVS (Chapter 5). However, in Ireland, while AUA (which focuses on three universities) and TecNet (which focuses on the ITs) can be categorised to some extent as network facilitators, they are not independent of EI and HEIs and are not established long enough for firms to be aware of their existence and their activities (Chapter 4).

In Ireland, the initiatives designed to promote U-I links in the indigenous sector are state-sponsored programmes driven by EI. While the Irish government retains a long term commitment to the promotion and funding of research in HEIs and while EI run programmes focus on developing U-I links, there is no independent body in Ireland working to utilise the research capabilities and resources of HEIs and relate them to the needs of industry.

Technology transfer is often referred to as a contact sport that is based on interpersonal networking between academics and industrialists. The existence of a networking body within a regional or national economy facilitates more effective U-I interaction, thereby creating knowledge linkages which support economic growth (Walshok, 1994). In this research, respondent firms had no experience of such stimuli and were, therefore, less likely to see how an initiative such as Connect Scotland could benefit the development of an environment that fosters U-I links.

The firms were also asked if EI should organise meetings to enable industrialists and academics to meet. Fifty-two percent of firms with links indicated

that EI should engage in this activity in order to encourage the development of more successful relationships between industry and HEIs. For firms without links the corresponding figure was 34%. A t-test was undertaken and the resultant 'prob-value' of .00 indicated that a significantly greater proportion of firms with links cited this policy option. This suggests that the firms with links place more value on the role that interpersonal communication and interaction can play in the development of U-I links.

Very often one of the key barriers cited by industry in relation to the creation and development of U-I links is a lack of information as to the capabilities of HEIs. When asked if EI should provide industry with information on the capabilities of HEIs, the survey data revealed that both samples of firms would welcome such a measure. Sixty-four percent of firms with links and 65% of those without indicated that such an initiative would encourage the development of more successful relationships between industry and HEIs.

Although the evidence suggests that EI has a crucial role to play in providing its client base with information about the capabilities of HEIs, according to the interviews with EI this is not a role that should be assumed by either a state-sponsored development agency such as EI or by the ILOs of HEIs. In interviews with EI, some interviewees felt that requiring EI and ILOs to provide firms with information about the capabilities of HEIs would do nothing to encourage or foster relationships between the two. It would be far more effective to encourage academics to provide information on their research interests and capabilities to industry. Therefore, it is crucial for EI and the ILOs to encourage a culture of dialogue and interaction within the academic community, one that is proactive and interested in establishing U-I links with companies that are receptive to engaging in such partnerships.

At the opposite end of the spectrum is the issue of whether or not EI should provide HEIs with information on the specific requirements of industry. The survey data revealed a highly significant difference of opinion between the samples. Fifty-four percent of firms with HEI links indicated that if EI were to provide the HEIs with information on the specific requirements of industry, this would encourage the development of more successful links between industry and HEIs. For firms without links the corresponding figure was 38%. A t-test was undertaken and the resultant 'prob-value' of .00 indicated that a significantly larger proportion of firms with links cited this policy option. In the sample of firms without links, there was significantly

less enthusiasm for this initiative. For these firms it is more important that EI provide industry with information on the capabilities of the HEIs (Figure 6.11). The evidence suggests that these firms are more interested in the capabilities of HEIs in terms of providing incentives to establish U-I links rather than communicating their needs to EI and onwards to HEIs. On the part of these firms, there is either a lack of knowledge or a lack of willingness to communicate their needs in relation to establishing links with HEIs.

6.5.1 Conclusion on the role of Enterprise Ireland in developing U-I links

In an effort to integrate the development of indigenous high-tech enterprise as a source of competition and innovation into Ireland's knowledge-based economy, EI has an important role to play in supporting technology transfer by facilitating the formation of strategic alliances between industry and academia. From a company perspective, EI should continue to provide a range of financial support schemes to foster the development of U-I links. Indeed, it should also provide industry with information about the capabilities of HEIs. Both of these initiatives emerged as the most important factors in developing U-I links. While a higher proportion of firms with links indicated that all the policies suggested should be pursued by EI, the general picture suggests that firms were most interested in continued financial support provided by EI. Furthermore, firms placed a high level of importance on the possibility of EI providing industry with information about the capabilities of HEIs. Amongst the respondents, there was less concern that EI should provide HEIs with information in relation to the specific requirements of industry or organise meetings between industrialists and academics or establish an independent networking agency to create links with HEIs. The evidence suggests that firms are more focused on what EI can directly provide to industry in terms of establishing links with HEIs rather than on the development of an environment conducive to the creation and development of such links (*i.e.* organise meetings to enable industrialists and academics to meet and establish an independent networking agency to create links with HEIs).

While state-funded development agencies, such as EI, have a crucial role to play in creating and developing an important channel for U-I interaction through the provision of financial initiatives, the responsibility for the creation and development of U-I links is not entirely the responsibility of state-funded agencies. It is the responsibility of effective U-I interaction. Academic and industry partners both have

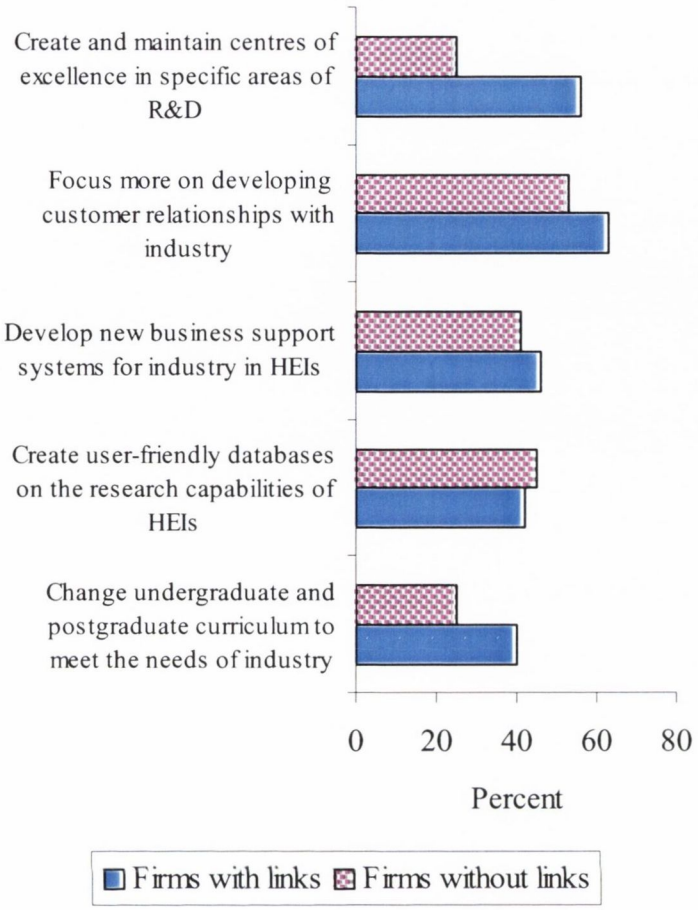
the responsibility to ensure the success of this interaction. The forthcoming section analyses the initiatives that the HEIs should implement in order to facilitate the establishment and development of U-I links from a company perspective.

6.6 ROLE OF HEIs IN DEVELOPING U-I LINKS

In Ireland, the universities and ITs represent key potential sources of innovation for the indigenous high-tech sector. But, despite recent success stories of companies such as IONA Technologies plc., the number of campus companies formed and the amount of spin-off activity would appear to be low (Whelan *et al.*, 2001). According to Whelan *et al.* (2001), the EI Campus Company Programme supported only 150 campus companies over a ten-year period from a research/university base of 1,700 researchers. While research has been done in relation to the barriers and stimulants to the commercialisation of university research in Ireland (Pandya and Cunningham, 2000; Pandya *et al.*, 2001), to date there has been no research completed assessing the extent to which HEIs have undertaken a pro-active role in attracting existing firms without links to HEIs to establish and develop links with them. Furthermore, there has been no research completed examining the role of HEIs in stimulating and developing U-I links from the perspective of non HEI-based indigenous high-tech firms.

The purpose of this section is to highlight what Irish HEIs can do in order to create and/or develop links with industry from the perspective of respondent firms. While the response categories are the same for both samples, there is a slight variation in the way the questions were phrased in relation to the role of HEIs in each questionnaire (questionnaire 1, question 10; questionnaire 2, question 6). Firms with HEI links were asked what they thought HEIs should do in order to contribute to the development of more successful relationships between industry and HEIs while firms without links were asked what they thought HEIs should do in order to encourage the establishment of such links. The responses from both samples are compared in the remainder of this section.

Figure 6.12 Role of HEIs in developing U-I links



Source: Industry questionnaire survey (2002)

Often, one of the key barriers cited by firms to the creation and development of U-I links is the inability of HEIs to meet the demands of industry. Firms were asked to indicate whether or not HEIs should change undergraduate and postgraduate curricula to meet the needs of industry. Forty percent of firms with links and 25% of those without indicated that the implementation of this initiative would contribute to the development of more successful relationships between industry and HEIs (Figure 6.12). A t-test was conducted and the resultant 'prob-value' of .00 indicated that a significantly larger proportion of firms with links cited this policy option. This is a significant conclusion given that firms with links can be expected to have a better understanding of what HEIs provide in terms of teaching/training. Therefore, they are in a better position to comment on the industrial relevance of the educational curriculum in HEIs. While an ongoing debate exists in HEIs as to whether or not the educational curriculum of S&T-based subjects should be tailored to meet the needs of industry (Chapter 2), it is significant that such a high proportion of firms with links to

HEIs confirmed that it was desirable to change the curriculum to meet industrial needs. This poses a major challenge for HEIs to articulate their central mission of teaching focused on the creation and dissemination of knowledge, juxtaposed with devising appropriate ways of channelling academic teaching to meet the needs of industry without distorting or impairing one of its central roles (McBrierty and O'Neill, 1991; Kelly, 1992).

During interviews in Ireland and Scotland, one of the stimulants to the creation and development of U-I links cited by the interviewees was the creation of a user-friendly database on the research capabilities of the HEIs. In particular, such a database would serve as a crucial access point for industrialists to initiate contact with relevant academics. While both countries are in the process of developing such a database, the survey data for this research revealed that 42% of firms with HEI links and 45% of firms without indicated that the creation of such a database would lead to positive outcomes in the creation and development of U-I links. A t-test 'prob-value' of .50 indicates that there was no statistically significant difference between the proportion of firms in each group citing this policy option.

The role of HEIs in creating and channelling innovative capabilities to firms within different regions has led to a proactive approach by HEIs, which is usually supported by state-sponsored development agencies in adopting a direct entrepreneurial role (Jones-Evans and Pandya, 1996). This can include a wide range of activities which support the development of both HEI-based campus companies and spin-offs while also including the establishment of support services for firms that are non-HEI based. In Ireland, there is considerable debate both within HEIs and within EI about the degree to which HEIs have developed internal entrepreneurial environments conducive to providing support to industry. In light of this, it is appropriate to assess company perspectives on this issue. Firms were asked to indicate whether or not the HEIs should: develop new business support systems for industry in HEIs; focus more on developing customer relationships with industry; and create and maintain centres of excellence in specific areas of R&D.

In relation to developing new business support systems for industry in HEIs, 46% of firms with links and 40% of those without indicated that such a measure would contribute to the development of more successful U-I relationships. A t-test was undertaken and the resultant 'prob-value' of .22 indicated that there was no

statistically significant difference in the proportion of firms with and without links citing this policy option.

In terms of HEIs focusing more on developing customer relationships with industry, 63% of firms with links felt this would contribute to the development of more successful U-I relationships while 53% of firms without links were of this opinion. A t-test was undertaken to assess whether or not a significant difference existed between these results. The resultant 'prob-value' of .02 indicated that a significantly larger proportion of firms with links cited this policy option. This is a highly significant conclusion, given that firms with links have direct experience of the attitude that the HEI sector has assumed towards its industrial partners. The results suggest that many firms with links do not consider HEIs to be customer-focused.

An assessment of the impact of HEIs in creating and maintaining centres of excellence in specific areas of R&D found that 56% of firms with links indicated that such an initiative would contribute to the development of more successful U-I links while 25% of firms without links were of this opinion. Having completed a t-test, the resultant 'prob-value' of .00 indicated that a significantly larger proportion of firms with links cited this policy option. From the perspective of the firms with links, it is surprising that 56% of the sample felt there is a need to create and maintain such centres. This is a significant conclusion given that, in recent years, HEIs in partnership with the Irish government have increased the number of specialist research facilities.

6.6.1 Conclusion on the role of HEIs in developing U-I links

The proactive role assumed by HEIs in developing innovation and entrepreneurship is crucial to the creation and development of successful U-I interactions. While HEIs have a policy which actively supports academic entrepreneurship on the campus, the real test of whether or not HEIs are entrepreneurial emerges from the perspectives of firms that are non-HEI based. According to the respondents, HEIs should focus more on developing customer relationships with industry. This is considered the most important initiative which should be implemented by HEIs. The initiative rated lowest relative to other initiatives was that HEIs should change undergraduate and postgraduate curricula to meet the needs of industry. In relation to the availability of a business support infrastructure in HEIs, firms assign equal importance to HEIs creating user-friendly databases about their research capabilities and to developing

new business support systems for industry. In their assessment of both of these initiatives, there was not enough evidence to suggest that there were statistically significant differences between the two samples. However, there was enough evidence to suggest that there was a significant difference between both samples in their assessment that HEIs should create and maintain centres of excellence in specific areas of R&D.

Overall, the evidence suggests that HEIs are not customer-focused and do not possess centres of excellence in specific areas of R&D. Within the sample surveyed there are mixed reactions about the need to develop new business support systems for industry in HEIs and create user-friendly databases on the research capabilities of HEIs. The only positive feature to emerge on the role of HEIs is that firms seem to be content that the existing curriculum is focused on meeting the needs of industry.

6.7 CONCLUSION

While HEIs represent a potential source of innovation for the indigenous high-tech sector in Ireland, this research data has revealed that only 25% of respondents interact with HEIs. On the basis of the survey evidence, both samples engaged in innovative activities. Yet, there was little evidence to suggest that HEIs were a key source of innovation for firms with HEI links. Despite this, the research found a strong association between geographical proximity and the propensity for firm engagement with HEIs.

It is clear that a communication gap exists between firms and HEIs. The barriers responsible for this pertain to the different cultures imbued by two very different types of organisation. However, the role played by a range of incentives in the creation and development of U-I links should not be underestimated. In particular, the research revealed the pivotal role played by academics in creating and developing successful partnerships with industry. While barriers and stimulants pervade all facets of the U-I interface, Ireland needs an innovation partnership programme which integrates the interests and needs of industry, HEIs and government at the regional and national level. Firms, keen to improve their competitiveness, and EI and HEIs keen to exploit new sources of economic and social progress must work in partnership to develop a support infrastructure which will enhance existing U-I links and will also enable non-interacting indigenous high-tech firms to access relevant industrial expertise in Irish HEIs. The challenge now facing EI is to promote

the benefits of technology absorption and innovation from HEIs to their indigenous high-tech client base. Furthermore, attention must be focused on creating a linkage infrastructure which matches the innovative needs of industry with relevant expertise in Irish HEIs.

While the government has introduced a number of measures designed to encourage the development of a knowledge-driven economy, it is now up to HEIs to redefine their roles both socially and economically. It is imperative that HEIs more actively seek to engage in a range of private sector partnerships especially in areas of R&D, consultancy and teaching/training. In particular, HEIs now have a public duty to utilise their multiple resources in order to promote sustained economic and regional development for Ireland's future.

CHAPTER 7

INDUSTRY-ACADEMIC LINKS

7.1 INTRODUCTION

> *The evolution and development of a new technology comes out of a university. It might be taken on then by the private sector who turn it into a product but typically it starts in a university. There is very little that comes 100% out of the private sector. Some of the best stuff is done where the private sector is working very closely with the universities...I think there is a lack of awareness with our indigenous sector of what the universities could do for them in terms of helping to, I will not say subsidise but, compliment their product development efforts and that is really how the private sector uses the universities in the continent and the UK and the US to compliment the in-house product development and research. Irish companies have not seen the opportunity to do that (Interview with a key regional actor in Ireland, number one).*

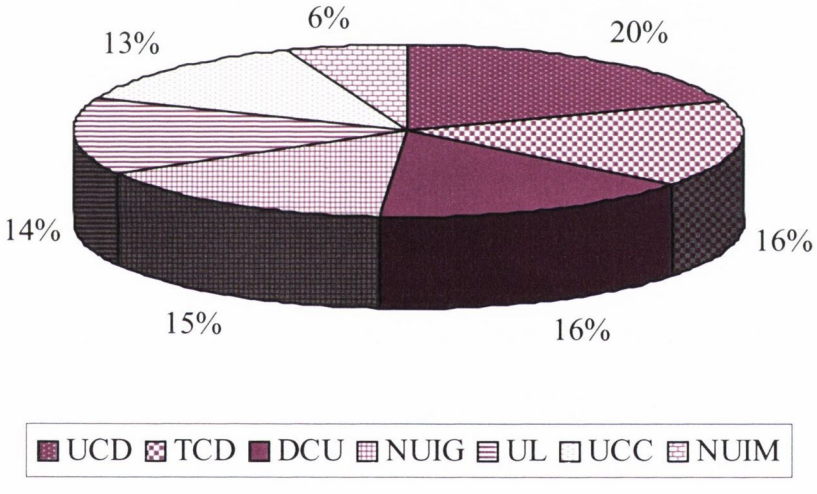
Much of the literature relating to U-I links has tended to focus on the frequency of interaction between firms and HEIs (Freel, 2000) and has failed to analyse the experience of such interaction from the perspectives of both industry and academia. While the literature suggests that technological collaboration with HEIs is an important source of technology for firms (Wong, 1999), no empirical evidence could be found to suggest that this is the case. Survey data from this research has revealed that Irish HEIs are not a key source of innovation for indigenous EI-assisted high-tech companies (Chapter 6, Section 6.3.3). Furthermore, in relation to innovation-related co-operation between firms and HEIs, there has been no assessment of the experiences and perceptions of such co-operation for firms with HEI links in R&D, consultancy and teaching/training. This population of firms represents a 'blackbox' of information on HEIs as a source of innovation for industrial development. The purpose of this chapter is to focus exclusively on firms with HEI links. The aim is to analyse the level of interaction between firms and HEIs, the types of links established and the factors contributing to and impeding such interaction. In addition, positive

and negative outcomes are assessed. This is followed by an analysis of formal and informal interaction and the problems associated with maintaining HEI links are also examined.

7.2 LEVEL OF INTERACTION WITH HEIs

In relation to the level of U-I links as a whole, universities accounted for 67% and ITs accounted for 33% of industry interaction. This almost certainly reflects the fact that universities have a longer history of engaging in research. It is only since 1992 with the publication of the RTC Act (1992) (Chapter 4, Section 4.2; Chapter 6, Section 6.2.1) that ITs have been permitted to undertake R&D, technology transfer, consultancy and the promotion of spin-off companies (McCarthy, 1998).

Figure 7.1 Level of interaction with universities



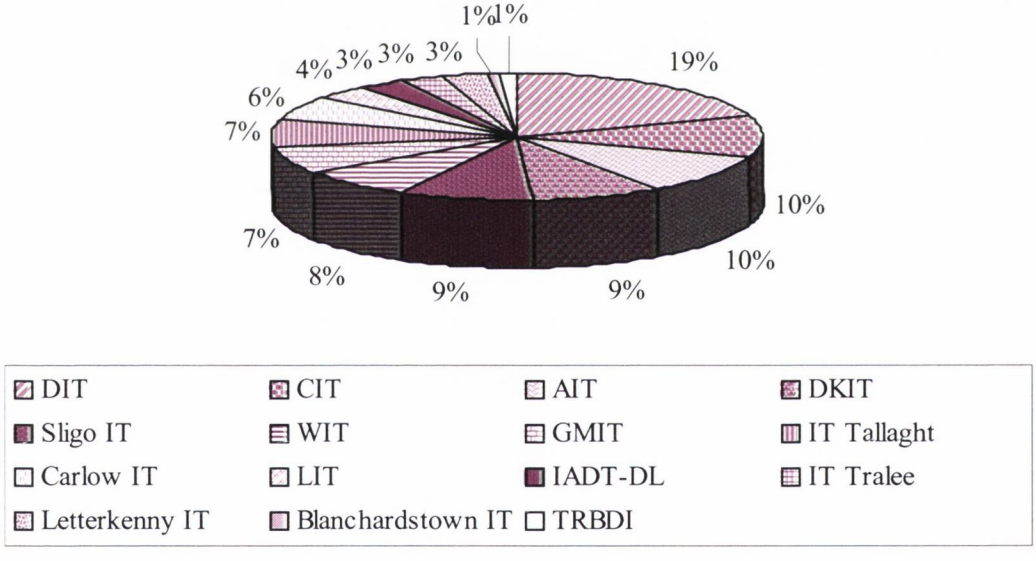
Source: Industry questionnaire survey (2002)

In relation to the universities, Dublin universities (UCD, TCD and DCU) combined accounted for 52% of all interaction with respondent firms (Figure 7.1). Universities in the mid-west of Ireland (NUIG and UL) accounted for 29% of interaction. In the south, UCC accounted for 13% and in the east region (outside Dublin) NUIM accounted for just 6%.

While a number of factors combine to facilitate the concentration of U-I interaction in Dublin, two are worthy of attention. The first is the concentration of both EI-assisted companies and HEIs in Dublin. As already noted, geographical proximity to a HEI increases the likelihood of interaction (Chapter 6, Section 6.2.5). The second attests to the research activities and commercial focus of each of Dublin's

universities. However, NUIG and UL were only marginally below TCD and DCU. This is significant considering the dispersed geography of EI-assisted companies in the mid-west and surrounding regions. In relation to UCC, the level of interaction was relatively low considering it has the NMRC and is located in close proximity to two high-tech industrial parks. In addition, Cork City is the second largest city in Ireland after Dublin and is one of Ireland's premier locations for high-tech industry in sectors such as pharmaceuticals, chemicals and electronics (Brunt, 1998; Barry, 1999; Barry and Brunt, 2002). NUIM emerged as the university with the lowest level of interaction with industry. The teaching focus in NUIM is predominantly in the humanities and social sciences. The number of academics in S&T subjects is significantly lower in NUIM than in any of the other universities. Thus the propensity for links with high-tech industry is less.

Figure 7.2 Level of interaction between ITs and industry



Source: Industry questionnaire survey (2002)

Despite the fact that there are four ITs in Dublin (DIT, Blanchardstown IT, IADT-DL and IT Tallaght), there was less of a Dublin bias in terms of the concentration of links with industry compared to the Dublin universities. This is a reflection of the total number of universities and ITs in the capital. Dublin has three of the seven universities (43%) and just four of the 15 ITs (27%). DIT accounted for 19% of all interaction with respondent firms (Figure 7.2). This reflects a number of factors. First, the history of DIT dates back to the late 19th century with the establishment of technical training in Ireland. Second, the teaching profile of DIT encapsulates a broad range of S&T orientated subjects. Third, such a high figure

reflects the activities of one of the most well developed ILOs in the HEI sector. The full spectrum of industrial liaison activities in DIT's ILO is divided among 18 ILO personnel, each of whom has a specialist subject focus.

In the remainder of ITs there was more or less equal representation in CIT (10%), AIT (10%), DKIT (9%), Sligo IT (9%), WIT (8%), GMIT (7%) and IT Tallaght[1] (7%). The origins of CIT date back to the early 19th century but the other RTCs were established in the early 1970s. Other ITs opened in the 1990s exhibited less interaction with industry. These include IADT-DL (established 1997), TRBDI (established 1998) and Blanchardstown IT (established 1999). While there are exceptions in the case of LIT (established 1852[2]), Letterkenny IT (established 1970) and IT Tralee (established 1977), the evidence suggests that the longer an IT is established the more likely it is to have interaction with industry.

7.3 STIMULANTS FOR THE DEVELOPMENT OF LINKS WITH HEIs

Each firm was presented with six stimulants and asked to indicate the level of importance they associated with each factor on a scale from 1 to 5 in terms of encouraging firms to interact with HEIs (Chapter 3, Section 3.2.1). It is important to note that these stimulants referred to links in general and were not specific to any type of link.

Table 7.1 Stimulants to the development of links with HEIs

Stimulant	Mean Score	Std. Dev.
Access to highly skilled graduates for recruitment	2.62	1.35
Gain exposure to current academic research and expertise	2.83	1.41
Access to newly emerging technologies	3.03	1.39
Access to consultancy services	3.30	1.47
Access to specialist education and training programmes	3.34	1.36
Access to management and marketing skills	3.94	1.12

Source: Industry questionnaire survey (2002)

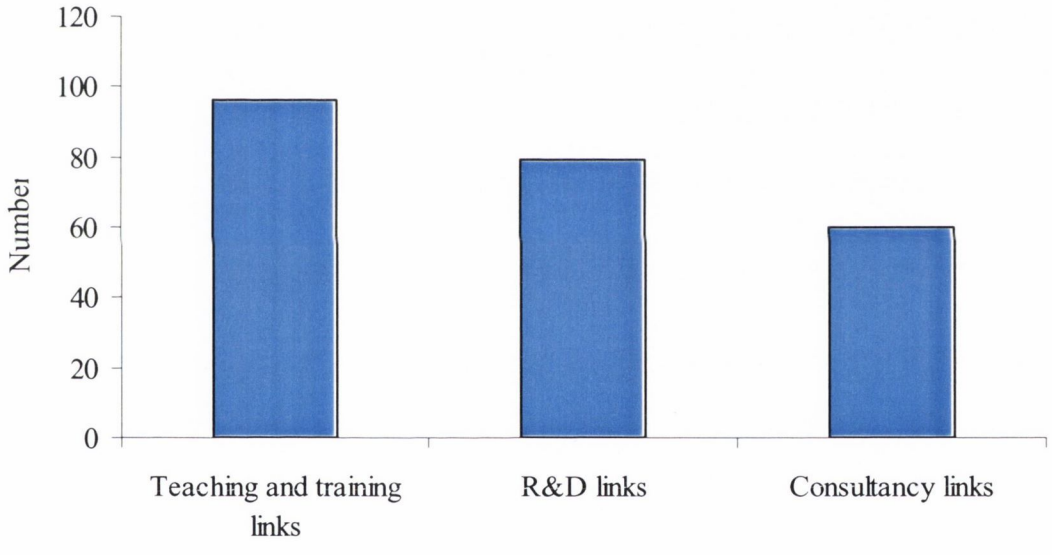
The factor cited by firms as the most important stimulant was 'access to highly skilled graduates for recruitment' with a mean of 2.62 (Table 7.1). The standard deviation of 1.35 suggests less variation existed in respondents' answers relative to most other stimulants in Table 7.1. This result correlates closely with earlier evidence (Chapter 6, Section 6.2.6) in relation to stimulants in HEIs which facilitate the

[1] IT Tallaght was the first RTC established in the GDA.
[2] LIT can trace its origins back to 1852 when the Anthenaeum Society started a School of Arts and Fine Crafts in Limerick.

development of U-I links in Ireland. In this instance, firms with links placed access to skilled graduates from a HEI (mean = 2.76; standard deviation 1.38) in joint second place with proximity to markets/customers/suppliers (mean = 2.76; standard deviation 1.55).

'Gain exposure to current academic research and expertise' with a mean of 2.83 was evaluated by firms as the second most important stimulant. However, a standard deviation of 1.41 highlights greater variation in the responses to this factor. Response variation ranged from very important and important, to moderate and minor, with most considering it to be an important factor. Of least importance was access to management and marketing skills with a mean of 3.94, which also had the lowest associated standard deviation.

Figure 7.3 Types of links established with HEIs



Source: Industry questionnaire survey (2002)

While the stimulants outlined provide an indication of the reasons why respondent firms engaged in links with HEIs, a comparison of the types of links established provides a more precise analysis. It is important to note that firms can engage in more than one type of link. Teaching and training was the most common type of link, cited by 96 firms (57% of firms with HEI links) (Figure 7.3). This is surprising given that 'access to specialist education and training programmes' was rated in fifth place (Table 7.1). R&D links were the second most common type of link with 79 firms (47% of firms with HEI links) participating. Again, one would expect this figure to be much higher, given that 'gaining exposure to current academic

research and expertise' was placed second in terms of importance. Only 60 firms (36% of firms with HEI links) engaged in consultancy links with HEIs. This is not surprising given that the stimulant 'access to consultancy services' was rated fourth in terms of importance. In order to provide more in-depth analysis, each of the three types of links (R&D, consultancy and teaching/training) are deciphered in detail in the following sections.

7.4 R&D LINKS WITH HEIs

> *Because the high technology demands...access to advanced knowledge about the technologies involved which will typically be university and research institute based as well as maybe the large corporation R&D unit based. If it is high-tech indigenous, very few of them are going to have sizeable R&D facilities of their own. So all things being equal there should be a need to reach out and plug into the development in the technology and maybe support for anything to do with managing/improving the technology whether in product or process side (Interview with an academic from a university in Ireland, 2001, number one).*

Forty-seven percent (79 firms) of firms (with HEI links) engaged in R&D links with HEIs. This is surprising, given that much of the focus of the literature on innovation is on the need for firms to engage in R&D links with HEIs as a means towards enhancing competitive advantage (Chapter 2, Section 2.4). This result is, however, also reflected in international research. Lee (2000) conducted a questionnaire survey in the USA in 1997 on affiliate members of AUTM. One of AUTM's responsibilities is to represent firms which collaborate with HEIs. Research findings indicated that of the 698 US-based[3] affiliate members only 44% (306 firms) engaged in R&D collaboration with a university. While there is a perceived need in the literature for firms to engage in links with HEIs, the results of this research corroborate with the evidence found by Lee (2000) indicating that less than half of firms with HEI links engage in R&D interaction with HEIs.

In order to assess the experience firms have had in their R&D interaction with HEIs, firms were presented with five barriers and five stimulants. Firms were asked to indicate the level of importance they associated with each factor as a barrier or a stimulant on a scale from 1 to 5. These were selected based on a reading of the relevant literature (Chapter 6, Section 6.4).

[3] Foreign firms were eliminated from the survey due to the logistical difficulty of co-ordinating the survey.

7.4.1 Barriers to R&D links with HEIs

With a mean of 2.25, the most important barrier to R&D links with HEIs was 'R&D is expensive' (Table 7.2).

Table 7.2 Barriers to the development of R&D links with HEIs

Barrier	Mean Score	Std. Dev.
R&D is expensive	2.25	1.16
R&D completed by HEIs is not always relevant	2.49	1.11
HEIs are too slow to respond to R&D demands of industry	2.64	1.23
Equipment base and facilities of HEIs are insufficient	3.31	1.19
R&D links increase risk of breech of confidentiality/risk of disclosures	3.31	1.29

Source: Industry questionnaire survey (2002)

The standard deviation of 1.16 indicates less variation in responses relative to most other barriers in Table 7.2. Expense is a critical factor which dictates firm interaction with HEIs. There is a perception amongst firms that the financial cost of R&D conducted in HEIs for industry is excessive. Some firms also consider that such R&D provision should be free given that HEIs are funded by government finance. Furthermore, firms do not take into consideration the cost of developing an in-house R&D facility and conducting the same R&D for the same price as they receive from HEIs.

Similar levels of importance and variation in responses were recorded for the barrier 'R&D completed by HEIs is not always relevant' (rated second) and the barrier 'HEIs are too slow to respond to R&D demands of industry' (rated third). Lack of industrial relevance and slow response by HEIs are problematic to the creation of U-I links. Cultural differences exist between industry and academia and pose important barriers to the creation of U-I links. In light of this, EI in collaboration with HEIs and industry have an obligation to establish an interface agency responsible for communicating and matching the appropriate requirements of industry with the provision capabilities of HEIs. Only then will the cultural differences between both emerge as less significant.

7.4.2 Stimulants to R&D links with HEIs

The most important incentive for respondents to form R&D links with HEIs was an ability to 'access specialist knowledge and support in industrial R&D' (Table 7.3). The standard deviation of 1.22 indicates less variation in responses compared to the

other stimulants in Table 7.3. An ability to source external support for internal innovative activities was the most important stimulant which motivated firms to engage in R&D links with HEIs. Firms utilise R&D links as a support for innovative capabilities which initially derive from within the firm (Chapter 6, Section 6.3.3). According to Berman (1990), firms expect to benefit from R&D collaboration mostly through improved in-house research projects and skill enhancement of existing and recruited personnel.

Table 7.3 Stimulants to the development of R&D links with HEIs

Stimulants	Mean Score	Std. Dev.
Access specialist knowledge and support in industrial R&D	2.20	1.22
Produce high-quality products that meet changing market demands	2.85	1.42
Increase the speed at which the firm produces products	2.92	1.41
Increase the competencies/skills of the R&D staff of the firm	2.98	1.23
Secure answers to problems associated with production	3.47	1.34

Source: Industry questionnaire survey (2002)

This research indicates that, despite their growing importance, HEIs are not the key source of technology for industry. Instead, firms source innovative ideas from HEIs in order to compliment in-house R&D activity. This is consistent with the findings of the benchmarking study of Strategic Management of Technology (SMOT) completed in 1994 in Singapore (cited in Wong, 1999). SMOT surveyed 103 high-tech firms (both indigenous and foreign) and found that, from an industry perspective, the purpose of R&D interaction with HEIs was to pursue collaborative R&D (rated first), to obtain innovative ideas (rated second) and to determine technology trends (rated third). Evidently, these firms considered access to innovative ideas to be an important stimulant of interaction. Similarly, respondent firms for this research considered access to specialist knowledge and support in industrial R&D to be an important factor which motivated firm decisions to interact with HEIs.

In the knowledge-based global economy, as already discussed (Chapter 2, Section 2.4), firms acquire competitive advantage through R&D partnerships with external sources such as HEIs (Yang and Sun, 2001). Not surprisingly, in second place, with a mean of 2.85, was the stimulant 'produce high-quality products that meet changing market demands'. The increasing responsiveness of firms to market demand is a key motivating factor which encouraged R&D interaction with HEIs.

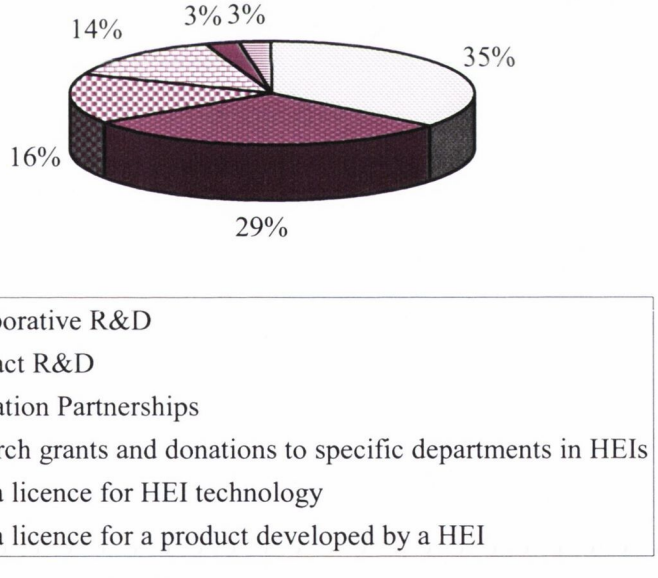
Allied to this and rated third in terms of importance was 'increase the speed at which the firm produces products'.

Enhancing the R&D skills of staff was rated fourth. Similarly, SMOT (1994) found that the training of company personnel was rated fourth (cited in Wong, 1999). Of least importance in this research was 'secure answers to problems associated with production'. Overall, the evidence suggests that respondent firms engage in R&D interaction with HEIs in order to compliment their in-house R&D capability and increase their product profile. Firms are less driven by the need to enhance the skills profile of R&D staff or to secure advice in relation to production problems.

7.4.3 Types of R&D links

In order to delineate the level of interaction in each of the various forms of R&D, respondents were presented with six different types of R&D interaction. They were asked to indicate which forms were applicable to their firm.

Figure 7.4 Types of R&D links



Source: Industry questionnaire survey (2002)

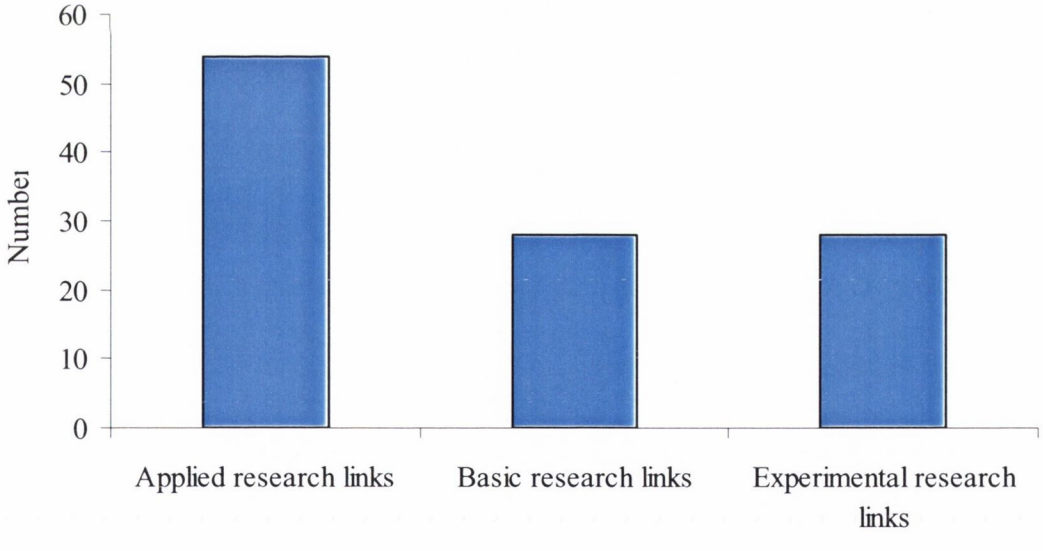
The most common type of R&D link established was collaborative research. Thirty-five percent of all R&D interaction was channelled through collaborative partnerships between academia and industry (Figure 7.4). Contract R&D was the second most important form, responsible for 29% of all R&D interaction. Innovation partnerships were in third place and constituted 16% of R&D links. This figure is relatively low, given that EI funds half of the partnership cost, and it may be

indicative of the lack of knowledge of firms on the existence of this initiative. Research grants and donations to specific departments in HEIs accounted for 14% of R&D interaction. This suggests that firms are not interested in simply making donations to fund research in universities and instead are more interested in making an investment and seeking a return. Finally, the two areas where a significantly low level of interaction was recorded were in firms holding a licence for HEI technology (3%) and firms holding a licence for a product developed by a HEI (3%). Evidently, efforts by HEIs and EI to commercialise HEI technology have failed, as licensing does not constitute a significant level of R&D interaction between respondent firms and HEIs.

7.4.4 Categories of R&D links

Firms were asked to specify whether or not they engaged in basic, applied and/or experimental research links with HEIs. Firms were permitted to select one or more of the categories of R&D links.

Figure 7.5 Categories of R&D links



Source: Industry questionnaire survey (2002)

The results indicate that of the 79 firms with R&D links, 54 engaged in applied research while a number of basic and experimental research links were cited (Figure 7.5). A comparison can be made between the categories of R&D conducted in-house and the level of interaction with HEIs in each of the three categories of R&D. As noted earlier (Chapter 6, Section 6.3.1), 52% of firms with HEI links and

with an in-house R&D facility engaged in in-house basic research. However, the findings here indicate that 25% of firms which engage in R&D interaction participate in basic research links with HEIs. Similarly, as highlighted earlier (Chapter 6, Section 6.3.1), 92% of firms with links and with in-house R&D facilities conducted applied research, while only 50% of all firms with links engaged in applied research links with HEIs. In relation to experimental research, as observed earlier (Chapter 6, Section 6.3.1), 64% of firms with an in-house R&D facility engaged in experimental research. Yet only 25% of firms with R&D links engaged in experimental research links with HEIs. These findings vindicate earlier evidence from this research which found that the key source of innovation for firms was sources internal to the firms and not HEIs.

7.4.5 Positive and negative outcomes of R&D links

Collaborative R&D projects result in a variety of outcomes for participating partners. From an industry perspective, R&D collaboration with HEIs provides firms with information about the capabilities and direction of current research (Berman, 1990). Such strategic guidance is an intangible part of U-I collaboration in R&D and provides firms with direction for further R&D interaction with HEIs. With this in mind, it is appropriate to assess positive and negative outcomes of R&D links from the perspective of industry.

Respondents were asked to outline positive and negative outcomes resulting from R&D interaction with HEIs. Responses were categorised from open questions.

Table 7.4 Positive outcomes of R&D links with HEIs

	Positive outcomes	Number of times cited	% of total mentions
1	Access to specialist knowledge, skills and expertise	25	30.2
2	Access to new technologies which enhance product profile of firm	16	19.2
3	Access to equipment and research facilities	9	11.0
4	Reduced cost for industry	8	9.6
5	Access to expensive capital equipment in HEIs	5	6.0
5	Leads to graduate recruitment	5	6.0
6	Achieve solutions to industrial problems	4	4.8
7	Creates other links between academics and industrialists	3	3.6
7	Increases speed at which new products are developed	3	3.6
8	Facilitates SME interaction with HEIs	2	2.4
9	Increases awareness of R&D and business needs in HEIs.	1	1.2
9	Improvement in the profile of the firm	1	1.2
9	Shows firms' capability to achieve certain goals	1	1.2
	TOTAL	83	100%

Source: Industry questionnaire survey (2002)

An examination of the positive outcomes shows that a total of 66 firms provided a response with eight firms naming more than one outcome (Table 7.4). The most frequently cited (25 respondents) was 'access to specialist knowledge, skills and expertise' which accounted for 30.2% of total mentions. It is significant that this factor is as much a stimulant to interaction as it is an outcome. Firms considered access to knowledge and expertise important not only in instigating R&D links but also, as already noted, in encouraging them to engage in links with HEIs (Table 7.1). While firms considered access to knowledge and expertise as a critical stimulant towards engaging in interaction with HEIs, it is significant that HEIs were not the key source of innovation for firms with HEI links.

'Access to new technologies which enhance the product profile of the firm' was the second most frequently cited positive outcome. Again, this factor can be considered a stimulant as well as an outcome and it reflects the importance firms associate with product configuration. This factor was manifested in a number of ways, most notably in terms of the costs associated with creating or enhancing in-house R&D facilities designed to create new product configurations. This is closely connected with the third most frequently cited factor 'access to equipment and research facilities'. In particular, it was SMEs which pointed to the important role

played by access to equipment and facilities in HEIs. According to these firms, making such facilities available in-house would not be economically justifiable to small companies with low R&D budgets.

Table 7.5 Negative outcomes of R&D links with HEIs

	Negative outcomes	Number of times cited	% of total mentions
1	HEIs are too slow to respond to R&D demands of industry	25	39.6
2	Academics lack experience in dealing with industrial R&D problems	9	14.2
3	R&D costs are too expensive	7	11.2
4	Uncertainty within HEIs on how to deal with IP issues	5	8.0
5	Disclosure of business sensitive information	4	6.3
5	Excessive bureaucracy in HEIs	4	6.3
6	Realisation that R&D in HEIs is not relevant to industrial needs	3	5.0
7	The ability of academic researchers to focus on a specific goal may be difficult, especially at the start of a project	2	3.2
7	Lack of commercial sophistication/knowledge of ILOs governing academics time/resources	2	3.2
8	Research assistant turnover on short-term contracts can be a problem for continuity	1	1.5
8	R&D interaction requires close monitoring by the firm to ensure value for money	1	1.5
		63	100%

Source: Industry questionnaire survey (2002)

Turning to the negative experiences of collaboration for firms with R&D links with HEIs, a total of 52 firms provided a response with eight firms citing more than one outcome (Table 7.5). The most frequent response (25 respondents) was 'HEIs are too slow to respond to R&D demands of industry' (39.6% of total responses). Responses were manifested in various ways, most commonly in terms of lack of adherence to deadlines and deficiencies in response time from academic partners. Reference was also made to the time commitments of academic staff in relation to teaching and other research activities. From the perspective of industry, this leads to the perception that there is a low sense of urgency on the part of HEIs to meet industrial R&D demands. Delayed response was earlier rated third as a barrier to the development of R&D links with HEIs (Table 7.2). It is significant that this factor was rated first by the subset of firms with R&D links. Similarly, 'R&D is expensive' was earlier rated first as a barrier but is in fourth place as a negative outcome of R&D

interaction. Evidently, some of the barriers to the development of R&D interaction also emerged as negative outcomes to R&D collaboration.

In terms of an analysis of both positive and negative outcomes of R&D interaction, all of the positive outcomes cited were associated with what firms have gained from such interaction. However, all the negative outcomes related to the failings of HEIs in their partnerships with industry. In order to prevent a biased perspective on U-I interaction, it is also important to include the academic experience of such interaction with industry.

7.5 CONSULTANCY LINKS WITH HEIs

Thirty-six percent of respondent firms with HEI links engaged in consultancy links. This activity represented the lowest level of interaction between firms and HEIs. Furthermore, consultancy has received little attention in the literature and thus there is virtually no empirical base from which to compare the findings of this research. PREST (1998) is the only substantive source in this regard. However, the PREST survey did not include an empirical assessment of consultancy activity from an industrial or academic perspective. Instead, it focused exclusively on the experiences of HEIs as institutions in their engagement in consultancy activity with industry. That approach analysed consultancy activity from the biased perspective of the governance role undertaken by HEIs in relation to consultancy links with industry. It failed to include the perspectives of both partners in terms of their consultancy interaction.

Many HEIs are able only to provide limited data on the number of firms engaging in consultancy links because much of this activity is not centralised within HEIs (CURDS, 2001). Even where it is centralised, there may be considerable activity which is not declared by academics involved. This creates difficulties in estimating actual levels of consultancy using HEI sources. A more accurate level of interaction between both partners can be estimated from that indicated by firms.

The purpose of this section is to analyse consultancy activity from an industrial perspective. In order to address the lack of an empirical base, respondents in this research were presented with a number of questions on their experiences as recipients of consultancy services provided by HEIs.

7.5.1 Barriers to consultancy links with HEIs

As a means towards providing an empirical assessment of the factors impeding the development of consultancy links, respondents were presented with five barriers and asked to score each in terms of importance from 1 to 5.

Table 7.6 Barriers to the development of consultancy links with HEIs

Barrier	Mean Score	Std. Dev.
HEIs are slow to respond to the consultancy needs of the firm	2.75	1.36
Consultants are unaware of the specific and changing needs of industry	2.90	1.36
It is time-consuming to build a working relationship with consultants	2.96	1.39
Consultancy services are too expensive	3.18	1.39
Getting in touch with relevant consultants is difficult	3.11	1.30

Source: Industry questionnaire survey (2002)

The factor considered to be the most important barrier was 'HEIs are slow to respond to the consultancy needs of the firm', with a mean of 2.75 (Table 7.6). The standard deviation of 1.36 was the average in Table 7.6. In relation to R&D links, the evidence suggested that firms considered the HEI reaction to R&D demands as slow (rated third as a stimulant and first as a negative outcome) (Section 7.4). Yet, R&D is a time-consuming process - a factor which may not always be appreciated by industry or included in their time schedule for work-in-progress. Therefore, it is more likely that firms would consider the associated issue of delayed time to be more significant with R&D links rather than with consultancy links. However, as already noted, the barrier 'HEIs are too slow to respond to R&D demands of industry' was rated third for firms with R&D links (Table 7.2) while in the case of consultancy links, respondents considered the issue of slowness to be the most important barrier. According to Geisler and Rubenstein (1989), there are two reasons for the time-delayed response from academia. First, most HEIs formally require the faculty member to obtain permission to provide consultancy services to industry from the dean or head of department, potentially adding a bureaucratic hurdle to the initiation of consultancy interaction. Second, HEIs tend to impose organisational limitations on the time expended on and the scope or content of consultancy activities.

The second most important barrier cited by respondents was 'consultants are unaware of the specific and changing needs of industry' with a mean score of 2.90. According to Geisler and Rubenstein (1989), academics do not lack such knowledge.

It is more the case that firms have not learned to use academic consultancy effectively. Consultancy requirements from industry are often sporadic, thereby reducing the possibility for the development of a long-term relationship with academia. Such consistency would create mutually beneficial effects for both partners in terms of enhancing each other's knowledge of ongoing academic and industrial developments.

Increased interaction between firms and HEIs through the creation of an informal networking agency is one of the mechanisms which would enhance the creation and sustainability of consultancy interaction. Greater engagement in consultancy by both industry and HEIs would facilitate increased knowledge and understanding of each other in a variety of ways. From an industry perspective, consultancy would provide industry with a unique opportunity to tap into a large 'knowledge bank' and gain access to insights into new problem solving techniques and emerging technologies. From a HEI perspective, the provision of consultancy services would enable academics to keep informed on developments in industry, particularly in relation to changes in R&D and in the organisation of production. This would facilitate a greater understanding in HEIs of the changing skill requirements of industry.

7.5.2 Stimulants to consultancy links with HEIs

In relation to the development of consultancy links, respondents were presented with five stimulants and asked to score them in terms of importance from 1 to 5.

Table 7.7 Stimulants to the development of consultancy links with HEIs

Stimulants	Mean Score	Std. Dev.
Access to complementary research and technical expertise	2.32	1.17
Access to HEI-owned technologies for testing/analysis	2.63	1.39
Seek help in developing new and commercially viable business ideas	3.48	1.38
Access to appropriate business mentoring and development advice	3.63	1.46
Access to specialised knowledge in marketing and management	3.68	1.34

Source: Industry questionnaire survey (2002)

With a mean of 2.32, 'access to complementary research and technical expertise' was considered to be the most important motivating factor which encouraged firms to establish consultancy links with HEIs (Table 7.7). The standard

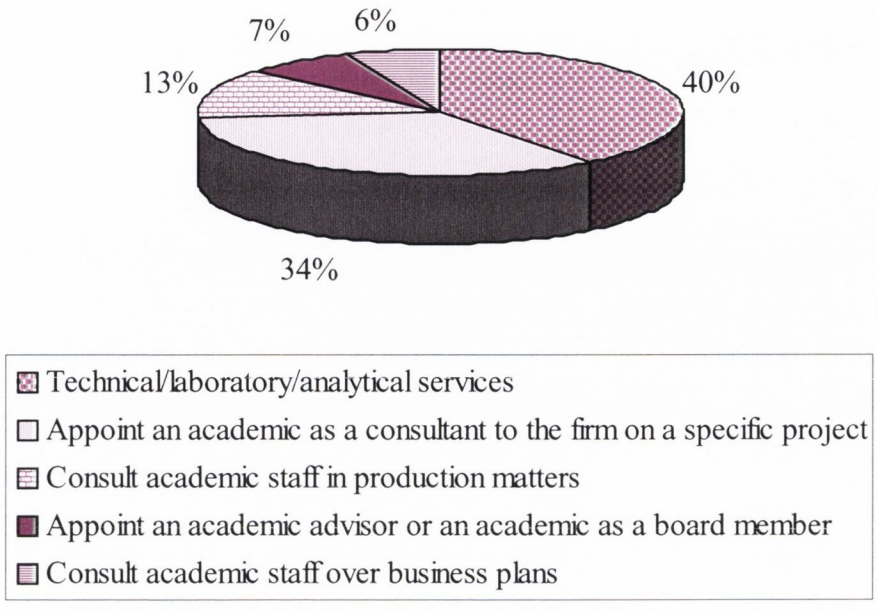
deviation of 1.17 indicates less variation in responses relative to each of the other stimulants. As when assigning importance to the stimulants to R&D links, respondents placed the factor 'access specialist knowledge and support in industrial R&D' in first place (Table 7.3). This would suggest that firms consider HEIs to be a critical source of knowledge in industrially relevant areas. However, the evidence suggests that HEIs are less important sources of business development and marketing know-how. In relation to consultancy links, the stimulant 'access to appropriate business mentoring and development advice' was rated fourth and 'access to specialised knowledge in marketing and management' was rated fifth. This concurs with earlier evidence in relation to the stimulants to the development of links in general which found that 'access to management and marketing skills' was rated sixth (Table 7.1).

In relation to the stimulants to the development of consultancy links, the second most important stimulant was 'access to HEI-owned technologies for testing/analysis', with a mean of 2.63. One of the reasons why this factor was considered to be so important is that the technologies used by HEIs for testing/analysis are too expensive for firms to acquire. To defray such costs, it is cheaper for firms, particularly SMEs, to gain access to HEI-owned technologies.

7.5.3 Types of consultancy links

As a form of technology transfer, consultancy differs from R&D in that it does not have as its prime purpose the generation of new knowledge (AURIL/CBI, 2001). In addition, consultancy has usually been carried out on an *ad hoc* and short-term basis with little commitment to long-term interaction between industrial and academic partners over time (Mitra and Formica, 1997). Little is known about the U-I interface from the perspective of consultancy. In particular, researchers have not attempted to categorise consultancy activity into its various forms. For the purpose of this research, respondents were asked to indicate the various types of consultancy activity in which they have engaged with HEIs.

Figure 7.6 Types of consultancy links



Source: Industry questionnaire survey (2002)

The most common type of consultancy link was technical/laboratory analytical services, accounting for 40% of interaction (Figure 7.6). As already noted, access to HEI-owned technologies was a key stimulant which encouraged the development of consultancy links (Section 7.5.2). Appointing an academic as a consultant to the firm on a specific project was the second most common type of consultancy, accounting for 34% of interaction. This concurs with AURIL/CBI (2001), who stipulated that one of the most common forms of U-I consultancy entails a relationship between a specified academic (or a specified team of academics) and an individual firm arranged on a project-by-project basis and over a specified period of time. The three remaining types of consultancy were deemed by respondents to be of less importance. Consulting academic staff over business plans constituted only 6% of all consultancy interaction. This reflects the inability of the HEI sector to respond to the business development needs of firms and was earlier mirrored in the fact that 'access to management and marketing skills' was considered to be the least important stimulant encouraging the development of links with HEIs (Table 7.1).

7.5.4 Positive and negative outcomes of consultancy links

Due to the paucity of research completed on U-I consultancy links, little is known of the positive and negative outcomes of such interaction. Respondents were asked in open-ended questions to outline their experiences.

Table 7.8 Positive outcomes of consultancy links with HEIs

	Positive outcomes	Number of times cited	% of total mentions
1	Access to specialist knowledge, skills and expertise	30	51.7
2	Access to analytical technologies of the future	8	13.7
3	HEIs provide an independent view on technical problems	6	10.5
4	Facilitates development of new products for firm	4	6.8
5	Leads to recruitment from HEI	2	3.5
5	Access to capital equipment not affordable by SME	2	3.5
5	Industrial experience for HEI staff/students	2	3.5
6	Facilitated firm start-up	1	1.7
6	High quality technical services at reasonable cost	1	1.7
6	Facilitates development of manufacturing process	1	1.7
6	Use of right consultant can provide access to broader international developments in fields which impact on the firm	1	1.7
	TOTAL	58	100%

Source: Industry questionnaire survey (2002)

In relation to positive outcomes, a total of 51 firms provided a response, with three firms naming more than one response (Table 7.8). By far, the most frequently cited (30 respondents) was 'access to specialist knowledge, skills and expertise' (51.7% of total responses). While this factor is as much a stimulant to interaction as it is an outcome, the nature of academic consultancy for industry is focused on the dissemination of expertise. It is, therefore, not surprising that firms cited this factor as a positive outcome. Second in importance (eight respondents) was 'access to analytical technologies of the future'. In particular, firms highlighted the importance of achieving awareness of future technologies as a means of acquiring competitive advantage. A surprising feature was that only four respondents stated that consultancy interaction facilitated the development of new products. Given the assumed role which U-I interaction plays in product development, one might have expected this value to be higher. The evidence from this research suggests that, in the main, firms are engaging in consultancy activity with HEIs in order to access the academic expertise and analytical technologies available.

Table 7.9 Negative outcomes of consultancy links with HEIs

	Negative outcomes	Number of times cited	% of total mentions
1	Differences in objectives	19	42.3
2	Problems with time commitment of academic staff	12	26.6
3	Too expensive	3	6.6
4	Breech of confidentiality	2	4.5
4	Difficult to identify suitable academic consultants	2	4.5
4	Lack of interest from HEIs to achieve successful outcomes	2	4.5
5	Academics can be too specialised. It can be a waste of time on both sides	1	2.2
5	Conflict of interest with different clients	1	2.2
5	Poor backup when problems develop after new product introduction	1	2.2
5	Changing staff – same academics not always available	1	2.2
5	Not enough encouragement given to the firm	1	2.2
	TOTAL	45	100%

Source: Industry questionnaire survey (2002)

Firms were asked to indicate the negative outcomes of consultancy interaction with HEIs. A total of 39 firms provided a response with six firms citing two outcomes (Table 7.9). 'Differences in objectives' was the most frequently cited negative outcome (19 respondents) and accounted for 42.3% of total mentions cited. This was manifested in various ways, most commonly in terms of industry's perception of academia's distance from the commercial world. Firms noted that the criteria for internal HEI career progression were such that considerations other than the needs of industry were important to academics. Respondents stated that academics engaged in consultancy interaction to enable HEIs to source funding exclusively for their own benefit rather than being focused on meeting the aims and objectives of consultancy interaction. Most HEIs were interested in big projects involving a large financial commitment from firms. 'Differences in objectives' is as much a barrier as it is an outcome of consultancy interaction. In interviews with ILOs and CEOs in UK universities, PREST (1998) found that this factor was rated fourth by HEIs as a barrier to establishing consultancy links with industry. Evidently, firms are aware of the difficulties associated with the different objectives of academia and industry in consultancy interaction.

In second place was 'problems with time commitment of academic staff' (12 respondents). Delayed response time, difficulties in meeting project deadlines and

reporting deficiencies were mentioned by respondents as negative outcomes of consultancy interaction with HEIs. Moreover, respondents stated that such interaction was time-consuming and excessive in terms of time invested in relation to results achieved.

7.6 TEACHING AND TRAINING LINKS WITH HEIs

As the global economy becomes more knowledge intensive, the demand by industry for 'knowledge' workers increases (PREST, 1998). HEIs have responded through the provision of a diversified range of educational and training programmes designed to meet the needs of industry. Distance learning and general/bespoke courses for industry (both full and part-time) have become integrated into the teaching profile of HEIs as part of a wider agenda of lifelong learning (PREST, 1998). Such change has the potential to create internal tensions in HEIs stemming from their roles as academic knowledge providers and their potential to contribute to regional economic and social development (Chapter 2, Section 2.5). In any case, changes in the profile of teaching activities in HEIs have resulted in the implementation of a broadened scope of educational provision and increased access to third-level education for the wider community. Within this context, potential for the development of high levels of U-I interaction in teaching and training has increased. This research found that 57% of respondent firms with HEI links engaged in teaching and training links, representing the most common form of interaction between the firms and HEIs. This section provides the industrial perspective on firm involvement in teaching and training links with HEIs.

7.6.1 Barriers to teaching and training links with HEIs

Respondents were presented with five barriers to the development of teaching and training links and were asked to score each from 1 to 5 in terms of importance.

Table 7.10 Barriers to the development of teaching and training links with HEIs

Barrier	Mean Score	Std. Dev.
It takes time and resources to train HEI students in the firm	2.53	1.26
It is difficult for the firm to release staff to attend HEI courses	3.06	1.37
Curriculum is not relevant to the educational and training needs of industry	3.09	1.29
Following completion of work placement students return to HEI	3.17	1.32
Lack of ability to pay HEI students on work placement	3.59	1.45

Source: Industry questionnaire survey (2002)

The most important barrier was 'it takes time and resources to train HEI students in the firm', with a mean of 2.53 (Table 7.10). The standard deviation of 1.26 indicates less variation in respondents' answers relative to each of the other barriers in Table 7.10. From a HEI perspective, the PREST (1998) report found that HEIs did not cite a lack of time on the part of industry to be a barrier to providing CET for industry (Chapter 2, Section 2.3.3.2, Table 2.4).

Considered to be of less importance was the barrier 'it is difficult for the firm to release staff to attend HEI courses', with a mean of 3.06. In the research completed by PREST (1998), HEIs stated that it was difficult for SMEs to release staff for training even for short periods. The PREST (1998) report found that this was the least important barrier. In this survey, it is noteworthy that the two most important barriers relate to internal deficiencies within firms and not HEIs.

Evaluated as the third most important barrier was 'curriculum is not relevant to the educational and training needs of industry', with a mean of 3.09. Similarly, in the PREST (1998) survey the barrier of industry not perceiving CET to be relevant to industrial requirements was rated third. According to the PREST (1998) report, HEIs were considered by industry to be ivory towers not capable of providing relevant work-related training and education.

7.6.2 Stimulants to teaching and training links with HEIs

In order to provide an empirical assessment of the factors which motivated firm engagement in teaching and training links with HEIs, respondents were presented with five stimulants and asked to rate each in importance from 1 to 5.

Table 7.11 Stimulants to the development of teaching and training links with HEIs

Stimulants	Mean Score	Std. Dev.
Access to high potential students early in the recruitment cycle	2.28	1.40
Maintain a high level of technical skills in the firm	2.41	1.33
Participate in student placement schemes with a HEI	2.58	1.27
Access to specialist education and training programmes	2.67	1.34
Recruit more experienced scientists and engineers	3.07	1.36

Source: Industry questionnaire survey (2002)

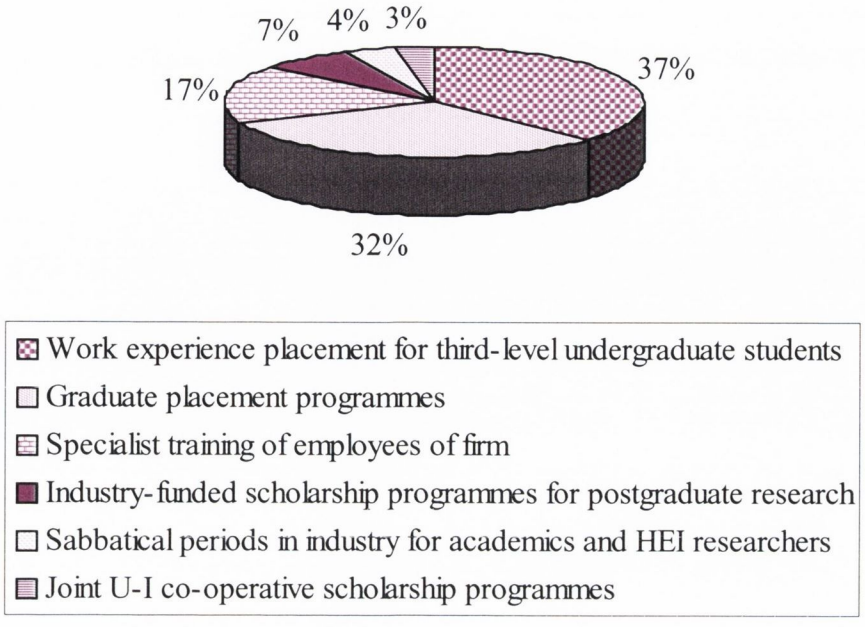
The most important stimulant was 'access to high potential students early in the recruitment cycle', with a mean of 2.28 (Table 7.11). However, the standard deviation of 1.40 indicates a greater variation in responses relative to the other stimulants. It is significant that firms had a greater preference for gaining access to high potential students early in the recruitment cycle than for recruiting more experienced scientists and engineers, which was considered the least important stimulant. Evidently, while firms seek access to a pool of 'knowledge workers', recently graduated personnel present a cheaper financial option compared with more experienced scientists and engineers with increased capability to command higher salaries.

The factor 'maintain a high level of technical skills in the firm' was rated second and is a reflection of the important role HEIs play in upgrading the technical skills of existing employees of firms. Surprisingly, of less importance were the factors 'participate in student placement schemes with a HEI' (rated third) and 'access to specialist education and training programmes' (rated fourth). The focus of HEIs on the provision of specialist training designed to meet the needs of industry was not an important motivating factor encouraging firms to establish teaching and training links with HEIs.

7.6.3 Types of teaching and training links

While teaching and training links constitute the most common form of U-I interaction, little is known of the types of teaching and training links formed. For the purpose of this research, respondents were presented with six types and asked to specify which were relevant to their teaching and training interactions with HEIs.

Figure 7.7 Types of teaching and training links



Source: Industry questionnaire survey (2002)

Undergraduate and graduate placement programmes together constituted 69% of all types of teaching and training links between respondent firms and HEIs (Figure 7.7). According to Phillips (1991), employing undergraduate interns and recent university graduates continues to be one of the chief ways in which knowledge is transferred from HEIs to industry. Firms recognise the critical value attached to the knowledge acquired by undergraduates and graduates of recent developments in academic research and innovation. The movement of this human resource into industry represents one of the most effective forms of U-I interaction in terms of the exchange of knowledge, technology transfer and the transferability of skills from HEIs to industry. This not only has positive effects in terms of enhancing firm competitiveness but also results in a range of spin-off effects in terms of creating and sustaining economic development with the regional economy.

'Work experience placement for third-level undergraduate students' was the single most common type of teaching and training link, accounting for 37% of interaction. This is surprising given that the stimulant 'participate in student placement schemes with a HEI' was rated third as a factor encouraging firms to engage in teaching and training links (Section 7.6.2). On the basis of the survey data, while student placement schemes are not central to the decision-making process of firms seeking to engage in teaching and training links with HEIs, work experience

placement for undergraduates becomes a central component of teaching and training links between partners.

As noted earlier, the primary motivating factor was access to students early in the recruitment cycle (Section 7.6.2). This is reflected in the high concentration of interaction in 'graduate placement programmes', which comprised 32% of teaching and training links. This suggests that firms consider HEIs to be a source of undergraduates and graduates equipped with the knowledge and expertise required by industry. Furthermore, this evidence highlights the success of placement programmes implemented by Irish HEIs.

In contrast, respondents were less inclined to engage in specialist training of their employees in HEIs. This form of teaching and training link constituted 17% of interaction. Such a low level of interaction could perhaps reflect the lack of confidence firms have of bespoke courses in HEIs for industry. It could also highlight the reluctance of firms to release staff for continuous training. Of less importance were the three remaining types of teaching and training link. Evidently, firms were not interested in providing finance for postgraduate scholarship programmes in HEIs (7%) and they were not focused on facilitating sabbatical periods in industry for academics (4%). Finally, joint U-I co-operative scholarship programmes accounted for only 3% of teaching and training interaction.

7.6.4 Positive and negative outcomes of teaching and training links

The educational role of HEIs has evolved to include a broad spectrum of teaching and training activities but little is known of the positive and negative outcomes to industry of these developments. This highlights a significant gap in the literature, given that teaching and training links constitute the most common type of U-I interaction. Respondents were asked in open questions to indicate both the positive and negative outcomes of teaching and training links with HEIs.

Table 7.12 Positive outcomes of teaching and training links with HEIs

	Positive outcomes	Number of times cited	% of total mentions
1	Placements provided recruitment opportunities for potential staff	30	31.0
2	Promoted new ideas/enhanced skills/expertise of existing staff	13	13.5
2	HEIs gained a better understanding of the needs of industry	13	13.5
3	Improved morale of existing staff due to HEI training	12	12.5
4	Facilitated access to latest research and technologies	7	7.3
5	Created opportunities to develop further research projects	6	6.1
6	Facilitated creation of contacts and future links with HEIs	4	4.1
7	Facilitated access to cost effective training	3	3.0
7	Increased firms' awareness in necessity for R&D	3	3.0
7	Facilitated increase in R&D activity in firm	3	3.0
8	Quality of students/graduates was very high	2	2.0
9	Facilitated access to innovative ideas of placement students	1	1.0
	TOTAL	97	100%

Source: Industry questionnaire survey (2002)

Examining first the positive outcomes, a total of 79 firms provided a response with 18 firms naming two outcomes (Table 7.12). By far the most frequently cited outcome (30 respondents) was 'placements provided recruitment opportunities for potential staff'. This accounted for 31% of total factors cited. Firms were united in their appreciation of the opportunities provided by student and graduate placements in terms of assessing potential candidates for future employment.

Considered to be second in terms of importance, respondents stated that teaching and training links 'promoted new ideas/enhanced skills/expertise of existing staff'. Responses were manifested in various ways, most commonly in terms of enhancing the skill profile of existing staff and seeding ideas about potential areas of R&D which could be beneficial to future firm growth. In joint second place, respondents stated that 'HEIs gained a better understanding of the needs of industry'. This is significant, given that this is one of the factors most often cited as a barrier to the development of U-I links from the perspective of firms (Chapter 2, Section 2.3.3.1).

Table 7.13 Negative outcomes of teaching and training links with HEIs

	Negative outcomes	Number of times cited	% of total mentions
1	Excessive time used training placement students	24	48
2	HEI courses were found not to be relevant to needs of industry	12	24
3	Student placement is too short	3	6
3	Requirement to pay students	3	6
3	Students return to HEIs following placement is a disadvantage	3	6
4	Difficult to release existing staff for training	2	4
4	Teaching and training links are expensive	2	4
5	Geographical distance	1	2
	TOTAL	50	100%

Source: Industry questionnaire survey (2002)

Focusing on the negative outcomes of teaching and training links, a total of 45 firms provided a response, with five firms citing two outcomes (Table 7.13). In all negative outcomes cited by respondents, there was no reference to graduate placements; firms focused exclusively on the negative outcomes of undergraduate student placements and of training their own staff.

The most frequently cited negative outcome was 'excessive time used training placement students' (24 respondents). This accounted for 48% of total factors cited. Lack of perception and appropriate preparation by HEIs for student placement in 'the real working world' was considered the root cause of this negative outcome. Furthermore, respondents highlighted an inability of students to switch quickly from an academic to a professional mindset.

'HEI courses were found not to be relevant to needs of industry' by 12 firms. Respondents provided various manifestations of this outcome, most commonly in terms of a curriculum irrelevant to industrial needs. Furthermore, respondents pointed to the existence of an inflexible academic system unable and unwilling to accommodate the teaching and training requirements of industry.

7.7 FORMAL AND INFORMAL LINKS

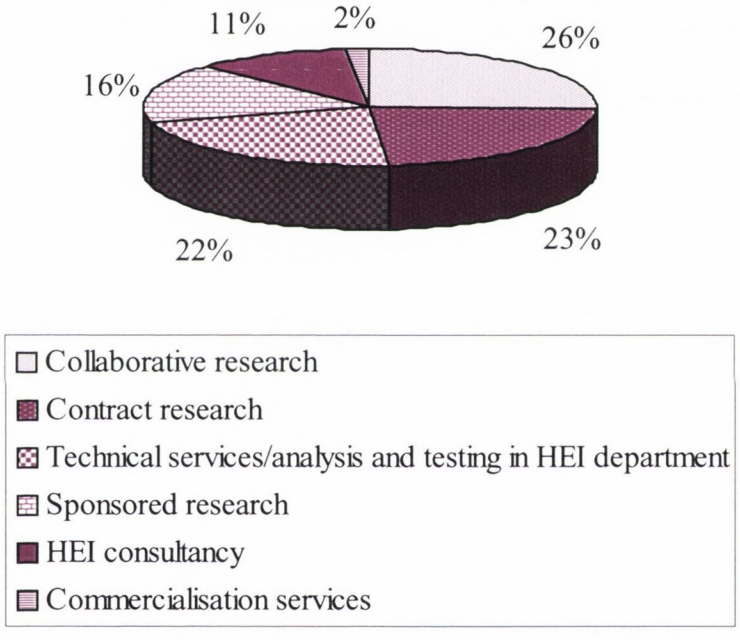
Previous sections of this chapter have focused specifically on three types of link which has facilitated a detailed assessment of specific aspects of each type of link. This section considers the broad macro perspective of U-I interaction by analysing the various ways by which links are formally and informally construed. At present,

relatively little is known about formal and informal interaction between industry and HEIs.

7.7.1 Formal links

In a study of links between a sample of 21 science park firms and researchers in the University of Surrey, Vedovello (1997) found that 33% (7 firms) engaged in formal links with the host university. In the present research 45% (75 firms) of respondent firms had formal links with HEIs.

Figure 7.8 Types of formal link



Source: Industry questionnaire survey (2002)

Just over a quarter of all formal links were in collaborative research (Figure 7.8). This finding is consistent with earlier evidence that 35% of R&D links were in collaborative research (Section 7.4.3). The evidence suggests that the majority of R&D interaction through collaborative research was implemented via formal links between firms and HEIs. Contract research provided similar results. Twenty-three percent of all formal interaction was through contract research. As noted earlier, contract R&D constituted 29% of R&D links (Section 7.4.3). Again, this suggests that the majority of contract R&D links are designed on a formal basis between respondent firms and HEIs.

Twenty-two percent of respondents had established formal links in technical services/analysis and testing in a HEI department. This type of link comes under the broad category of consultancy activity. As noted earlier, technical/laboratory analytical services constituted 40% of consultancy interaction between respondents (with consultancy links) and HEIs (Section 7.5.3). Again, parallels can be drawn between the high concentration of consultancy interaction in technical/laboratory analytical services and the fact that this type of link constituted nearly a quarter of all formal interaction between respondent firms and HEIs.

Sponsored research, which involves industry paying fully for a research programme implemented by an academic (or a team of academics), constituted just 16% of formal interaction. This type of link is not desirable, either from the perspective of industry or academia. Industry is less inclined to totally finance a project and prefers instead to receive government-sponsored finance (*e.g.* EI's Innovation Partnerships) or to share the cost with HEIs in the form of collaborative research. From a HEI perspective, academics prefer to work on collaborative research projects with industry as it facilitates greater freedom in terms of the design and implementation of the research.

HEI consultancy constituted just 11% of formal interaction. This is not surprising given that consultancy was the least important type of interaction between firms and HEIs (Section 7.5). In addition, consultancy activity in HEIs tends to be on an informal basis (Chapter 2, Section 2.5.4). Thus, the low level of formal interaction via HEI consultancy is to be expected.

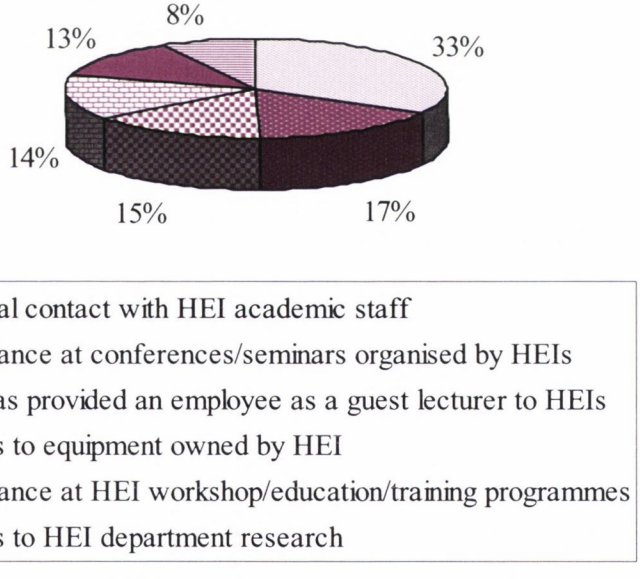
Just 2% of all formal interaction between firms and HEIs was through commercialisation services provided by ILOs within HEIs. Despite the increasing focus of government initiatives (implemented through EI) designed to increase the commercialisation of HEI research, the evidence from this research indicates that only a small proportion of this activity is being implemented through formal links between firms and HEIs. While a higher level of commercialisation may be emerging from the HEI sector in the form of HEI-generated spin-offs, very little of the commercialisation activity is being directed towards existing industry. There are a number of reasons for this result. First, respondent firms may not have the technological sophistication or the capital necessary to recognise and exploit HEI research with commercial potential. Second, respondent firms may not have realised the potential benefits that could be accrued from the commercial exploitation of new technology. Third, ILOs in HEIs

are not resourced to market research with commercial potential to the industrial community. HEIs are more focused on commercialisation from within their institutions and are reluctant to look outwards to existing firms as potential partners in the commercialisation process. In the absence of such comprehension, the potential for the commercial exploitation of Ireland's S&T base will never be fully realised.

7.7.2 Informal links

In this research, it was found that 76% (127 firms) of respondent firms had informal links with HEIs. This is consistent with the view that exchanges in information and ideas via informal links between industry and HEIs vastly outnumber any formalised interactions (Faulkner, 1992; Westhead and Storey, 1995; Vedovello, 1997). Vedovello (1997) found that 90% (19 firms) of the sample of science parks firms had informal links with the host university.

Figure 7.9 Types of informal links



Source: Industry questionnaire survey (2002)

According to Vedovello (1997), there is an increased propensity for firms to engage in links which require a low level of structured organisation. Results from this research confirm this view. The most common form of informal interaction between respondents and HEIs was 'informal contact with HEI academic staff', accounting for 33% of informal interaction between respondent firms and HEIs (Figure 7.9). Vedovello (1997) found that, of the 19 firms which had informal links with the host university, 74% (14 firms) engaged in 'personal contact with university academic

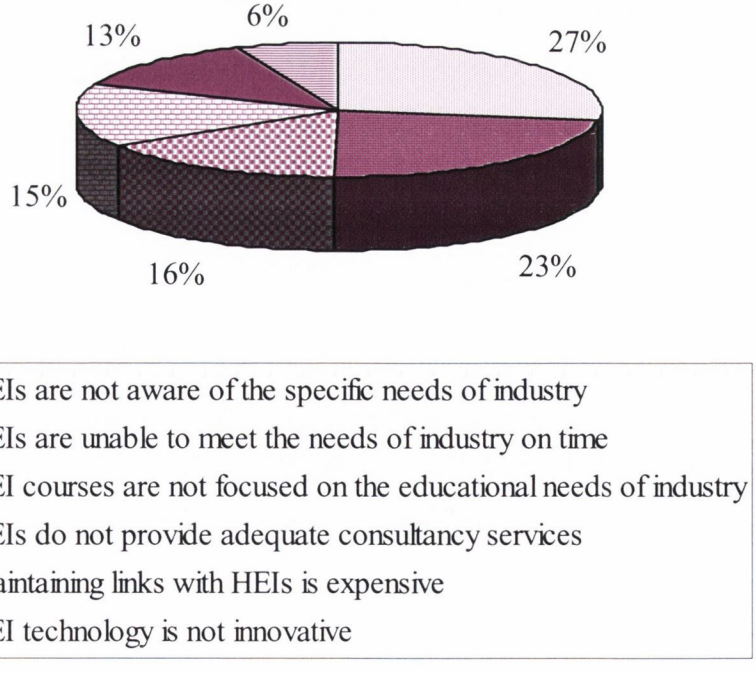
staff'. This link comprised the highest form of informal interaction between science park firms and host universities.

With the exception of 'attendance at conferences/seminars organised by HEIs', which accounted for 17% of informal interaction, the proportion of firms concerned with each type of link decreased as the level of structure and organisational requirement associated with the links increased. Surprisingly, the link which scored the lowest level of interaction was 'access to HEI department research', which accounted for just 8% of informal interaction. This could suggest a lack of confidence from firms on the relevance and adequacy of HEI research for their needs. It could also be symptomatic of a lack of communication and marketing from academia on the existence and availability of its research base which could potentially be relevant to industry.

7.8 PROBLEMS ASSOCIATED WITH MAINTAINING LINKS

Having established links with HEIs, respondents were presented with a number of potential problems associated with maintaining links and were asked to select those relevant to their firms.

Figure 7.10 Problems associated with maintaining links



Source: Industry questionnaire survey (2002)

The most significant problem associated with maintaining links was HEI's lack of awareness of industrial needs (Figure 7.10). This problem accounted for 27% of the total responses. This has been a recurring theme emerging throughout the survey results and reflects the perception that many HEIs do not understand industry and its specific requirements, which would be desirable in the forging of links. HEIs are not pro-active in seeking to interact with industry, either due to a lack of interest or lack of motivation. They do not perceive their role to be one which could inform indigenous industry or forge links with Irish firms.

Time delays in meeting the demands of industry accounted for 23% of responses and again is a problem mirrored in the survey results discussed throughout this chapter. The underlying issue here is that academia and industry have different and somewhat conflicting organisational cultures which mean that they operate under different time pressures. Less problematic were the issues of HEI courses not being focused on industry's needs and HEIs not providing adequate consultancy services, which scored 16% and 15% of the total responses respectively. On a more positive note, just 13% of respondents considered that maintaining links is expensive. In general, the issue of high costs associated with collaboration is a barrier which deters the initial formation of U-I links (Section 7.4.1) but does not necessarily hinder their maintenance.

Finally, the problem 'HEI technology is not innovative' accounted for just 6% of total responses. This could suggest that respondents are content with the quality of innovative technologies in HEIs.

7.9 CONCLUSION

This chapter has considered U-I interaction from the perspective of firms with HEI links. Particular attention has focused on types of links established; barriers and stimulants associated with interaction; and problems in maintaining U-I links. Teaching and training links were found to be the most common form of interaction, followed by R&D links and consultancy links. Access to a pool of highly skilled graduates and exposure to the S&T research base in HEIs were primary influences encouraging firm interaction with HEIs.

This has important ramifications for future industrial policy and development in Ireland. Regions which can harness the intellectual assets in their third-level educational and public research institutes in order to meet the needs of industry may

have a higher propensity to attract and maintain investment in the future. Furthermore, with a well-educated labour force and a strong third-level educational system, Ireland is now in a position to become a competitive location for new knowledge-intensive industries. However, if Ireland is to fully exploit the knowledge base of its HEIs, enhance the profile of existing indigenous enterprise and attract foreign high-tech investment in high value-added sectors, the barriers which impede the development of U-I links must first be addressed.

Delayed response from HEIs, combined with the perception that HEIs lack relevance to industry's needs were the primary influences impeding interaction between firms and HEIs. While the evidence suggests a distinct lack of compatibility between HEI and industrial firm cultures, it does not preclude the potential of effective two-way interaction between both partners. Effective communication between firms and HEIs is crucial for the development of U-I links. HEIs must market their capabilities to industry and develop support systems which facilitate the requirements of indigenous high-tech enterprise. By the same measure, firms interested in developing links with HEIs need to understand that the U-I relationship involves a high level of commitment and is not premised on providing just-in-time quick fixes to the demands of industry. The absence of such action will result in a crucial underutilisation of a scarce and valuable resource in Irish HEIs and will limit the potential of the Irish economy to move successfully into a phase of stronger self-sustaining growth.

CHAPTER 8

FIRMS WITHOUT HEI LINKS

8.1 INTRODUCTION

> *Universities are seen by industry as places where research is done as a means of collecting funds and where the results are secondary – basically they don't live in the real world and don't have to produce real products (Firm without HEI links, number 422).*

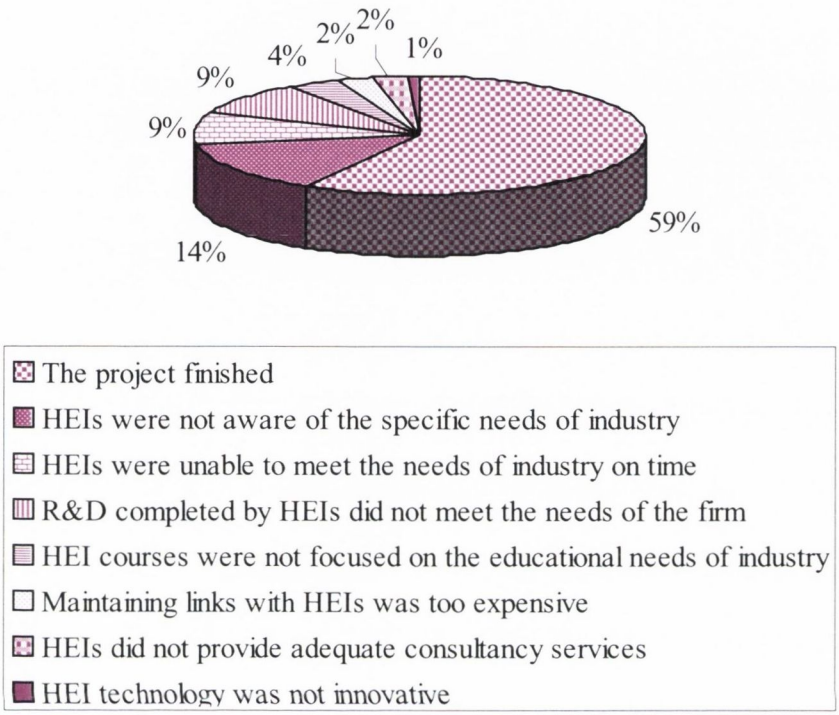
For firms, links with HEIs are not a necessary prerequisite for achieving product and process innovation. Survey evidence from this research has shown little difference in the level of innovative activity practiced by both independent samples of firms (Chapter 6). Furthermore, firms with HEI links did not consider HEIs to be a key source of innovation. Rather, such firms collaborate with HEIs as a means of supplementing and complementing limited internal resources and expertise. This leads to consideration of the factors impeding firms without HEI links from engaging in such interaction. In the overall context of research in U-I links, as already noted, relatively little is known about firms without HEI links. They have remained outside the scope of most other analyses and as a result there are no corresponding findings with which to compare the results of this research. Previous research has excluded firms without HEI links as a critical source of understanding of barriers and stimulants associated with the creation of U-I links. The purpose of this chapter is to analyse the reasons why these firms have not engaged in links with Irish HEIs.

8.2 PREVIOUS INTERACTION WITH HEIs

As already noted, 75% (505 firms) of respondent firms did not have links with HEIs (Chapter 3, Section 3.4.2, Figure 3.3). The reasons firms choose not to engage in links with HEIs are as complex and varied as those which may inform decisions to cease interaction with HEIs. In all, 12% (64 firms) of firms without HEI links had engaged in such links in the previous five years but had ceased to do so by the time of

the survey. In order to assess the reasons why these firms ceased interaction with HEIs, they were presented with a number of factors and asked to highlight those relevant to them.

Figure 8.1 Factors which led to the cessation of links with HEIs



Source: Industry questionnaire survey (2002)

The completion of projects was the most common factor (59%) leading to the cessation of interaction between firms and HEIs (Figure 8.1). Given the short-term focus of the various forms of U-I interaction, it is not surprising that project completion should feature so highly as a terminating factor. Second in terms of importance (14%), was 'HEIs were not aware of the specific needs of industry'. This is consistent with earlier evidence (Chapter 7, Section 7.8) from the sample of firms with HEI links when they indicated that the main problem associated with maintaining links with HEIs was that 'HEIs are not aware of the specific needs of industry'. Similar comparisons can be drawn in relation to the issue of HEI response time relative to the needs of industry. These findings are consistent with those of firms with HEI links. In general, both samples of firms consider HEIs problematic in terms of a lack of awareness of industrial needs and an inability to react to commercial requirements of industry on time.

8.3 FACTORS WHICH WOULD ENCOURAGE INTERACTION WITH HEIs

Reflecting the presumed role played by U-I links in enhancing the competitiveness of firms, an assessment of the factors which may encourage firms without HEI links to engage in such interaction was undertaken. Firms were presented with six factors and asked to rate the level of importance they associated with each on a scale from 1 to 5 as a potential stimulant which may encourage them to create links with HEIs (Chapter 3, Section 3.2.1).

Table 8.1 Factors which would encourage firms to establish links with HEIs

Stimulant	Mean Score	Std. Dev.
Access to newly emerging technologies	2.76	1.37
Access to highly skilled graduates for recruitment	2.81	1.30
Access to specialist education and training programmes	3.02	1.21
Access to consultancy services	3.11	1.30
Gain exposure to current academic research and expertise	3.14	1.41
Access to management and marketing skills	3.19	1.27

Source: Industry questionnaire survey (2002)

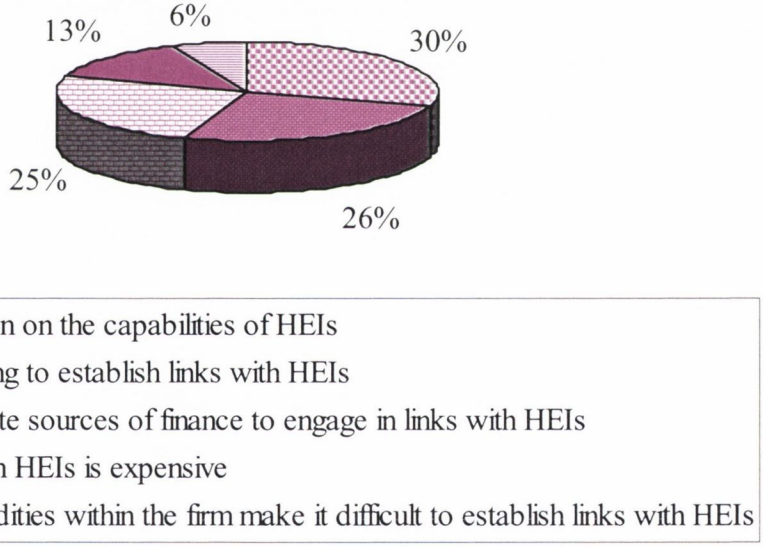
The factor evaluated as most important was 'access to newly emerging technologies' with a mean of 2.76 (Table 8.1). The standard deviation of 1.37 indicates that the data are relatively clustered around the mean. Most firms considered this to be an important factor which would encourage them to develop links with HEIs. By way of comparison, this factor was considered to be third in terms of importance by firms with HEI links (Table 7.1). In general, the differences in rank ordering in Tables 7.1 and 8.1 suggests clear differences in the perceptions of both samples in relation to their expectations of outcomes created through interaction with HEIs. Firms without links expect 'quick-fixes' in the form of access to new technologies while firms with links realise that access to academic research and expertise is in many cases a precursor to accessing newly emerging technologies.

'Access to highly skilled graduates for recruitment' was one of the factors which both samples scored highly. Firms with HEI links considered this factor to be the most important (Chapter 7, Section 7.3), while those without links considered it to be second in terms of importance (Table 8.1). Similarly, both samples considered 'access to management and marketing skills' to be the lowest in terms of importance. Evidently, firms do not consider that HEIs provide adequate entrepreneurial education in the areas of management and marketing.

8.4 OBSTACLES TO ESTABLISHING LINKS

Several studies have noted that cultural differences and lack of communication are the main barriers preventing the development of U-I links (Canadian Research Management Association, 1991; Fassin, 1991; Warda, 1995; Oyebisi, *et al.*, 1996; CIHE, 1998). While a number of impediments prevent the creation of U-I links, there has been little research to determine which are the most significant factors. This pertains not only to firms without HEI links but equally to firms with HEI links. In order to assess the relative importance of reasons for non-collaboration, firms without HEI links were presented with five factors responsible for impeding the creation of such links. Firms were asked to indicate those factors relevant to their firm's decision for not engaging in HEI interaction.

Figure 8.2 Obstacles to establishing links with HEIs



Source: Industry questionnaire survey (2002)

'Lack of information on the capabilities of HEIs' emerged as the most prominent obstacle to interaction, accounting for 30% of all responses (Figure 8.2). Firms are not aware of what HEIs can provide them with, and without access to such knowledge, it is unlikely that this sample of firms will form partnerships with HEIs. It is the responsibility of HEIs in collaboration with both EI and industry to take the initiative (should they so choose) to market their capabilities to the segment of the industrial community interested in and receptive to co-operation with HEIs. Twenty-six percent of firms felt that establishing links with HEIs was time-consuming. Twenty-five percent of respondents stated that they lacked the appropriate sources of

finance to engage in such activities. As already noted (Chapter 6, Section 6.2), 63% of the sample of firms without HEI links were small-sized firms with 1-9 employees. In general, small firms do not have the personnel or the financial resources to establish links with HEIs. As already highlighted (Chapter 2, Section 2.3.1.1), it is mainly large-sized firms who engage in links with HEIs and the propensity for interaction with HEIs increases with firm size (Corsten, 1987a, 1987b; Bishop, 1988; Vedovello, 1995). This is due to the availability of greater staff numbers and financial resources in large-sized firms which are often directed specifically towards creating and maintaining HEI links.

8.5 REASONS FOR NOT ESTABLISHING LINKS WITH HEIs

> *Our company is too small, not high-tech or skilled. Too much effort on company behalf. We would love it, if the onus was on the universities or government (Firm without HEI links, number 23).*
>
> *Small business has to be approached and convinced of the need to link with universities/ITs (Firm without HEI links, number 708).*
>
> *They do not offer services we require or if they do, they keep it a secret. Academics tend to be non-commercial persons (Firm without HEI links, number 1004).*
>
> *It is not clear what advantages we would gain – I think the tie-in (link) would possibly be too, over-defined, not able to run with changing markets for us (Firm without HEI links, number 2090).*

In order to assess why this sample of firms do not engage in links with HEIs, they were asked in an open-ended question to outline the reasons why they have refrained from engaging in such co-operation. Responses were categorised into two groups: reasons related to the firm and reasons related to the HEIs. Firms provided a significantly higher proportion of reasons related to themselves than to the HEIs.

8.5.1 Reasons within firms

A total of 339 firms provided a response, with 38 firms citing more than one reason. In all, the 387 reasons were categorised into eleven individual categories which were ranked (Table 8.2).

Table 8.2 Reasons within firms for not establishing links with HEIs

	Reasons	Number of times cited	% of total mentions
1	Lack of information/awareness of HEI capabilities	86	22.2
2	No present requirement for links with HEIs	75	19.3
3	Lack of time to create HEI links	57	14.7
4	Industrial sector of firm is not relevant to creation of HEI links	51	13.1
5	Lack of finance within firm to create HEI links	31	8.0
6	No perceived advantage/benefit to be gained from HEI links	30	7.7
7	Small company limited resources to justify creation of HEI links	26	6.7
8	Perception that links with HEIs are too expensive	11	2.8
9	Lack of a network programme to facilitate creation of links	10	2.5
10	Firm has never been approached/encouraged by a HEI	7	2.0
11	Geographical distance between firm and nearest HEI is a barrier	3	1.0
	TOTAL	387	100%

Source: Industry questionnaire survey (2002)

'Lack of information/awareness of HEI capabilities' (86 firms) was the most common reason preventing firm engagement with HEIs and accounted for 22.2% of total factors cited (Table 8.2). It seems that firms are not aware of what HEIs can provide in terms of products or services which may benefit them. While firms noted that they lack a structured approach and commitment to the creation of HEI links, the lack of information on HEI capabilities is more significant as a factor preventing the possible development of HEI links. In highlighting lack of knowledge as a deterrent to the creation of links, firms were united on one key point. Firms lack knowledge on how to initiate contact and gain access to relevant sources of expertise in HEIs. It would seem that a lack of knowledge of HEI capabilities is fuelling a perception amongst firms that HEIs are inaccessible to industry. While there is the argument that firms should take the initiative to seek out such information, equally there is the case that HEIs have an obligation to market their capabilities to industry. HEIs need to be more pro-active in approaching industry.

In second place, 75 firms stated that they had 'no present requirement for links with HEIs'. This was manifested in one of two ways. Either firms had never considered links with HEIs as an option or there was no perceived necessity to engage in such activities at the time of the survey.

'Lack of time to create HEI links' emerged as the third most important reason which prevented these firms from engaging in such links. This was manifested in a variety of ways, most commonly in terms of firms not having the time to seek information on developing HEI links. Furthermore, firms stated that, even if they had access to such information, they would not have the time to create and sustain HEI links. As an adjunct, firms emphasised that the daily pressures of conducting business were too great to be further burdened by time demands associated with HEI interaction.

8.5.2 Reasons within HEIs as perceived by firms

Firms also provided HEI related reasons which prevented the creation of HEI links. A total of 37 firms responded with four firms naming two reasons, giving 41 reasons. These were categorised into eleven groups (Table 8.3).

Table 8.3 Reasons within HEIs as perceived by firms

	Reasons	No. of times cited	% of total mentions
1	HEIs are slow to react to industrial needs	10	24.3
2	HEIs have no understanding of commercial reality	7	17.0
3	HEIs do not engage in R&D relevant to industry	6	14.6
4	HEI courses are not focused on industry requirements	4	10.0
4	Lack of industry awareness in HEIs	4	10.0
5	Lack of co-operation and commitment by HEIs	3	7.3
6	Bureaucracy in HEIs is too difficult	2	4.8
6	Lack of confidentiality by HEIs	2	4.8
7	Difficulty in identifying expertise within HEIs	1	2.4
7	No point of contact in HEIs	1	2.4
7	HEIs lack capability	1	2.4
	TOTAL	41	100%

Source: Industry questionnaire survey (2002)

'HEIs are slow to react to industrial needs' was the most frequently cited problem (Table 8.3). In particular, firms noted that HEIs do not respond quickly enough in order to meet market demands. Ranked second, firms stated that 'HEIs have no understanding of commercial reality'. This lack of commercial awareness within HEIs was based on the perceived distance of HEIs from the commercial world. This was manifested in various ways, most commonly in terms of lack of adherence to deadlines and lack of appreciation of the imperatives associated with partnership. Ranked third, six firms stated that 'HEIs do not engage in R&D relevant to industry'.

In particular, limited expertise in Irish HEIs and R&D not relevant to market demand were the two main points of contention for firms. As an adjunct, firms stated that Irish HEIs do not provide relevant R&D services required by industry.

8.6 CONCLUSION

The purpose of this chapter has been to consider the reasons why firms without HEI links have refrained from engaging in interaction with Irish HEIs. Attention has focused on: previous interaction with HEIs; factors which would encourage interaction with HEIs; obstacles to establishing links; and reasons for not establishing links with HEIs. One of the findings which emerged as a critical barrier to interaction was the lack of information possessed by firms in relation to HEI capabilities. Evidently, a lack of effective communication exists between firms and HEIs. This is further reinforced by the fact that only 23% (119) of these firms plan to engage in links with HEIs in the future. Just under a quarter of respondent firms have considered the possibility of future engagement with HEIs.

This has significant ramifications, not only for the development of indigenous industry but also for long-term sustainable industrial growth allied with the continued development of a high growth economy. Traditionally, Ireland has exhibited low levels of indigenous industrial technological development. However, Irish HEIs, equipped with a critical mass of expertise, are now in a unique position to create and enhance the profile of indigenous technology-based industry focused on value-added high-tech activity. If such a scenario is to become a reality, the Irish government must develop effective policies supporting the creation of links between industry and HEIs in order to enhance the innovative capabilities of indigenous enterprise and encourage the spread of new technologies by the indigenous high-tech sector. Included in the development and implementation of such policies should be the creation of a forum focused on communicating the needs of industry and the capabilities of HEIs between both partners.

In particular, the government needs to tap into the large reserves of indigenous companies without HEI links and find ways to integrate such enterprises into effective partnerships with HEIs. By the same token, more effective measures should be undertaken to encourage Irish HEIs to assume a more pro-active role in informing indigenous industry about their capabilities. Without enhancing and exploiting the

full innovative capabilities of indigenous enterprise, Ireland will fail to become a key player in the knowledge-based global economy.

To date, little empirical research has been completed on the role of the academic community in shaping the innovative capabilities of companies. The following three chapters analyse academics with and without industry links. An assessment is made of the types of links created and the barriers and stimulants to such interaction.

CHAPTER 9

CHARACTERISTICS OF SURVEY ACADEMICS

9.1 INTRODUCTION

> *If the university is to engage in developing society, either as a knowledge-based society or sharing its information to make society a fair or more equitable place, you're going to have to engage with all stakeholders and they will be governments, industries, non-governmental organisations. So I think it would be, even if you were an extraordinarily wealthy university and had plenty of money for basic research, I think you would not be fulfilling your social role if you didn't engage with society as a whole (Interview with an academic from a university in Ireland, 2002, number two).*

On a global scale the emergence of the 'knowledge economy' (Cooke and De Laurentis, 2002), driven by competitiveness and technological innovation, has encouraged HEIs to redefine their economic and social role. HEIs have undergone a series of changes over the last decade, particularly in relation to their roles and responsibilities in supporting regional and national innovation systems (PREST, 1998). The increasing focus of HEIs on industrial and regional development emerged through the restructuring of the role of the HEI. Such restructuring has resulted in internal changes to HEIs, especially in terms of their core functions, and in alterations to their external activities in terms of their relationship with the public and private sector. It is generally recognised (OECD, 2000, 2002; Skilbeck, 2001; Waagø *et al.*, 2001) that the academic community has a role to play in economic and regional development through its contribution to technological innovation. Despite this, as already noted, relatively little attention has been focused on the role that the academic community plays in enhancing regional development through links with industry (Chapter 2, Section 2.5.2; Chapter 3, Section 3.5). Similarly, relatively little is known about academics who refrain from industrial interaction.

In analysing the data on the characteristics of academics, two points are worthy of attention. First, there were no relevant data with which to compare the

findings of this research. This is in contrast to the data collected on the characteristics of firms (Chapter 6). Second, industrial links are not a stated feature of the working life of an academic. In the sample of academics with industrial links, it is important to note that links with industry do not constitute their main work activity. Therefore, it is more difficult to assess the likelihood that certain characteristics of academics make them conducive or not to establishing links with industry. Firms are more transparent in this regard as links with HEIs can prove fundamental to their business development. It is, therefore, easier and more appropriate to assess the characteristics of firms in relation to their links or lack of links with HEIs (Chapter 6).

The aim of this chapter is to offer comparisons between academics with and without industrial links. The key research question focuses on the degree to which the characteristics of academics with links to industry differ from those without links. The aspects discussed fall into three categories: (1) the characteristics of the academics, (2) the role that EI should undertake in order to encourage the development of U-I links and (3) the role that Irish HEIs should undertake in order to encourage higher levels of U-I interaction.

9.2 CHARACTERSITICS OF RESPONDENT ACADEMICS

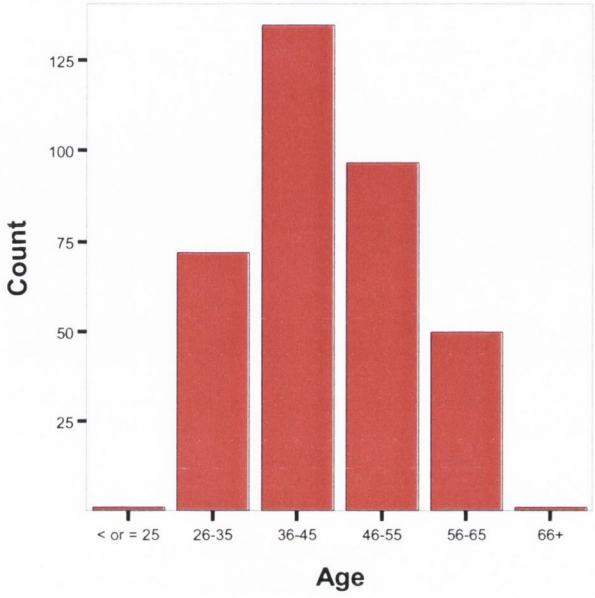
Data pertaining to personal characteristics (age and gender), academic position, education and previous employment outside of academia were collected. This facilitated an analysis of the profiles of academics with and without industrial links.

9.2.1 Age and gender

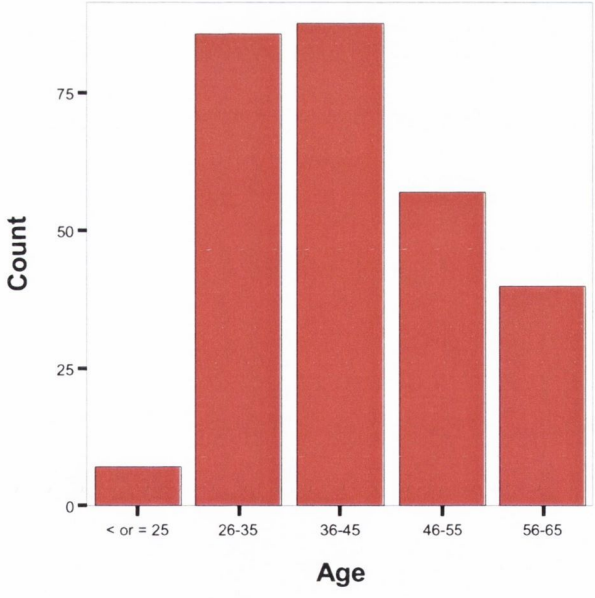
An analysis of the overall age profile and gender of academic respondents was undertaken. The purpose of this was to ascertain if a certain age cohort is more likely to have industrial links than others. Similarly, an analysis of the gender profile of respondents was undertaken to assess whether male or female academics engage more in links with industry.

Figure 9.1 Age profile of academic respondents

Academics with links



Academics without links



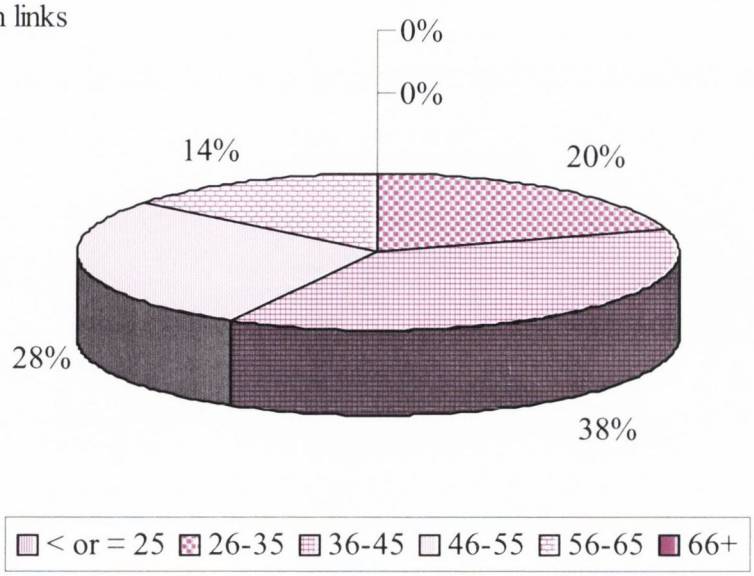
Source: Academic questionnaire survey (2002)

The majority of respondents were in the age cohorts 26-35 (24% of total), 36-45 (35% of total) and 46-55 (24% of total) (Figure 9.1). This was followed by a significant drop in the number of academics in the age cohort 56-65 (14% of total). A small proportion of academics were found in the age categories of 25 (1% of total)

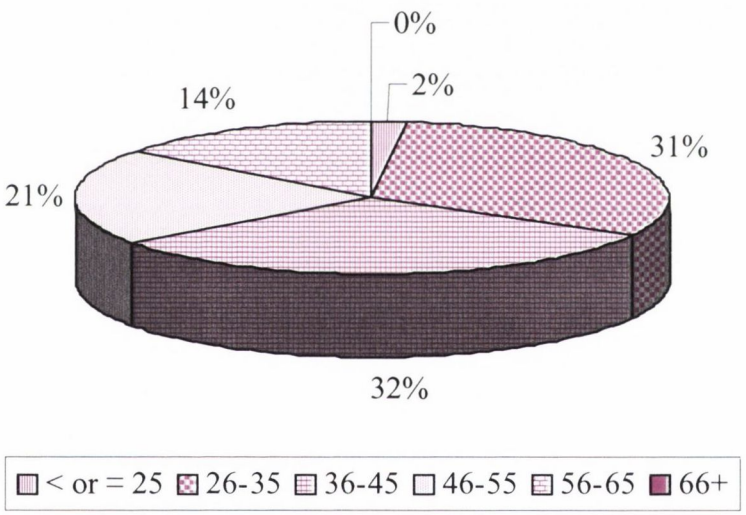
and 66+ (2% of total). These figures are clearly representative of the overall age profile of academics, the majority of whom are between the ages of 26 and 55 years. In the age cohort 25, a significantly low proportion of academics was expected given the number of years academics must commit to their education and training for academia. Lower proportions were also expected in the age cohorts 56-65 and 66+ which are affected by retirement. Overall, the figures also reflect the expansion and growth of Irish HEIs since the mid 1980s with the majority of academics being employed in the 1990s with the expansion of the ITs in particular (McCarthy, 1998; Skilbeck, 2001).

Figure 9.2 Age profile of academics with and without industrial links

Academics with links



Academics without links



Source: Academic questionnaire survey (2002)

There were some significant differences between the proportion of academics within each age group with and without industrial links (Figure 9.2). Statistically significant differences were found in the age cohorts 25 ('prob-value' = .02), 26-35 ('prob-value' = .00) and 46-55 ('prob-value' = .04). Of these cases, it was only in the age category of 46-55 that the proportion of academics with industrial links was significantly greater than without links. Of the academics with industrial links, 28% were aged between 46 and 55 compared to 21% of academics with the same age but without such links. In the remaining age categories, there was not enough statistical evidence to suggest that there were significant differences between both samples. Younger academics are less likely to have links with industry due in part to the fact

that they have not yet had developed contacts with industry as they are more likely to be focused on publishing their research in order to enhance promotions prospects.

Of the total number of respondents 119 were female (18.8% of total) and 517 were male (81.2% of total). The low proportion of females reflects the low proportion of females in the overall population of academic staff in Irish HEIs. Academia is still predominantly staffed by males, this situation has changed albeit at a slow rate. Women, however, are still under-represented in academia even though there is equal representation of both males and females on postgraduate courses. While there are many gender-specific theories which attempt to explain the lack of female representation in the higher professions (Barry and Brunt, 2002), there is no evidence to suggest that certain factors preclude female appointments to academic positions in HEIs.

In the sample of 356 academics with industrial links, 13% were female and 87% were male. The current data relates to academics in the S&T sectors. One explanation for the higher numbers of males in the sciences is that some have previously worked outside of academia in manufacturing industry. Another explanation may be that significantly fewer female academics are found in the science disciplines.

While in the sample of 280 respondents without industrial links, 27% were female and 73% were male. Furthermore, there were statistically significant differences between the proportion of female respondents with and without links ('prob-value' = .00). Evidently, male academics are more likely than their female colleagues to engage in links with industry. It is likely that the responsibility of child care for those academics in the sample with children is factor which adversely affects the level of interaction of female academics in interaction with industry.

9.2.2 Academic position

Respondents were asked to specify the type of department they worked in and to highlight a number of features relevant to their academic position. The purpose of this was to assess whether or not certain characteristics associated with the academic's position within the HEI play a role in their involvement with industry.

Table 9.1 Departments

Department	Academics with links (%)	Academics without links (%)	Independent samples t-test 'Prob-value'
Chemical and Physical Sciences	19	19	.93
Engineering	46	27	.00
Health and Life Sciences	13	21	.79
Information Technology	20	27	.69
Other	2	6	.49

Source: Academic questionnaire survey (2002)

In relation to departments, the hypothesis tested was that there should be no difference between the proportion of academics with and without industrial links in each department. With the exception of engineering ('prob-value' = .00), there was not enough evidence to suggest that there was a statistically significant difference in the proportions (Table 9.1). Engineering emerged as the only department which had a significantly higher proportion of academics engaged in industrial links compared to those without such links. One likely reason for the prominence of engineering as sector in this regard is that in Ireland in recent years has undergone significant infrastructural developments reflected in the number of new housing developments and upgrading of transportation systems. An increase in need for engineering expertise is reflected in high levels of interaction between the engineering industry and relevant academic expertise in civil, structural and electronic engineering.

Table 9.2 Type of post

Type of post	Academics with links (%)	Academics without links (%)	Independent samples t-test 'Prob-value'
Research assistant/research fellow	0	2	.05
Postdoctoral researcher	0	1	.31
Lecturer	55	75	.00
Senior lecturer	26	16	.00
Professor	13	2	.00
Other	6	4	.08

Source: Academic questionnaire survey (2002)

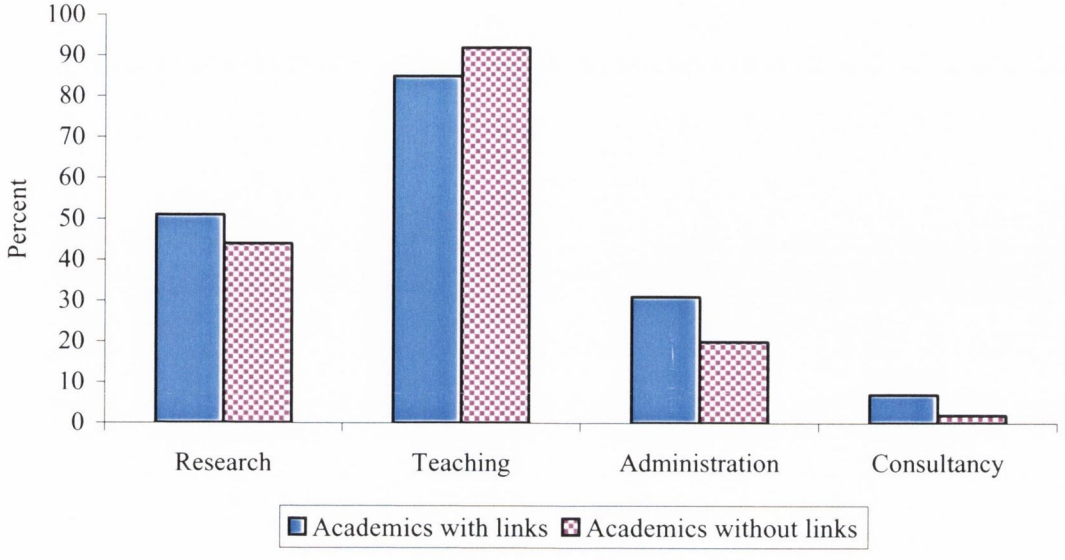
The independent samples t-test was conducted on the proportions of academics with and without links by type of post held. Statistically significant differences were found in the categories of research assistant/research fellow ('prob-value' = .05), lecturer ('prob-value' = .00), senior lecturer ('prob-value' = .00) and professor ('prob-value' = .00) (Table 9.2). A statistically significant higher proportion of academics without industrial links were lecturers (75%), while a significantly higher proportion of academics with industrial links were senior lecturers

and professors. Despite the assumption that links with industry are not important in terms of career advancement in academia, the results from this research indicate that the opposite is the case with a higher proportion of senior lecturers and professors having industrial links.

This is further reinforced by the data on permanent versus temporary employment. It was found that 92% of academics with industrial links have permanent positions compared to 84% of academics without links. An independent samples t-test was conducted and the resultant 'prob-value' of .00 indicates that there is enough evidence to suggest a statistically significant difference between the two proportions. Overall, the evidence suggests that academics with industrial links are more likely to have permanent positions in academia. It is presumably more difficult for temporary staff to establish links based on the short-term nature of their contracts and an associated inability to make long-term commitments to creating and maintaining links with industry. Furthermore, temporary academic staff are younger and, therefore, have had less time in which to establish industrial links.

Linked somewhat to the issue of career advancement is longevity of employment within the HEI. In terms of length of time employed in the HEI, academics without links were employed an average of 10.9 years while those with links were employed an average of 12.8 years. A t-test produced a 'prob-value' of .00 highlighting a statistically significant difference between both samples. A significantly higher proportion of academics with industrial links have been employed longer within the HEI. Similarly, 98% of academics with industrial links are employed full-time compared to 96% of academics without such links. A t-test 'prob-value' of .09 highlights a statistically significant difference between both samples.

Figure 9.3 Main work activities of academics



Source: Academic questionnaire survey (2002)

Respondents were asked to indicate their main work activities. They were given the opportunity to indicate more than one variable. An independent samples t-test was conducted to ascertain in the case of each type of work activity whether or not significant differences existed between the proportions of those with and without links engaging in the activity. The resultant 'prob-values' indicated that there was enough evidence to suggest a statistically significant difference in each of the main work activities (Figure 9.3). Teaching was the only main work activity in which the proportion of academics without industrial links was significantly greater than that of academics with links ('prob-value'= .01). In the case of research ('prob-value'= .09), administration ('prob-value'= .00) and consultancy ('prob-value'= .01) a significantly higher proportion of academics with industrial links engaged in such activities. Overall, the evidence would suggest that academics who consider their teaching commitments to be one of their main work activities are less likely to have industrial links. It could also be the case that academics with heavy teaching loads have less time to engage in research or in the creation and maintenance of industrial links.

9.2.3 Education and previous employment outside of academia

Respondents were asked to indicate the highest level of education which they had achieved and if they had been employed in a full-time capacity outside of academia. The purpose of the question on education was to assess the level of educational attainment and to deduce if a relationship exists between this variable and whether

respondents have industrial links or not. Information relating to full-time employment outside of academia was sought in order to examine if a difference exists between academics who have worked in academia all of their working lives and those who were previously employed in a full-time capacity outside academia in relation to their level of interaction with industry. The independent samples t-test was conducted on the data from both questions.

Table 9.3 Highest level of education achieved

Qualification	Academics with links (%)	Academics without links (%)	Independent samples t-test 'Prob-value'
Doctorate	56	48	.06
Masters Degree	31	34	.40
Postgraduate Certificate or Diploma	1	3	.08
Both a degree and a professional qualification	5	6	.46
Professional qualification	1	1	.47
Primary Degree	6	6	.11
Other	0	2	.07

Source: Academic questionnaire survey (2002)

In relation to the question on educational achievement, significant differences between the proportion of academics with and without links in the case of those with a doctorate ('prob-value' = .06), postgraduate certificate or diploma ('prob-value' = .08) and other ('prob-value' = .07) (Table 9.3). A significantly higher proportion of academics with industrial links (56%) have a doctorate which is significant when it is considered that this has become increasingly important for securing a permanent academic position in Irish HEIs (particularly in universities) in the last 20 years. Evidently, academics with a doctorate and a permanent position are more likely to engage in links with industry.

Results on previous employment outside of academia revealed that 73% of academics with industrial links and 63% of those without such links had been previously employed outside of academia. A 'prob-value' of .00 indicates that a significantly higher proportion of academics with industrial links had previously been employed outside of academia. This is almost certainly related in part to the fact that such academics are more likely to have research interests in areas relevant to industry.

Table 9.4 Sectors in which previously employed

Sector	Academics with links (%)	Academics without links (%)	Independent samples t-test 'Prob-value'
Agriculture	1	2	.53
Manufacturing	52	20	.00
Service Sector	19	21	.56
Public Sector (Not a HEI)	22	32	.03
Other	6	25	.00

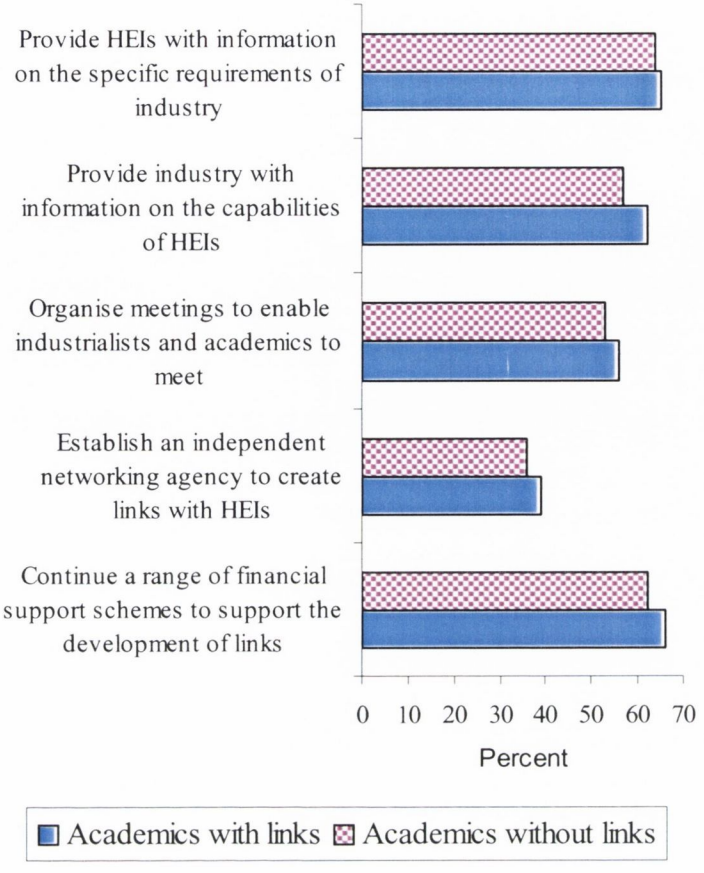
Source: Academic questionnaire survey (2002)

An independent samples t-test was undertaken on the difference between the proportion of academics with and without links employed previously in each sector. Sectors in which a significant difference was found were manufacturing ('prob-value' = .00) and the public sector ('prob-value' = .03) (Table 9.4). A significantly higher proportion (52%) of academics with industrial links had worked in manufacturing compared to their counterparts without links (20%). Evidently, previous employment in manufacturing plays a significant role in encouraging academics to combine their academic careers with continued interaction with industry. In relation to the public sector, the opposite was the case. A significantly higher proportion of academics without links (32%) had previously worked in the public sector. It is most likely that both samples of academics worked either in the civil service, in second-level teaching or in a publicly-funded research institute.

9.3 ROLE OF ENTERPRISE IRELAND IN DEVELOPING U-I LINKS

Similar to the industry questionnaire survey, the academic questionnaire survey provided respondents with a number of suggestions which EI might implement in order to develop U-I links. While the response categories were the same both for academics with and without links, there was a slight variation in the way the question was phrased in each questionnaire (questionnaire 1, question 13; questionnaire 2, question 7). Academics with links were asked what they considered EI should do in order to encourage the development of more successful relationships between HEIs and industry. Those without industrial links were asked what they considered EI should do in order to encourage them to establish links with industry.

Figure 9.4 Role of EI in developing U-I links



Source: Academic questionnaire survey (2002)

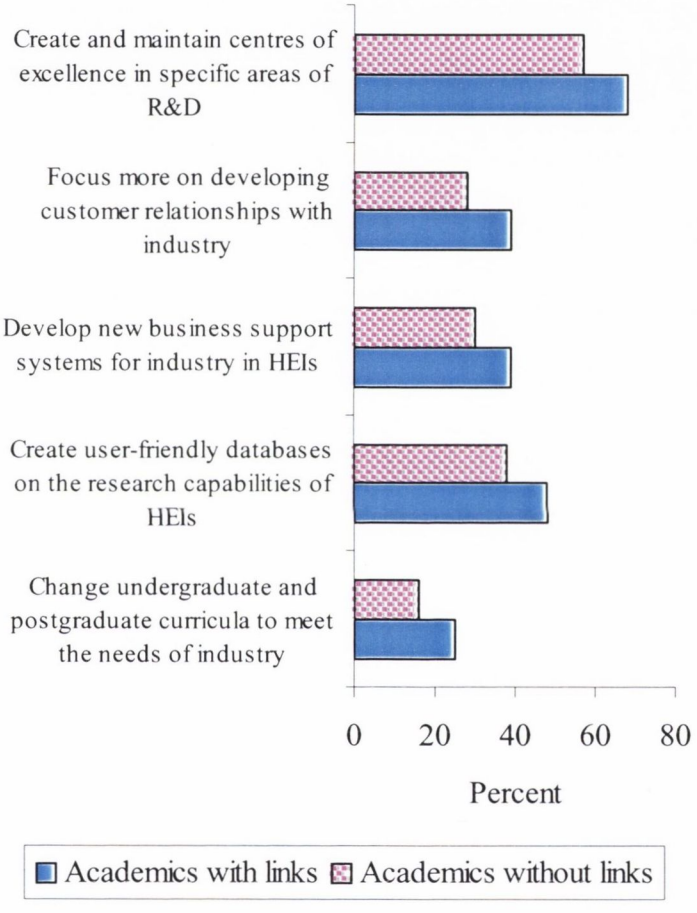
Measures which received the highest level of support from both samples were 'provide HEIs with information on the specific requirements of industry' and 'continue a range of financial support schemes to support the development of links' (Figure 9.4). The initiative with the lowest level of support was 'establish an independent networking agency to create links with industry'. In the case of each policy initiative, an independent samples t-test was conducted on the proportions of those with and without links citing the factor. None of the resultant 'prob-values' were below .10, indicating that there was not enough evidence to suggest any significant differences. This is significant given the differences in the responses returned from firms (Chapter 6, Section 6.5).

9.4 ROLE OF HEIs IN DEVELOPING U-I LINKS

The purpose of this section is to highlight what Irish HEIs could do in order to create or develop links with industry from the perspective of both samples of respondent academics. Again, while the response categories were the same for both samples,

there was a slight variation in the way the questions were phrased (questionnaire 1, question 12; questionnaire 2, question 6). Academics with industrial links were asked what they thought HEIs should do in order to encourage the development of more successful relationships between HEIs and industry. Their colleagues without industrial links were asked what they considered HEIs should do in order to encourage them to establish links with industry.

Figure 9.5 Role of HEIs in developing links



Source: Academic questionnaire survey (2002)

A test for the difference in the proportion of academics with and without links citing each factor yielded 'prob-values' for each of the five measures provided below .10. Furthermore, a significantly higher proportion of academics with links cited each factor (Figure 9.5).

The measure which received the highest level of support from both independent samples was 'create and maintain centres of excellence in specific areas of R&D'. Sixty-eight percent of academics with links and 57% of those without indicated that HEIs should implement this initiative. The resultant 'prob-value' was

.00. It is also very significant that both samples of academics stated the need for such centres despite the existence of the PATs and recent increases in government expenditure to promote excellence in R&D in specialist research areas in Irish HEIs. SFI is a case in point.

Receiving the lowest level of support from both independent samples was 'change undergraduate and postgraduate curricula to meet the needs of industry'. It is significant that this measure also received the lowest level of support from both independent samples of firms (Chapter 6, Section 6.6). Twenty-five percent of academics with links and 16% of those without links stated that such changes would encourage the development of U-I links. With a 'prob-value' of .00, a higher proportion of academics with industrial links considered the need to change the curricula of HEIs to meet the needs of industry. From the perspectives of both the firms and academics the evidence would suggest that the educational curricula provided by HEIs should not be driven by the agendas of industry.

It is interesting that a quarter of academics with industrial links and one-sixth of those without felt that changing the curricula which they teach would benefit HEI interactions with industry. As already discussed (Chapter 2, Section 2.5), while there is an on-going debate in relation to the role of HEIs in economic development and the perceived positive and negative outcomes of designing an educational curricula to meet the needs of industry, there is some merit in evaluating existing curricula and assessing their appropriateness for the education and training of graduates who will enter industry. It is not the case that the entire curricula of HEIs should be restructured and driven to meet the needs of industry; rather those subjects which have direct relevance to industry should be examined to assess ways in which some elements of those courses could become more industry-relevant.

9.5 CONCLUSION

The aim of this chapter was to analyse the characteristics of academic respondents and to provide comparisons between both independent samples. Emphasis was placed on the degree to which the characteristics of academics with industrial links differed from those without links.

The survey data showed that the greatest number of academics with industrial links were in the age cohort 46-55 years. Data on gender revealed that a significantly higher proportion of female academics did not engage in industrial links.

In relation to academic position, Engineering emerged as the only department in which a significantly higher proportion of academics engaged in links with industry. The position of lecturer emerged as the only academic post which had a significantly higher proportion of academics without industrial links. The opposite was the case for senior lecturers and professors. Evidently, there is some correlation between the academic who engages in links with industry and promotion within academia. This was further reinforced by the fact that a significantly higher proportion of academics with industrial links are permanent. In relation to main work activities, a significantly higher proportion of academics without links consider teaching to be one of their main work activities. Research, administration and consultancy were considered to be the main work activities of a significantly higher proportion of academics with industrial links.

An analysis of highest level of education achieved found that a significantly higher proportion of academics with industrial links have a doctorate. Furthermore, the survey data revealed that a significantly higher proportion of academics with industrial links have been previously employed outside academia. Manufacturing was the most common source of such employment. In relation to the various initiatives which EI should implement, there was not enough evidence to suggest a significant difference between both samples. However, significant differences did emerge in the responses to what HEIs should do in order to encourage the development of U-I links. A significantly higher proportion of academics with industrial links placed particular emphasis on the need to 'create and maintain centres of excellence in specific areas of R&D'.

CHAPTER 10

ACADEMIC-INDUSTRY LINKS

10.1 INTRODUCTION

> *Industry is unaware of the potential benefits which may accrue from involvement with ITs and universities. I suggest that a forum, which would involve academic institutions and national and overseas companies getting together would be very useful. It is important that industry develop a partnership approach to dealing with third level institutes. I believe the projection of a positive and profitable relationship between industry and academic institutions will be an asset when attracting overseas companies to this country [Academic with industrial links, number 410].*

While the purpose of HEIs is to create, disseminate and extend knowledge, it is increasingly recognised that HEIs have a pivotal role to play as a source of competitive advantage for national economies. This can be done by facilitating the creation and development of regional innovative capacities (Chapter 2). The perception of HEIs merely as institutions of higher learning is gradually being replaced by the view that they are important engines of economic growth and development with increasing evidence that the higher education sector can undertake a variety of roles in developing the technological and industrial profile of a region (Jones-Evans *et al.*, 1998; Pandya and Cunningham, 2000; Pandya *et al.*, 2001). This is not surprising, as increasingly, regional and national governments view the high-tech sector as a source of direct and indirect employment opportunities. Accordingly, HEIs are seen as crucial in facilitating the growth of local high-tech industry (Jones-Evans *et al.*, 1997b, 1998). HEIs have a responsibility to establish a variety of links with indigenous high-tech firms in areas of R&D, teaching/training, consultancy and also in the commercialisation of the S&T base. In addition, HEIs have a social and economic obligation to build partnerships with local high-tech enterprise in R&D, promote technological innovation in the indigenous high-tech SME base and assist in technology transfer. Such measures are vital in ensuring the sustainable development

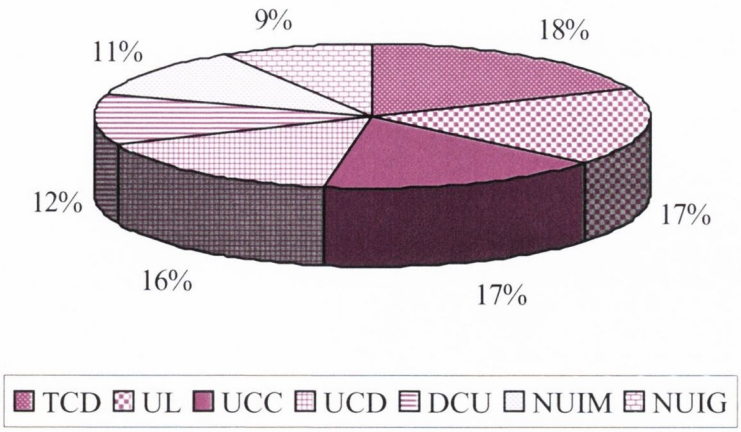
of local and regional economies. Despite this, there has been no assessment to date of the experiences and perceptions of academics who engage in links with industry. At present relatively little is known about the activities of academics in relation to these links. In the literature on U-I links, academics have been excluded as a source of information on the barriers and stimulants to the development of links. This has produced a biased view on U-I interaction which up to now has focused exclusively on the perspectives of industry.

The purpose of this chapter is to focus exclusively on academics with industrial links. The aim is to analyse the level of interaction between academics and industry, the types of links established and the factors contributing to and impeding such interaction. This is followed by an analysis of formal and informal interaction and the positive and negative outcomes of such collaboration. The chapter ends with an analysis of the barriers and stimulants to the development of U-I links followed by an assessment of the problems associated with maintaining links from the perspective of academics with links.

10.2 LEVEL OF INTERACTION WITH INDUSTRY

In the sample of 356 academics with industrial links, 181 were academics from a university and 175 were academics from an IT. It is significant that there is more or less equal representation from both the universities and ITs in terms of academic respondents, given that the firms stated earlier that 67% of their interaction is with universities and 33% is with ITs (Chapter 7, Section 7.2). While it is difficult to explain this difference, it is likely that the equal proportions of academics with industrial links from both universities and ITs is representative of the overall population. This, however, does not explain the difference between firms and their reported levels of interaction with universities and ITs.

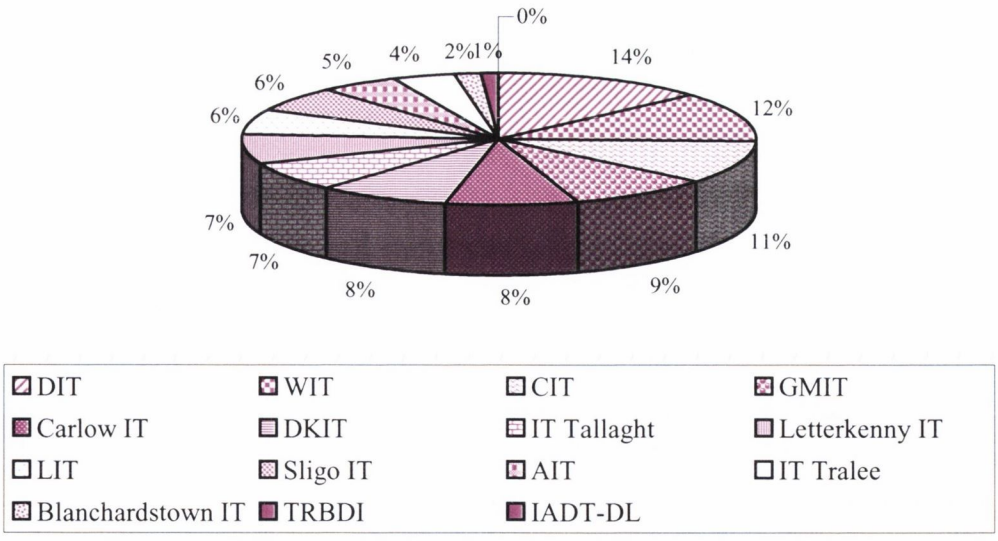
Figure 10.1 Level of university academics' interaction with industry



Source: Academic questionnaire survey (2002)

In relation to the universities, TCD had the highest proportion of academic respondents (18%) with industrial links, followed by UL (17%), UCC (17%) and UCD (16%) (Figure 10.1). Collectively, the Dublin universities (UCD, TCD and DCU) accounted for 46% of all university academics with industrial links. It is significant that UCD and DCU did not have a higher share, given that the survey data on the firms illustrated that the Dublin universities collectively accounted for 52% of all university interaction with respondent firms (Chapter 7, Section 7.2).

Figure 10.2 Level of IT academics' interaction with industry



Source: Academic questionnaire survey (2002)

Similar to the data on firms with HEI links, the DIT emerges as the IT with the highest proportion (14%) of academic respondents with industrial links (Figure 10.2). For the reasons already mentioned, the DIT is one of Ireland's leading HEIs in

relation to links with industry (Chapter, 7, Section 7.2). It has an ILO office with 18 personnel focused on matching each of the different academic subjects with the relevant industrial sector. The other remaining high-performers were WIT (12%), CIT (11%) and GMIT (9%). Again, similar to the data on firms with HEI links, the ITs with the lowest proportions of academic respondents with industrial links were those founded in the 1990s. These were Blanchardstown IT (2%), TRBDI (1%) and IADT-DL which had no academics with industrial links.

10.3 FACTORS ENCOURAGING ACADMEMICS TO ENGAGE IN LINKS WITH INDUSTRY

The academics were presented with six stimulants and asked to rate each factor on a scale from 1 to 5 in terms of their importance in encouraging them to engage in links with industry (Chapter 3, Section 3.2.1). These stimulants referred to links in general and were not specific to any type of link. These categories were selected on a braod reading of the literature (Chapter 2).

Table 10.1 Stimulants to the development of links with industry

Stimulant	Mean Score	Std. Dev.
Facilitates exposure to industrial environments	1.97	1.00
Contributes to the diffusion of knowledge	2.21	1.06
Creates employment for graduates	2.31	1.09
Enhances local/regional/national economic development	2.36	1.16
Increases the prestige associated with the college	2.49	1.10
Provides additional source of income for the college	2.77	1.26

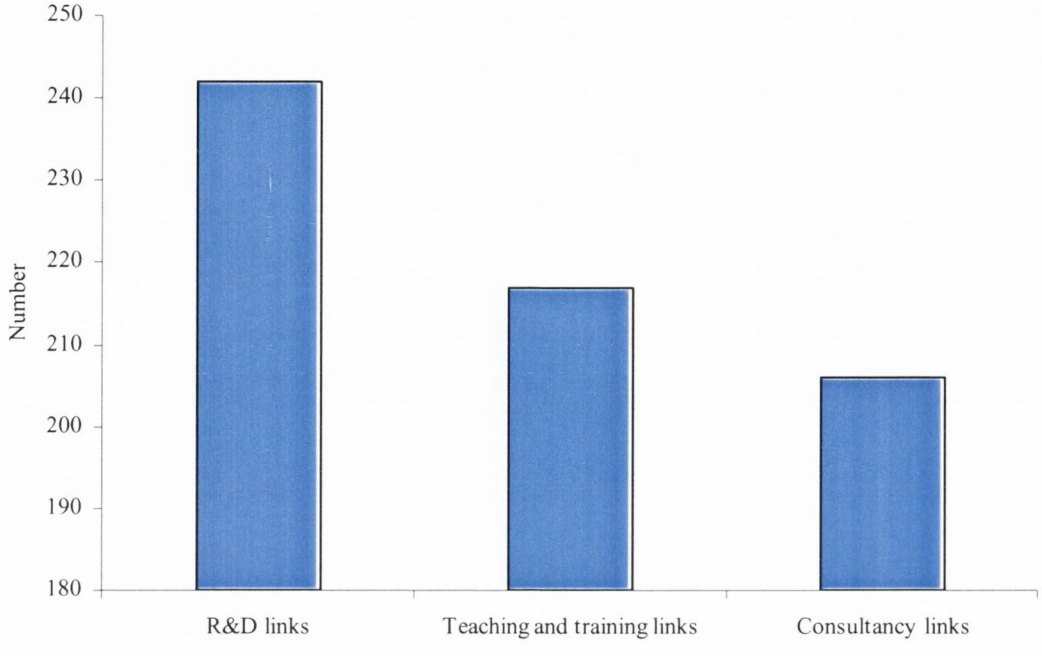
Source: Academic questionnaire survey (2002)

The most important stimulant was that interaction with industry 'facilitates exposure to industrial environments' with a mean of 1.97 (Table 10.1). The standard deviation of 1.00 suggests less variation in respondents' answers relative to each of the other stimulants in Table 10.1. Evidently, academic respondents consider that gaining access to industrial environments is important in terms of keeping up-to-date with developments, for example, in industrial research, particularly in product and process technologies.

Of less importance was the factor 'contributes to the diffusion of knowledge' with a mean of 2.21. The standard deviation of 1.06 indicates slightly greater variation in responses in comparison to the factor considered to be the most important, but with less variation relative to each of the remaining factors. It is significant that

this factor is rated as being highly important while factors such as 'creates employment for graduates', 'enhances local/regional/national economic development' and 'provides additional source of income for the college' are considered less so.

Figure 10.3 Types of links established with industry



Source: Academic questionnaire survey (2002)

While the stimulants outlined provide an indication of the reasons why respondent academics engage in links with industry, a comparison with the types of links established provides a different aspect to the analysis of linkages. Again, similar to respondent firms (Figure 7.3), it is important to note that academics can engage in more than one type of link.

R&D links were the most common type of link, cited by 242 (68%) of academics with industrial links (Figure 10.3). For the firms, teaching and training was the most common type of link with HEIs. For the academics, it was the second most common type of link, with 217 (60%) of academics with industrial links stating that they engage in teaching and training links with industry. Similar to the firms, consultancy had the lowest level of participation with 206 academics (57%) citing it. In order to provide more in-depth analysis, each of the three types of links (R&D, consultancy and teaching/training) are analysed in detail in the following sections.

10.4 R&D LINKS WITH INDUSTRY

In order to assess the experience academics had in their R&D interaction with industry, respondents were presented with five barriers and five stimulants. They were asked to indicate the level of importance they associated with each as a barrier or a stimulant.

10.4.1 Barriers to R&D links with industry

With a mean of 2.16, the most important barrier to the development of R&D links with industry was that the college workload takes up much of the time of academics (Table 10.2).

Table 10.2 Barriers to the development of R&D links with industry

Barrier	Mean Score	Std. Dev.
College workload takes up much of your time	2.16	1.13
The work needed by industry is not always interesting/relevant to us	2.82	1.30
Links with industry have little influence on institutional base-line funding	2.95	1.30
Working with/for industry has little influence on academic promotions	3.00	1.47
Equipment base/facilities are insufficient to meet needs of industry	3.09	1.39
Little interest shown by industry	3.10	1.26
Working with/for industry leads to delay in publications	3.18	1.37

Source: Academic questionnaire survey (2002)

The standard deviation of 1.13 indicates less variation in responses relative to the other barriers in Table 10.2. Evidently, the time commitments associated with teaching and research are not conducive for the academic community to foster industrial links. Lack of time is a critical barrier. Of less importance, with a mean of 2.82, was the factor 'work needed by industry is not always interesting/relevant' to academia. In their interviews with ILOs, CEOs and senior management (mainly vice-chancellors), PREST (1998) also found that this factor was rated second out of nine barriers to establishing research and consultancy links with industry (Chapter 2, Section 2.3.3.2, Table 2.2). Evidently, differences in objectives and aspirations between academia and industry constitute a significant barrier to collaboration. Of least importance, with a mean of 3.18, was the barrier 'working with/for industry leads to delay in publications'. Similarly, PREST (1998) found that 'delay in

publications' was scored seventh as a barrier to establishing research and consultancy links with industry.

10.4.2 Stimulants to R&D links with industry

In the context of stimulants to establishing links with industry in R&D, the most important factor noted by academics was 'to access industrial funding for research', with a mean of 1.99 (Table 10.3). The standard deviation of 1.06 highlights significantly less variation in responses relative to each of the remaining stimulants in Table 10.3. PREST (1998) also found that access to industrial funding was considered to be the most important motivating factor encouraging academics to engage in research links with industry (Chapter 2, Section 2.3.3.2, Table 2.3). In light of the recent cuts in government expenditure for publicly funded research in Irish HEIs, it is likely that access to industrial funding will remain one of the key stimulants encouraging the academic community to engage in research links with industry.

Table 10.3 Stimulants to the development of R&D links with industry

Stimulant	Mean Score	Std. Dev.
To access industrial funding for research	1.99	1.06
To find an exploitation outlet for research capabilities	2.34	1.22
Provides additional source of income for the college	2.89	1.23
To find complimentary expertise in industry	2.90	1.20
To access state-of-the-art equipment and facilities	3.26	1.28
Provides additional source of income for me	3.38	1.51

Source: Academic questionnaire survey (2002)

'To find an exploitation outlet for research capabilities' was the second most important factor with a mean of 2.34. PREST (1998) found that this factor rated third in terms of importance (Chapter 2, Section 2.3.3.2, Table 2.3). Collaboration with industry provides academics with the opportunity with an alternative avenue in which to exploit research results.

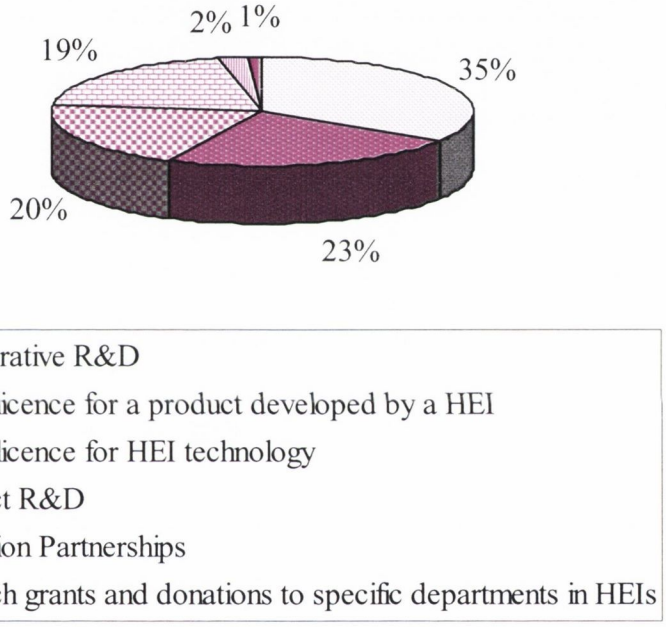
'Provides additional source of income for the college' was rated third with a mean of 2.89. This is significant given that the factor 'provides additional source of income' for the academic was lowest in terms of importance with a mean of 3.38. It is significant that academic respondents indicate that they are more driven by the desire to engage in links with industry in order to provide an additional source of

income for their respective HEIs than they are focused on accumulating personal wealth from such activities.

10.4.3 Types of R&D links

In order to delineate the level of interaction in each of the various forms of R&D, academics were presented with six different types of R&D interaction. They were asked to indicate which forms of R&D activity were applicable to their engagement with industry.

Figure 10.4 Types of R&D links



Source: Academic questionnaire survey (2002)

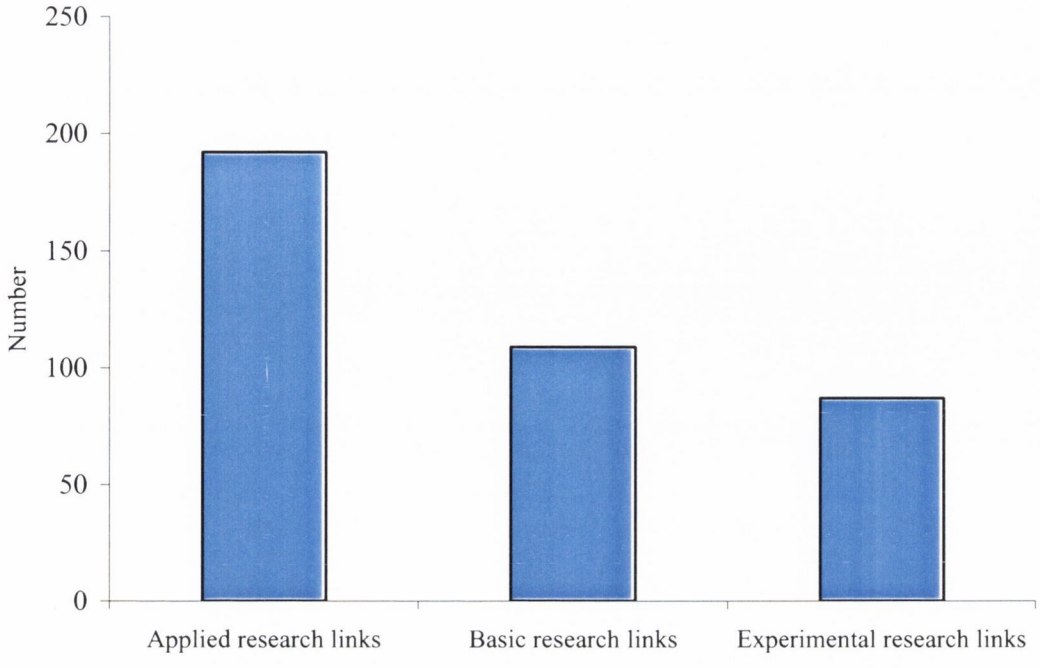
As specified by the firms, the most common R&D link established was collaborative research, accounting for 35% of all R&D interaction between academia and industry (Figure 10.4). This was the same figure as for firms with HEI links (Chapter 7, Section 7.4.3, Figure 7.4). Academics who were involved in the licensing of a product which they had developed out to industry were responsible for 23% of all R&D interaction, while those who were involved in the licensing of a HEI technology accounted for 20% of R&D interaction. Contract R&D accounted for 19% of interaction. Compared to collaborative R&D, this figure is relatively low. Academics do not like to engage in contract R&D because industry pays fully for all costs incurred and therefore drives the research agenda of the project. Academics prefer to have a certain level of autonomy and flexibility in undertaking research. Finally, the

two areas where a significantly low level of interaction was recorded were in innovation partnerships (2%) and research grants and donations to specific departments in HEIs (1%). Evidently, efforts by EI to promote its innovation partnerships programme have failed to reach the academic community. In relation to the provision of research grants and donations, the evidence gathered from both firms and academics would suggest that industry is more interested in making an investment into a research project and seeking a return rather than in donating money to research units in HEIs.

10.4.4 Categories of R&D links

Academics were asked to specify whether or not they engaged in basic, applied and/or experimental research links with industry. Respondents were permitted to select one or more of the categories of R&D links.

Figure 10.5 Categories of R&D links



Source: Academic questionnaire survey (2002)

The results indicate that of the 242 academics engaged in R&D links with industry, 192 engaged in applied research links with the remainder almost divided equally between basic research links (109 academics) and experimental research links (87 academics) (Figure 10.5). While the figures are different, these findings are consistent with those from firms with HEI links (Chapter 7, Section 7.4.4, Figure 7.5). Evidently, applied research links are the most common form of R&D interaction between academia and industry. This is based on the demands of firms. As noted earlier in Chapter 7, firms are conducting basic research in-house and are using the HEIs to engage in applied research. Of less importance were basic research links and experimental research links. It is significant that basic research links are low for academics with industrial links given that basic research in itself represents one of the main activities of an academic within a HEI. The evidence would suggest that the type of R&D links in which academics are engaged are focused on the demands of industry for applied research links. Firms are not interested in basic research links with academia and this is reflected in part by the fact that they conduct their basic research in-house and delegate prototype development to HEIs through applied research links.

10.5 CONSULTANCY LINKS WITH INDUSTRY

Fifty-eight percent of academics with industrial links engaged in consultancy links. Similar to the data returned from the firms, consultancy links represented the lowest level of interaction between academics and industry. At present relatively little is known in a systematic way about the consultancy activities of academics. HEIs have been unable to acquire a true estimate of the actual levels of consultancy activities undertaken by their academic staff because not all academics declare either to their employer or to the revenue commissioners that they engage in consultancy activities with commercial ventures. The current survey has gained valuable information in this regard because respondents were assured of complete confidentiality and a reference number was not attached to each completed questionnaire (Chapter 3, Section 3.6.2).

10.5.1 Barriers to consultancy links with industry

In order to assess the factors impeding the development of consultancy links from the perspective of academia, respondents were presented with seven barriers and asked to assess each in terms of importance from 1 to 5.

Table 10.4 Barriers to the development of consultancy links with industry

Barrier	Mean Score	Std. Dev.
Lack of time due to heavy teaching/admin/research commitments	1.94	1.06
No incentives in college for academics to engage in consultancy	2.50	1.40
Consultancy activities have little influence on academic promotions	2.96	1.43
The rate of tax you pay on earnings from consultancy is too high	2.98	1.55
Industry's needs are often basic with little need for scholarly research	3.12	1.15
Little interest shown by industry	3.48	1.21
Do not like consultancy/have little interest in consultancy	4.33	1.15

Source: Academic questionnaire survey (2002)

Evaluated as being the most important barrier was 'lack of time due to heavy teaching/admin/research commitments', with a mean of 1.94 (Table 10.4). The standard deviation of 1.06 indicates less variation in responses relative to all of the other barriers in Table 10.4. The second most important barrier cited by respondents was that there were 'no incentives in college for academics to engage in consultancy', with a mean of 2.50. Within the HEIs, there is no defined support structure to initially

guide academics into consultancy. There are two main reasons for this lack of support. First, the ILOs in each of the HEIs (with the exception of DIT) do not have the personnel or resources to monitor consultancy activities between academia and industry. As a result, this activity goes unchecked with little assessment of the actual value that an academic is bringing to a company through consultancy activity. Often the academic is underpaid for such activities and, therefore, is less inclined to get involved in further consultancy projects. Second, if the consultancy activity is monitored by the ILO, the college bureaucracy associated with this is often excessive and deters the academic from officially engaging in such activities. Hence, consultancy from the perspective of the academic tends to be a no-win situation.

10.5.2 Stimulants to consultancy links with industry

In relation to the development of consultancy links, respondents were presented with five stimulants and asked to asses each in terms of importance from 1 to 5.

Table 10.5 Stimulants to the development of consultancy links with industry

Stimulant	Mean Score	Std. Dev.
Increase in academic expertise in a broad spectrum of research areas	2.28	1.09
Consultancy often leads to research and training partnerships	2.36	1.24
Improves college's knowledge of industry and commercial reality	2.46	1.27
Increase in personal income	2.94	1.50
Provides additional source of income for the college	3.43	1.32

Source: Academic questionnaire survey (2002)

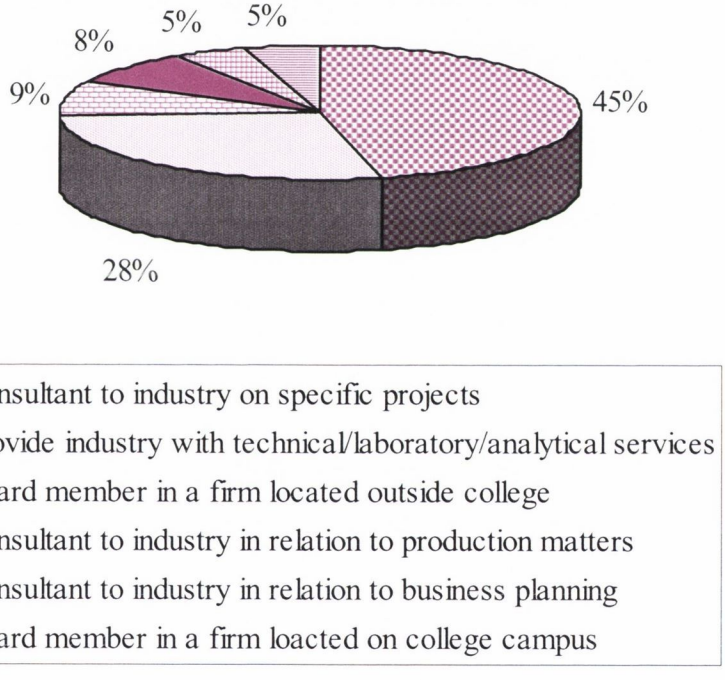
With a mean of 2.28, an 'increase in academic expertise in a broad spectrum of research areas' was considered to be the most important motivating factor which encouraged academics to establish consultancy links with industry (Table 10.5). The standard deviation of 1.09 highlights less variation in responses relative to all of the other stimulants in Table 10.5. The opportunity to gain access to new research areas through links forged with industry is a recurring stimulant encouraging academics to establish links with industry. As noted earlier, the factor 'facilitates exposure to industrial environments' was evaluated as being the most important stimulant encouraging academics to develop links in general with industry (Section 10.3, Table 10.1). This evidence would suggest that academics develop links with industry as a measure towards enhancing the profile of their research activities. Other factors such

as an 'increase in personal income' were of less importance. However the factor 'increase in personal income' rated higher than 'provides additional source of income for the college'. By way of comparison, in relation to stimulants to R&D links, 'increase in personal income' was least important while the stimulant 'provides additional source of income for the college' was rated as being more important (Section 10.4.2).

10.5.3 Types consultancy links

Academic respondents were asked to indicate the various types of consultancy activity in which they engaged with industry.

Figure 10.6 Types of consultancy links



Source: Academic questionnaire survey (2002)

Consultancy to industry on specific projects was the most common form of consultancy link, accounting for 45% of interaction (Figure 10.6). This type of consultancy is on a project-by-project basis and is sporadic in terms of how often such projects emerge. Of less importance was the provision of technical/laboratory/analytical services to industry. From the perspective of firms, this factor rated as the most common type of consultancy link firms had established with HEIs (Chapter 7, Section 7.5.3, Figure 7.6). There was more or less an equal proportion of activity in each of the remaining types of consultancy link.

10.6 TEACHING AND TRAINING LINKS WITH INDUSTRY

As already noted, the potential for teaching and training links between academia and industry has increased dramatically in recent years (Chapter 7, Section 7.6). The survey data show that 61% of respondent academics with industrial links engaged in teaching and training links. For academics, this was the second most common form of interaction with industry. In contrast, for respondent firms, teaching and training links constituted the most common form of interaction (Chapter 7, Section 7.3, Figure 7.3). R&D links constitute the most common form of interaction with industry for academics as such links provide an alternative venue in which to exploit research findings and often is considered to be a valuable source of alternative finance for research projects in HEIs. It is likely that teaching and training links constitute the most common form of interaction for firms due to the increasing need for a flexible workforce with polyvalent skills. As firms become more flexibly specialised they need a pool of labour which engages in continuous lifelong learning and training to enhance their profile of skills. Firms are, thus, looking to the HEIs as sources of short bespoke courses deigned to enhance the skills of their existing employees. The following section provides the academic perspective on involvement in teaching and training links with industry.

10.6.1 Barriers to teaching and training links with industry

Respondents were presented with six barriers to the development of teaching and training links and were asked to score each from 1 to 5 in terms of importance.

Table 10.6 Barriers to the development of teaching and training links with industry

Barrier	Mean Score	Std. Dev.
Teaching workload in college is already too heavy	2.06	1.22
Lack of resources in college to develop industry-relevant courses	2.69	1.41
Teaching and training needs of industry are short-term	3.01	1.36
Mismatch between what college can provide and industry's needs	3.08	1.26
Attitudes/age profile of staff contribute to a lack of interest	3.14	1.38
Little interest shown by industry	3.28	1.24

Source: Academic questionnaire survey (2002)

With a mean of 2.06, the barrier 'teaching workload in college is already too heavy' was considered to be the most important in terms of preventing the

development of teaching and training links with industry. The standard deviation of 1.26 indicates less variation in respondents' answers relative to each of the other barriers in Table 10.6. A heavy teaching workload is linked to the issue of lack of time which has already been cited in the results of this research as being a significant deterrent to the creation of links with respect to R&D and consultancy links (Table 10.2).

'Lack of resources in college to develop industry-relevant courses' was considered to be of less importance, with a mean of 2.50. HEIs do not have a formal structure ingrained within their ILO function which focuses on providing support for the development of industry-orientated courses. This reflects two main factors. First, HEIs have yet to recognise that they have the potential to develop industrially focused courses and at the same time continue to provide the broad spectrum of courses that are not associated with industry. Second, as already noted, the ILO function in Irish HEIs does not have the personnel or resources to be able to encourage academics to develop industry-relevant courses. Without such a support structure, Irish HEIs are not availing of the opportunity to provide a pool of knowledge workers with specialised skills from industry-tailored courses designed to meet the needs of both indigenous and foreign industry in Ireland.

10.6.2 Stimulants to teaching and training links with industry

In order to assess the factors which motivated academics to engage in teaching and training links, respondents were presented with five stimulants and asked to rate them in importance from 1 to 5.

Table 10.7 Stimulants to the development of teaching and training links with industry

Stimulant	Mean Score	Std. Dev.
Provides college with the knowledge of skills required by industry	2.13	1.25
Diversifies the college's teaching and training capabilities	2.41	1.19
Facilitates the transfer of human resources from college to industry	2.70	1.31
Provides additional source of income for the college	3.50	1.32
Creates additional employment of teaching staff in the college	3.67	1.26

Source: Academic questionnaire survey (2002)

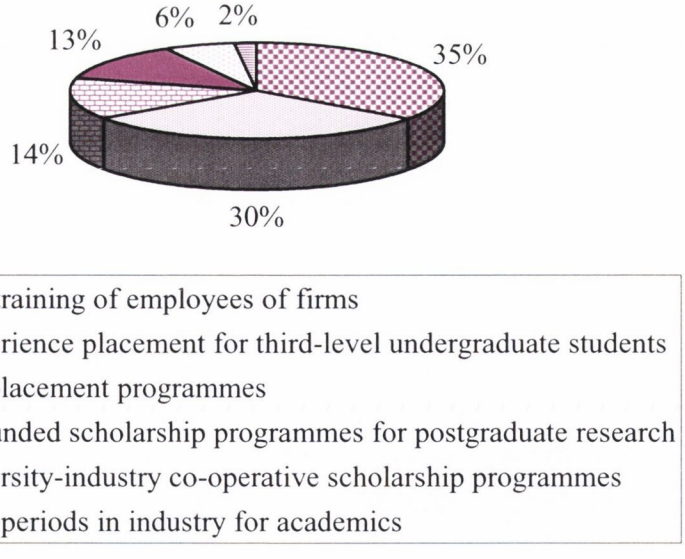
The most important stimulant to the development of teaching and training links with industry was that such interaction 'provides college with the knowledge of skills

required by industry', with a mean of 2.13 (Figure 10.7). The standard deviation of 1.25 suggests less variation existed in respondents' answers relative to most other stimulants in Table 10.7. The very fact that this stimulant was considered to be the most important provides evidence of the level of commitment amongst respondents to sourcing knowledge of skills required by industry. Again, it is significant that the factor 'provides additional source of income for the college' was considered to be low in terms if importance, with a mean of 3.50. Generating extra finance through engagement with industry via teaching and training links is not the issue for academic respondents. The evidence from this research shows that academics are more interested in meeting the educational needs of industry while diversifying the teaching and training capabilities of their HEIs.

10.6.3 Types of teaching and training links

In order to provide an assessment of the types of teaching and training links in which academics were engaged, respondents were presented with six types and asked to specify which were relevant to their teaching and training interactions with industry.

Figure 10.7 Types of teaching and training links



Source: Academic questionnaire survey (2002)

Specialist training of employees of firms was the most prominent form of teaching and training link and accounted for 35% of all such interaction (Figure 10.7). It is significant that this type of link should exceed that of work experience placement for third-level undergraduate students (30%). The assumption was until now that

undergraduate and graduate placement accounted for the highest level of teaching and training interaction between academia and industry. HEIs are now providing such courses while maintaining their existing profile of a non-industry focused educational curriculum. However, in relation to the survey data returned from firms, only 17% of firms stated that their firm had engaged in specialist training of its employees in a HEI. It could be the case that training is oriented only towards a minority of firms who have a long track record of placing their employees in industry courses run by HEIs.

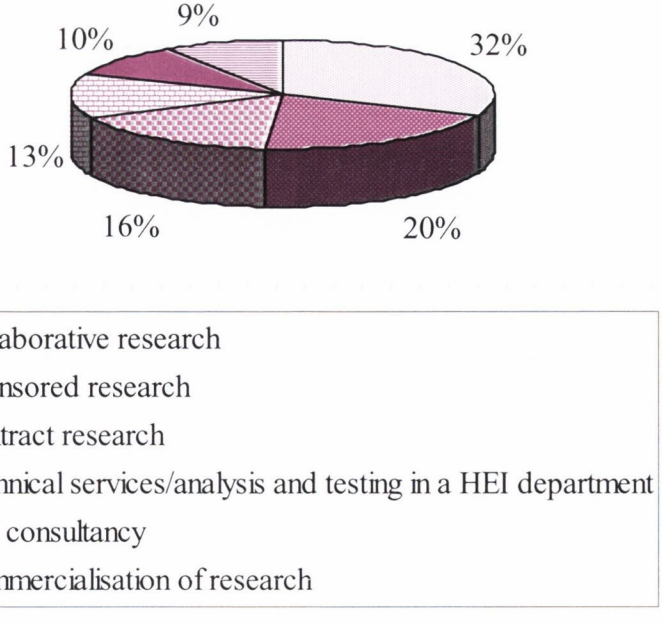
10.7 FORMAL AND INFORMAL LINKS

As was done from the perspective of the firms, an analysis of formal and informal interaction between academics and industry was undertaken (Chapter 7, Section 7.7). Relatively little is known about formal and informal interaction from either perspective.

10.7.1 Formal links

Fifty-seven percent of the academics with links had formal links with industry. Respondents were presented with six types of formal link and asked to select those which were relevant to them.

Figure 10.8 Types of formal link



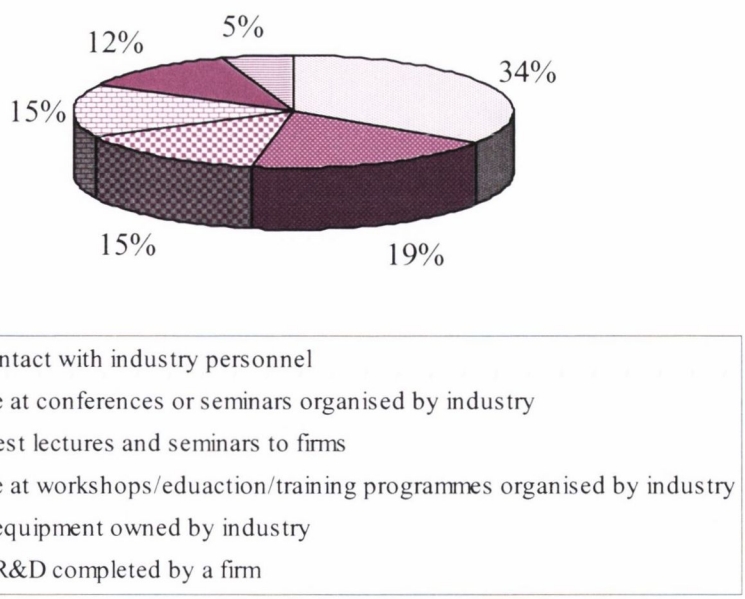
Source: Academic questionnaire survey (2002)

Thirty-two percent of all formal interaction was in collaborative research (Figure 10.8) and this is consistent with earlier evidence from the firms as being the most important formal link with academia (Chapter 7, Section 7.7, Figure 7.8). Academics prefer collaborative research than either sponsored (20%) or contract research (16%) because, while it is funded by industry, the academic partner retains a high level of autonomy in the decision-making processes associated with the scope and direction of the research. Of less importance were technical services/analysis and testing in a HEI department (13%) and HEI consultancy (10%). Commercialisation of research accounted for only 9% of formal interaction. Such a low figure is yet another indication of the low level of commercialisation being conducted in Irish HEIs.

10.7.2 Informal links

Sixty-eight percent of the academics had informal links with industry. In order to assess the type and level of informal interaction, respondents were presented with six types of informal link and asked to select those which were relevant to their informal interaction with industry.

Figure 10.9 Types of informal link



Source: Academic questionnaire survey (2002)

The top three types of informal links considered by academics were the same as those stated earlier by firms (Chapter 7, Section 7.7.2, Figure 7.9). The most

common form of informal interaction between academics and industry was through 'informal contact with industry personnel', which accounted for 34% of interaction (Figure 10.9). The corresponding figure for firms of 'informal contact with HEI academic staff' was 33%. Evidently, personal contact between academia and industry is critical to the development of U-I links. Of less importance were 'access to equipment owned by industry' (12%) and 'access to R&D completed by a firm' (5%). In terms of access to equipment and R&D, firms are more likely to gain access to such resources in HEIs and it is often the case that the HEIs have the finance to purchase such equipment. In relation to R&D, while firms engage in basic R&D, they use HEIs for applied research, largely for problem-solving. Even though firms are engaging in basic R&D, as the evidence from this research shows, academics are rarely involved in the in-house R&D activities of firms.

10.8 POSITIVE AND NEGATIVE OUTCOMES OF LINKS WITH INDUSTRY

At present relatively little is known about the positive and negative outcomes of links with industry for HEIs. For the purpose of this research, respondents were asked to indicate both the positive and negative outcomes for their HEI based on their experience of the links established with industry.

10.8.1 Positive outcomes

Respondents were presented with eight positive outcomes of links with industry. Based on their experiences of interaction with industry, respondents were asked to assess each in terms of importance from 1 to 5.

Table 10.8 Positive outcomes of links with industry

Positive outcome	Mean Score	Std. Dev.
Facilitated exposure to industrial environments	2.11	1.00
Enhanced the expertise of the college in research, teaching and consultancy	2.17	1.01
Contributed to the diffusion of knowledge	2.38	1.07
Created employment for graduates of the college	2.61	1.19
Increased the prestige associated with the college	2.74	1.14
Enhanced local/regional/national economic development	2.81	1.28
Created a culture of academic entrepreneurship on the college campus	2.96	1.24
Provided additional source of income for the college	3.20	1.31

Source: Academic questionnaire survey (2002)

The positive outcome assessed to be the most important was 'facilitated exposure to industrial environments', with a mean of 2.11 (Table 10.8). The standard deviation of 1.00 indicates less variation in responses then with respect to any of the other positive outcomes. Not only do academics consider this factor to be the most important outcome but as the earlier evidence showed, also it was the most important stimulant to the development of links in general (Chapter 10, Section 10.3, Table 10.1). A second reason as to why academics are eager to gain exposure to industrial environments was that it 'enhanced the expertise of the college in research, teaching and consultancy'. This outcome was considered close to the first in terms of importance with a mean of 2.17. Academics are eager to enhance their capabilities in the areas of teaching, research and consultancy and links with industry are providing them with the opportunities to do so. This in turn 'contributes to the diffusion of knowledge' with a mean of 2.38.

Of less importance to the academics was that links 'enhanced local/regional/national economic development', with a mean of 2.81. Either respondents do not consider that links with industry enhance regional development or they are not aware of the positive spin-off effects in this context. Furthermore, it could also be the case that economic development is not a major consideration for academics. In Ireland, research on the economic spin-off effects of U-I links in the regional economy of the HEI is lacking so that there is no evidence to suggest that U-I links enhance economic development (Chapter 2). Similarly, academics did not consider that their interaction with industry 'created a culture of academic entrepreneurship on the college campus'. Evidently, such a culture does not exist in Irish HEIs, given the lack of an appropriate support structure for academics with industrial links and for those involved in the commercialisation of their research. Finally, the outcome 'provided additional source of income for the college' was considered to be of least importance as a positive outcome of links with industry with a mean of 3.20. Respondents considered that HEIs are not paid fully for the services which they provide to industry. The issue of income relates back to the lack of an appropriate support structure in Irish ILOs which do not have the necessary staff, resources and information on the value of IP to be able to effectively charge industry for the services which it receives.

10.8.2 Negative outcomes

Respondents were presented with five negative outcomes and asked to score each in terms of importance from 1 to 5.

Table 10.9 Negative outcomes of links with industry

Negative outcome	Mean Score	Std. Dev.
Industry's confidentiality needs conflict with academia's need to publish	3.18	1.36
Leads to disagreements concerning intellectual property rights	3.52	1.35
Links with industry create internal conflicts of interest in college	3.59	1.34
Perception that industry is driving the research agendas of the college	3.76	1.23
HEI has become too dependent on industry for funding	4.04	1.21

Source: Academic questionnaire survey (2002)

The survey data revealed that the most important negative outcome was 'industry's confidentiality needs conflict with academia's need to publish', with a mean of 3.18 (Table 10.9). However, the standard deviation of 1.36 indicates less agreement in respondents' answers relative to all the other negative outcomes. Depending on the type of research in which the academic is engaged and the length of time it takes to commercialise that research, the issue of confidentiality may or may not be problematic. For example, an academic working in biochemistry may come up with a new drug. He/she may wish to publish the findings but a company may have bought the patent on the agreement that the drug and its contents remain confidential until it has passed all research trials and is on the market in 12 years time. Alternatively, an academic working in media technology may have come up with a new technology. A firm may buy the patent on the agreement that it remains confidential for a year in which time the academic prepares his/her papers for publication. These are too very different scenarios which highlight the different situations in which academics can find themselves *vis a vis* publication versus patenting. The differences are often sector-specific.

Of least importance in terms of negative outcomes was the 'perception that industry is driving the research agendas of the college' with a mean of 3.76 and that the 'HEI has become too dependent on industry for funding' with a mean of 4.04. Respondents consider that industry is not driving the research agendas of HEIs and that academics are maintaining their autonomy in deciding the direction and scope of

their research portfolios. Finally, the negative outcome evaluated as being the lowest and which received the highest level of agreement amongst respondents was that HEIs have become too dependent on industry for funding. If recent cuts in government expenditure on publicly funded research in HEIs are to continue, it is highly likely that HEIs will become even more dependent on industry for funding.

10.9 BARRIERS AND STIMULANTS TO THE DEVELOPMENT OF LINKS WITH INDUSTRY

In order to examine the barriers and stimulants to the development of links with industry, academics were presented with seven barriers and seven stimulants for establishing such links and were asked to select those relevant to their experiences. In analysing the resultant data, it is important to reiterate that there are no other empirical findings available in the literature with which to compare the results from this research. Comparisons were made with the data returned from firms with HEI links (Chapter 6, Section 6.4.1, Table 6.4).

10.9.1 Barriers

Respondents were presented with seven barriers and asked to select those which were relevant to their experience in developing links with industry.

Table 10.10 Perceptions of barriers to establishing links with industry

Barrier	Percentage of academics indicating each barrier (%)
Collaboration is problematic due to industry's short-term product development focus versus the HEIs longer-term research objectives	53
Industry's lack of knowledge on the capabilities of HEIs	51
HEIs are too slow to respond to the demands of industry	51
Equipment base/facilities of HEIs are insufficient	46
Perception of the HEI as an 'Ivory Tower' by industry	45
There is an inadequate culture of entrepreneurship in HEIs	41
Work completed by HEIs is not always relevant	35

Source: Academic questionnaire survey (2002)

'Collaboration is problematic due to industry's short-term product development focus versus the HEIs longer-term research objectives' was the barrier with the highest proportion of responses from academics (Table 10.10). In all, 53% of academics

stated this to be a barrier to establishing links with industry. Similarly, 50% of firms with HEI links also stated this to be the case, making it for them the most significant barrier to the development of links with academia. As already noted, PREST (1998) also found that differences in objectives was the most significant barrier to the development of links between academia and industry. It is important to reiterate that the results from PREST were based on interviews with ILOs, CEOs and senior management (mainly vice-chancellors) and not academics (Chapter 2, Section 2.3.3.2).

Of equal importance, at 51% of mentions, were the barriers 'industry's lack of knowledge on the capabilities of HEIs' and 'HEIs are too slow to respond to the demands of industry'. While the academics are aware of deficiencies in response time in HEIs to the demands of industry, equally they are cognisant of industry's lack of knowledge of HEI capabilities. This issue also emerged a number of times as an important barrier from the perspectives of firms (Chapter 6). Forty-four percent of firms with HEI links stated that a lack of knowledge of HEI capabilities was a barrier to establishing U-I links. To overcome such an obstacle, academics in collaboration with EI and industry have an obligation to market their capabilities to industry in the same way that firms have an obligation to pro-actively seek out such information.

10.9.2 Stimulants

In relation to stimulants to the development of U-I links, comparisons were made with the relevant data on firms with HEI links (Chapter 6, Section 6.4.2, Table 6.5). Only the same variable listed for both firms and academics are compared.

Table 10.11 Perceptions of stimulants to establishing links with industry

Stimulant	Percentage of academics indicating each stimulant (%)
Collaboration with individual academics	85
Increased government funding in HEI research	52
Excellence in academic research	47
Support schemes to encourage collaboration with HEIs	47
Increased commercialisation of HEI research	33
Rapidly evolving technology incubation facilities in HEIs	26
Dynamic academic entrepreneurial climate of HEIs	13

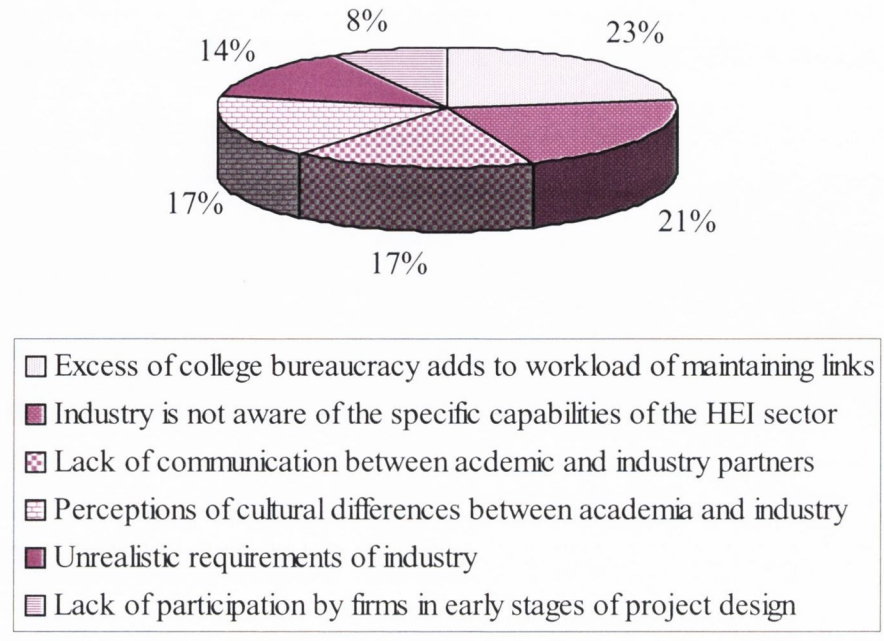
Source: Academic questionnaire survey (2002)

Stated by 85% of academics, the most frequently cited stimulant was 'collaboration with individual academics' (Table 10.11). The corresponding figure for firms with HEI links was 83%. Evidently, individual academics with an interest in engaging in interaction with industry play a very important role in establishing links between academia and industry. Just over half (52%) of academics stated that 'increased government funding in HEI research' is a key incentive for collaboration with industry. As already noted, the recent decline in government expenditure in publicly funded research will constrain the potential for increased U-I interaction in the foreseeable future. Closely related is the stimulant 'support schemes to encourage collaboration with HEIs' which was cited by 47% of academics. Again, the support schemes presented by EI are under current scrutiny given the recent downturn in the Irish economy. If the government is focused on effectively integrating Ireland into the global knowledge economy, it would do well not to cut government expenditure both in publicly funded research in HEIs and in EI-assisted schemes focused on creating U-I links.

10.10 PROBLEMS ASSOCIATED WITH MAINTAINING LINKS

Having established links with industry, respondents were presented with a number of potential problems associated with maintaining links and were asked to select those relevant to them.

Figure 10.10 Problems associated with maintaining links



Source: Academic questionnaire survey (2002)

The most significant problem associated with maintaining links with industry was 'excess of college bureaucracy adds to workload of maintaining links' (Figure 10.10). This problem accounted for 23% of total responses. This is manifested in various ways from gaining permission from a head of department to engage in links with industry, to scheduling time to commit to the activity, to dealing with on-going IP issues with the ILO.

Industry's lack of awareness of HEI capabilities accounted for 21% of the responses and again is a recurring problem emerging throughout the survey results from both respondent firms and academics. This is conditioned by a 'lack of communication between academic and industry partners' which was cited by 17% of academics. Evidently, a lack of communication is a barrier which pervades the U-I interface both in terms of establishing and maintaining links.

10.11 CONCLUSION

This chapter has examined U-I collaboration from the perspective of the experiences of academics with industrial links. In particular, attention has focused on level of interaction; types of links created; barriers and stimulants associated with such interaction; and problems associated with maintaining collaboration. R&D links were found to be the most common form of interaction, followed by teaching and training

links and consultancy links. This is significant given that the role of HEIs in economic development is changing, with increasing emphasis being placed on research and innovation.

In general, academics perceived the main stimulants to fostering links with industry to be the opportunity to gain access to industrial environments with a view to broadening their research experience and to contribute to the diffusion of knowledge. The main barriers to developing such links were shortage of staff time, lack of resources in HEIs to support such collaboration and the short-term nature of industrial research. Furthermore, academics viewed HEIs as being reactive rather than pro-active in responding to U-I collaboration. The most important benefit of collaboration with industry was gaining access to industrial environments with a view to enhancing expertise in research, teaching and consultancy. A significant drawback to such engagement for academics was that industry's need for confidentiality imposes limitations on publication opportunities. Academics highlighted that of the drawbacks to maintaining interaction, the most significant were excessive college bureaucracy associated with sustaining links and industry's lack of knowledge of HEI capabilities.

These findings have important implications for the policies of Irish HEIs and the government in relation to their ability to enhance economic development and at the same time place Ireland firmly in a knowledge-based global economy. HEIs in Ireland need to consider more their entrepreneurial role and their responsibility to engage in social and economic development in the regions in which they are located by actively forging and supporting U-I interaction as a key component of their activities alongside their stated missions of teaching and research. This can be achieved by creating a culture of academic entrepreneurship on-campus through the provision of incentives for academics interested in U-I collaboration to engage in such activities. In particular, attention should be focused on the effective marketing of HEI capabilities at both the level of the institution and the individual academic. The ILO function needs increased staff numbers and financial resources if it is to emerge as anything more than a reactive, administrative and functional unit. Furthermore, ILOs need resources for the identification and commercialisation of IP and they require both HEI and government support for the development of university technology transfer policies. HEIs need to be pro-active rather than reactive both to the demands of industry and to the needs of academics with a desire to interact with industry.

In relation to the role played by government in fostering increased U-I interaction, EI needs to create greater awareness amongst the academic community of its impressive range of schemes (*e.g.* Innovation Partnerships) aimed at creating U-I links. EI should also consider setting up a networking forum focused on creating interpersonal interaction between academia and industry (*e.g.* Connect Ireland). Finally, a proactive culture needs to be collectively adopted by HEIs, academics, government and industry towards the creation of U-I links if Ireland is to exploit fully the knowledge base of its HEIs and move towards creating sustainable long-term economic development in the future.

CHAPTER 11

ACADEMICS WITHOUT INDUSTRIAL LINKS

11.1 INTRODUCTION

> *My research area would in the long-term be useful in the 'real world' but is currently very academic. Some research is valid for research sake alone and does not always have direct/immediate commercial value (Academic without industrial links, number 657).*
>
> *There is quite a lot of "specialised" research going on that is not represented in an industrial environment in Ireland. I have numerous industrial links in the UK where there are a lot more "specialised" companies (Academic without industrial links, number 663).*

Links with industry are not a specified or necessary component of the professional responsibilities of an academic. U-I collaboration is more likely in certain S&T-based disciplines (Chapter 2, Section 2.3.2). The propensity for academics in certain S&T-based subjects to engage in links with industry is dependent upon their specialist research area.

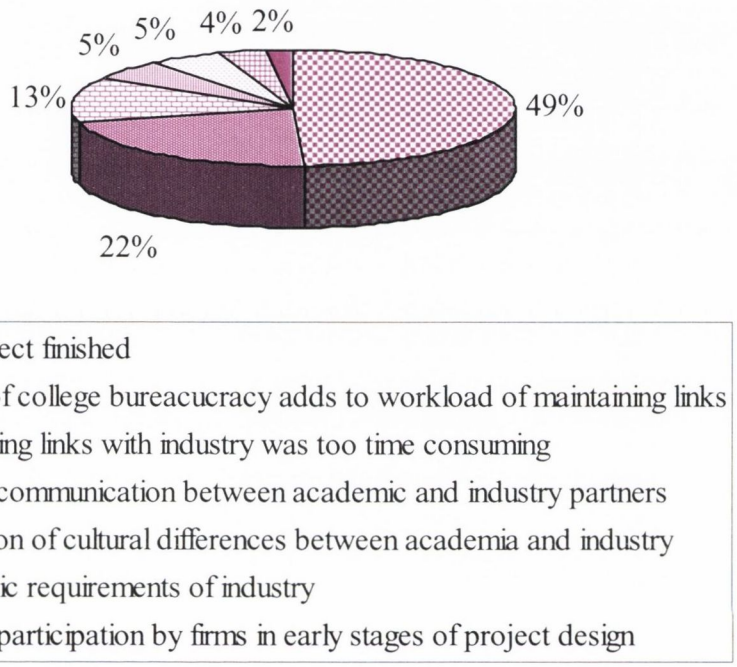
It is not the intention of this research to undermine or criticise those academics without industrial links. Rather, its purpose is to assess the barriers and stimulants to the development of U-I links from the perspectives of firms and academics with and without links at present. Academics without industrial links comprise an essential component of the research. As already noted, it is likely that the barriers to the development of U-I links are the very reasons that have prevented some academics from engaging in such links (Chapter 3, Section 3.6). The aim of this chapter is to assess the reasons why these academics have not forged links with industry.

11.2 PREVIOUS INTERACTION WITH INDUSTRY

As already noted, 44% (280 academics) of respondent academics did not have links with industry (Chapter 3, Section 3.6.2, Figure 3.5). Similar to the firms, academics

without industrial links were asked if they had engaged in links with industry in the previous five years but had ceased such collaboration by the time of the survey. In all, 30% (84 academics) of academics had engaged in such interaction in the previous five years and had since ceased to do so.

Figure 11.1 Factors which led to the cessation of links with industry



Source: Academic questionnaire survey (2002)

Completion of projects was by far the most common factor which led to cessation of interaction (Figure 11.1). Given the short-term focus of industrial projects, it is not surprising that project completion should rate so highly as a reason for the cessation of interaction. Of less importance (22%) was the factor 'excess of college bureaucracy adds to workload of maintaining links'. This is consistent with earlier evidence from the sample of academics with industrial links who indicated that the most significant problem they experienced with maintaining links was due to excess college bureaucracy (Chapter 10, Section 10.10). Lower down in terms of importance was the issue of lack of staff time. This factor was the most significant barrier to academics with industrial links and emerged as a common deterrent throughout the data in Chapter 10.

11.3 FACTORS WHICH WOULD ENCOURAGE INTERACTION WITH INDUSTRY

In order to assess factors with the potential to encourage interaction with industry, academics were presented with six factors. They were asked to score each factor on a scale from 1 to 5 in order to indicate the level of importance they associated with each as a potential stimulant which may encourage them to collaborate with industry (Chapter 3, Section 3.2.1).

Table 11.1 Factors which would encourage academics to establish links with industry

Stimulant	Mean Score	Std. Dev.
Facilitates exposure to industrial environments	2.22	1.11
Creates employment for graduates of the college	2.37	1.17
Contributes to the diffusion of knowledge	2.45	1.18
Enhances local/regional/national economic development	2.48	1.09
Provides additional source of income for the college	2.85	1.26
Increases the prestige associated with the college	2.90	1.19

Source: Academic questionnaire survey (2002)

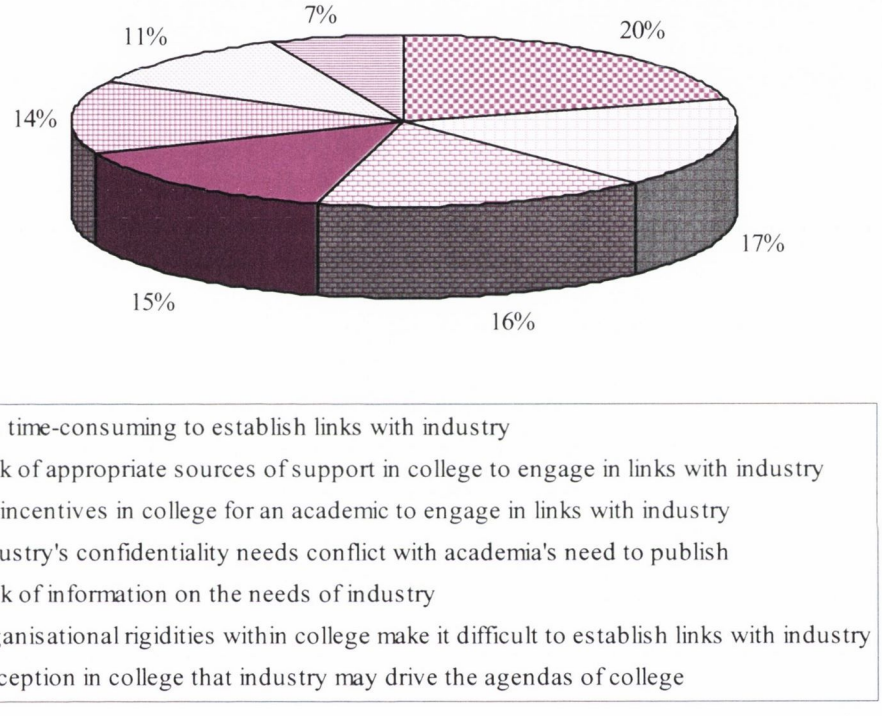
The factor considered to be the most important was 'facilitates exposure to industrial environments' with a mean of 2.22 (Table 11.1). The standard deviation of 1.11 indicates less variation amongst respondents' answers relative to most other stimulants, with the exception of the stimulant 'enhances local/regional/national economic development'. This finding is consistent with that of academics with industrial links (Chapter 10, Section 10.3, Table 10.1).

Of less importance, with a mean of 2.37, was the factor 'creates employment for graduates of the college'. By way of comparison, academics with industrial links associated less importance with this factor as a stimulant. 'Contributes to the diffusion of knowledge' was rated third for academics without industrial links and second for those with links. Evidently, both samples of respondents are committed to the diffusion of knowledge beyond the HEI and out into industry. Of less importance was the factor 'enhances local/regional/national economic development', with a mean of 2.48. This factor scored lowest for the academics with links. Academics from both samples are either not aware of the potential economic benefits to the regions in which their respective HEIs are located or their motivation for interacting with industry is not driven by a need to enhance local development. All in all, the evidence suggests that economic development is not a major consideration for academics.

11.4 OBSTACLES TO ESTABLISHING LINKS

In order to examine reasons for non-collaboration with industry, respondents were presented with seven factors which could be responsible for preventing the development of links with industry. They were asked to indicate those factors which they perceive would be an obstacle to their participation in links with industry.

Figure 11.2 Obstacles to establishing links with industry



Source: Academic questionnaire survey (2002)

Twenty percent of respondents indicated that it was 'time-consuming to establish links with industry'. Lack of staff time also emerged throughout the data as a significant barrier to the development of U-I links for academics with industrial links (Chapter 10). Of less importance (17%) was 'lack of appropriate sources of support in college (*e.g.* Tables 10.2, 10.4, 10.6) to engage in links with industry'. Again, this obstacle was cited as a significant barrier to the development of U-I links from the perspectives of academics with industrial links. Evidently, both samples perceive that the HEIs do not provide an adequate support structure for the creation and development of U-I links. The obvious source of failure in relation to support for U-I links in a HEI is poorly resourced ILOs. Clearly related was the obstacle, 'no incentives in college for an academic to engage in links with industry', accounting for 16% of responses. Again, this finding mirrors the level of importance academics with

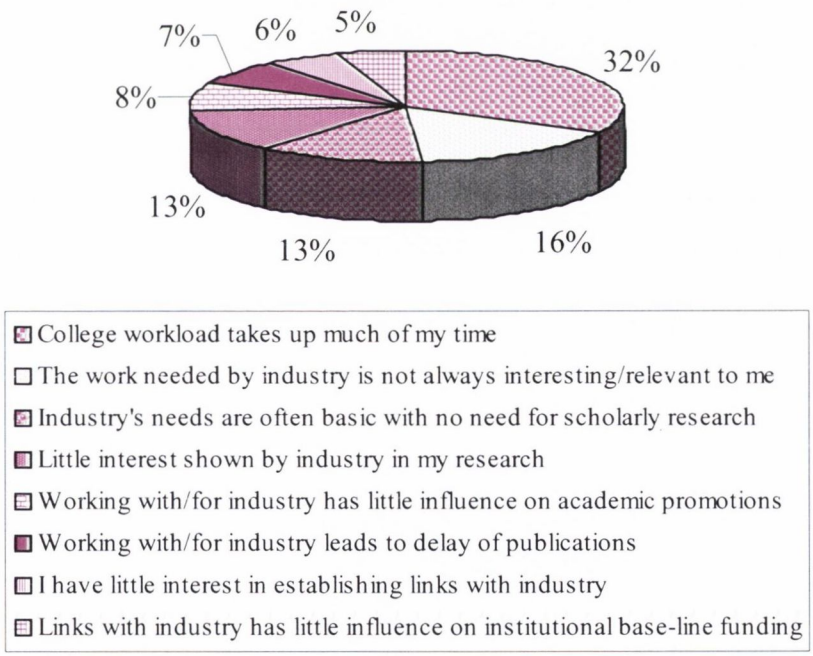
industrial links associated with such factors as barriers to the development of U-I links (Chapter 10).

11.5 REASONS FOR NOT ESTABLISHING LINKS WITH INDUSTRY

> *Industry needs differ from research objectives of academic laboratory (Academic without industrial links, number 577).*
>
> College doesn't actively support links with industry *(Academic without industrial links, number 744).*
>
> Little support shown by industry in environmentally sustainable product development *(Academic without industrial links, number 829).*

In order to assess why academics without industrial links have refrained from such activities, they were presented with a number of possible reasons and asked to indicate those relevant to them.

Figure 11.3 Reasons for not establishing links with industry



Source: Academic questionnaire survey (2002)

The most important reason motivating academics without industrial links not to engage in such interaction was 'college workload takes up much of my time', accounting for 32% of responses. Again lack of time due to college workload was the most important barrier to the development of each of the types of links for academics with industrial links (Chapter 10).

Of less importance was the reason 'the work need by industry is not always interesting/relevant to me', accounting for 16% of responses. This is clearly related to the fact that 'industry's needs are often basic with no need for scholarly research'. Industrial research projects are often short-term and lack depth in terms of scholarly content. Academics tend to prefer long-term research projects with a high level of scholarly content.

11.6 CONCLUSION

The purpose of this chapter has been to consider the reasons why academics without industrial links have refrained from engaging in such interaction. Attention has focused on: previous interaction with industry; factors which would encourage interaction with industry; obstacles to establishing industrial links; and reasons for not establishing links with industry. Respondents stated that of the factors which would encourage them to establish links with industry, the opportunity to gain access to industrial environments was the most important motivating factor. This is a significant result given that 50% of academics without links stated that they plan to engage in links with industry in the future. This highlights a significant untapped resource in HEIs of academics with the interest and enthusiasm to engage in links with industry. As already stated, the Irish government in collaboration with HEIs and industry have a social and economic obligation to lessen the barriers and enhance the stimulants to U-I collaboration in order to encourage the development of synergistic relations between academia and industry.

CHAPTER 12

CONCLUSION

12.1 INTRODUCTION

> *There is a lack of 5-15 year planning with governmental agencies such as Enterprise Ireland and the IDA to prepare the Irish workforce for the emerging industries that we want to attract into the country. For example, we're probably already dead in world market terms, for attracting new biopharmaceutical manufacturing facilities into Ireland – and we don't even realise that we're dead, that the train has left the station and we're not on it (Firm with HEI links, number 1860).*

In recent years, much attention has focused on the emerging knowledge economy and the associated need for collaboration between industry and academia. This perception is premised on the belief that such interaction will generate positive economic and social outcomes for national and regional economies. However, in light of this, relatively little is known in a systematic way about U-I interaction and factors responsible for encouraging and discouraging such collaboration from the perspectives of both industry and academia. Furthermore, existing research has failed to examine U-I links in a national economy with an extensive focus on empirical evidence from industry, academia and key actors in innovation in relation to U-I links and the barriers and stimulants to such collaboration. This research has addressed this gap in the literature and has focused on U-I interaction in the Republic of Ireland. The fundamental aim of this thesis has been to examine the barriers and stimulants to the development of U-I links in Ireland from the perspectives of both industry and academia.

12.2 METHODOLOGY

Research completed on U-I links is fragmented and disjointed both in terms of providing a conceptual basis to the field and in terms of the focus of research at the interface between academia and industry. The evolution of U-I links is dictated by different spatial and institutional factors which in turn are affected by a series of other variables such as government S&T policy, level of national and regional development and the degree to which synergistic relationships between government, HEI and industrial partners are integrated into the effective implementation of national and regional innovation systems. Research completed to date has failed to encapsulate this diversity and instead has focused on fragments of the U-I interface to the exclusion of other equally important facets. In particular, the literature has focused on the experience of industry to the exclusion of academia. Academics have been excluded from any analysis of U-I interaction. Instead, the literature has focused on ILOs in HEIs as being representative of the academic perspective. Much attention has been directed towards a case study approach of a small population of firms (often science park firms) and their relationship with an associated university. While such studies have generated a wealth of information on interactions from the perspectives of the companies, they exclude the perspectives of academia and those of key actors in innovation and U-I links within the context of both regional and national economies. Furthermore, companies studied in micro-level case studies cannot be considered to be representative of those at the national level.

This research has contributed to the body of existing knowledge by incorporating the perspectives of indigenous high-tech firms, S&T-based academics and key regional actors associated with innovation and U-I links in Ireland (and also in Scotland) with a particular emphasis on the barriers and stimulants to the development of U-I links. It provides critical data on the characteristics and innovative activities of firms and their perception of the role HEIs play in enhancing industrial innovation. By the same token, this research provides invaluable data on academics and on the level and type of industrial links in which they engage. This is significant given that the perspectives of academia have been excluded from previous analyses of U-I links. At the same time, this research also includes the perspectives of a broad range of key regional actors associated with innovation and U-I links in both Ireland and Scotland. This research provides information on the environment in

which U-I links have evolved and highlights a background to understanding the evolution of U-I links at both the regional and national levels. Finally, the case study approach associated with the research completed at the National Technological Park, Plassey provides data at the micro-level and analyses the interplay between science park firms and their associated university. Overall, the most significant contribution that this research has made to the existing literature is its extensive and simultaneous focus on each of the key facets of research associated with the field of U-I links.

The initial phase of this research included an analysis of the perspectives of key actors involved in the development of U-I links, innovation and commercialisation of HEI research in both Ireland and Scotland. This phase of the research was conducted through the use of structured and semi-structured interviews. In all, a total of 91 interviews were conducted (56 in Ireland and 35 in Scotland). This included representatives from state-sponsored development agencies, policy advisory bodies, specialist industrial research units in HEIs, business support agencies and key network actors with a regional and national focus. In Ireland, two separate categories of respondents were also identified. These were the ILOs of the HEIs and academic entrepreneurs who had formed campus companies. A case study of Ireland's only science park, the National Technological Park, Plassey, Limerick was undertaken in order to analyse the level of interaction between the park and its associated university UL. This phase of the research involved the participation of Shannon Development personnel, the park's management team, specialist industrial research units in UL and companies located on the science park. The focus of this phase of the research was on links between the science park and UL and the barriers and stimulants associated with such collaboration. Conducting interviews provided the freedom to include a broad range of stakeholders in the development of U-I links, commercialisation and innovation and to analyse these perspectives in the context of this research.

The scope of the inquiry was extensive in that it was inclusive of all EI-assisted indigenous high-tech firms and covered the entire HEI sector in the Republic of Ireland. It involved two separate postal questionnaire surveys. The industry questionnaire survey was posted to a total population of 1,980 EI-assisted high-tech firms and yielded a response of 34% after a follow-up re-mailing. The academic questionnaire survey was sent to a total population of 2,973 S&T-based academics in each of the universities and ITs in Ireland. In this instance, in order to ensure

complete anonymity, a unique code number was not attached to each questionnaire. Hence the mail-out survey was conducted once and was not accompanied by a follow-up survey. It yielded a total response of 21%.

12.3 SCOTTISH RESEARCH

The environment of commercialisation of university research in Scotland was investigated in order to provide an international comparative perspective with Ireland. Commercialisation and U-I links are specific to each individual country, as such interaction is conditioned by a variety of different social, economic and industrial factors which are specific to the national and regional development of each economy. National and regional variations dictate the need for the implementation of different innovation policies. Furthermore, state-sponsored development agencies take different approaches to the formulation of policy initiatives designed to mobilise the effective implementation of national and regional industrial innovation strategies. Similarly, while many HEIs have a stated commitment to enhance regional development, significant regional variations emerge in relation to the degree to which HEIs actually implement such a philosophy. Despite such regional and national variations, an international comparison was made with Scotland to assess the level and effectiveness of strategies which have been implemented there in order to create an environment conducive to the commercialisation of university research.

In Scotland, two significant problems were found to prevent the creation and sustainability of an environment conducive to the commercialisation of university research. One was the lack of knowledge that the universities had on the needs of industry and the other was the low number of technologically sophisticated, research-dependent firms. Not only do universities not realise what the needs of the firms are in relation to R&D, consultancy and teaching/training, but there is not a significant pool of firms ready to absorb technology transfer from HEIs. Similar problems were also found in Ireland. Irish HEIs are not aware of the needs of industry and similarly there exists a small population of technologically sophisticated firms with the potential, capability and desire to absorb knowledge flows from HEIs.

It was found that, while SE has a stated commitment to the creation of an environment conducive to the promotion and sustainability of academic entrepreneurship in Scotland, it has not implemented to the same extent the range of initiatives that EI has invoked in Ireland. Instead the Scottish model focuses on

creating networks of interaction between industry and academia via the services provided by Connect Scotland and TVS. While both of these bodies are critical in terms of creating relationships between industry and academia, Scotland needs to reassess its policies in relation to industrial innovation and to focus on building a population of indigenous technologically sophisticated firms with the capability to absorb knowledge and technology transfer from Scottish HEIs. Without such a sector, Scotland will not fully benefit from its efforts to create an environment conducive to the commercialisation of university research.

12.4 U-I LINKS IN IRELAND

In 1958, Ireland directed its industrial policy to the attraction of FDI focused on export-orientated development. Following accession to the EU in 1973, Ireland became one of the most attractive locations in Western Europe for multinational firms focused on standardised manufacturing production and employing unskilled labour to conduct assembly-based activities. By the early 1990s, Ireland was experiencing unprecedented levels of economic growth. However, it was not until the late 1990s that the Irish government focused on developing policies directed towards the exploitation of Ireland's S&T base in Irish HEIs. Emphasis was then placed on the development of a competitive, export-orientated indigenous sector. EI had already implemented a number of initiatives aimed at instigating links between industry and academia in Ireland, but it was not until the late 1990s that a significant level of government funding was directed towards the enhancement of such initiatives. Like Scotland, Ireland has a HEI sector with a highly developed S&T base. However, like Scotland, Ireland also does not have a large number of technologically sophisticated indigenous firms with the potential to absorb and utilise the expertise of HEIs to enhance industrial innovation, increase competitiveness and encourage the spread of new technologies. The challenge now for the Irish Government is to create an effective collaboration between EI, industry and the HEIs in order to develop a profile of indigenous high-tech companies whose business is focused on the exploitation of the S&T base of Irish HEIs. Only then will Ireland really benefit from the funding directed at the existing range of initiatives aimed at creating U-I links. Emphasis should first be placed on creating a stock of high-tech indigenous firms and then focused on the effective implementation of programmes aimed at developing the HEI-industry interface in Ireland. This will lay the foundation for long-term sustainable

growth in the Irish economy and will help to ensure that Ireland has a competitive edge in the attraction of value-added foreign investment in the knowledge-driven global economy.

12.5 PERSPECTIVES FROM INDUSTRY

From the perspective of firms, both those with and without HEI links were investigated. Comparisons of the characteristics of both samples were made in order to deduce if differences existed in relation to firm propensity to engage in HEI links. In relation to firms with HEI links, emphasis was placed on R&D, consultancy and teaching/training links, allied with an analysis of formal and informal interaction. This also included an analysis of the barriers and stimulants to such collaboration. In relation to firms without HEI links, emphasis was placed on the factors responsible for impeding interaction with HEIs and on the possible inducements which would encourage interaction with academia.

In relation to level of interaction, a significantly higher proportion (75%) of respondent firms did not engage in links with HEIs than did. One of the main barriers to U-I interaction was the cultural differences between firms and HEIs. In relation to stimulants to interaction, firms stated that they found the most fruitful forms of collaboration to emerge from one-to-one relationships between industry and academics. For firms with HEI links, the most common form of interaction was via teaching and training links, followed by R&D links and consultancy links. Access to skilled graduates was the primary factor motivating such interaction. Firms without links stated that a key barrier preventing them from engaging in links with HEIs was a lack of information on HEI capabilities.

Despite the existence of a well-developed HEI sector in Ireland allied with the recent implementation of government initiatives designed to enhance the infrastructure and profile of research activities, EI-assisted firms are not major benefactors of Ireland's S&T base. While firms are engaging in innovative activities, HEIs are excluded from such developments. This is significant given that a strong association was found between geographical proximity and the propensity for firm engagement with HEIs. In relation to firm location, the majority of firms from both samples were located in urban areas. In terms of the activities of firms, a significantly higher proportion of firms without HEI links engage in marketing, provision of services, R&D and software development. Focusing on R&D, firms without HEI

links are engaging in basic research and new product development activities. Firms with HEI links are engaging in similar levels of innovative activity but are not utilising HEIs as sources of such knowledge. Rather, such firms are interacting with HEIs to complement existing in-house R&D activities and to sporadically use the teaching/training and consultancy services available in HEIs.

12.6 PERSPECTIVES FROM ACADEMIA

In analysing links between academia and industry, the same variables were analysed but from the perspectives of academics from S&T-based disciplines with and without industrial links. Similar to the research on the firms, the characteristics of the academics with and without links were compared to deduce if significant differences were evident between both independent samples in relation to their propensity to engage in links with industry. Again, in relation to the academics with industrial links, emphasis was placed on R&D, consultancy and teaching/training links, formal and informal interaction and the barriers and stimulants to such collaboration with industry. In relation to academics without links, emphasis was placed on the factors responsible for impeding such interaction and on the possible stimulants which may lead to collaboration with industry.

In relation to level of interaction, 56% of academic respondents had links with industry compared to 44% who did not. The key stimulant encouraging academics to engage in links with industry was the opportunity to gain access to industrial environments. This provided academics with industrial links with the unique opportunity to enhance the profile of their research activities. Amongst the most important barriers to collaboration were lack of staff time, lack of an infrastructure in HEIs to support links with industry and the short-term nature of industrial research.

These barriers were confirmed by the interviews with ILOs, which focused in particular on the commercialisation of HEI research. According to the ILOs, one of the significant barriers to research commercialisation is lack of staff time due to excessive teaching and administrative workloads. Another barrier cited by firms was the lack of a support structure in HEIs to support links with industry. This again was confirmed by ILOs when they stated that their offices lacked financial and personnel resources. This necessitated that ILOs be reactive rather than proactive to the commercialisation of HEI links. Interviews with campus companies and with the academic spin-off from UL confirmed the reactive rather than proactive stance of

ILOs and stated that such offices did not have sufficient time or empathy to deal adequately with academic entrepreneurs and did not possess sufficient knowledge on the commercialisation process and IP. Furthermore, campus companies stated that bureaucracy and a lack of incubation space and a culture of academic entrepreneurship were significant barriers within HEIs to the formation of a campus company. In the National Technological Park, Plassey, none of the three science park companies had links established with UL at the time this phase of the research was completed. Of the barriers cited, the most significant related to a lack of an appropriate infrastructure within UL to support interactions with science park companies combined with a lack of knowledge of the capabilities of UL.

For academics with industrial links, the most common link with industry was via R&D. Collaborative R&D emerged as the most popular form of R&D interaction, while applied research links constituted the most common form of R&D links. Similar to the data on the firms, basic research links did not constitute a significant form of R&D interaction. This is in stark contrast to the perception in the existing literature, that basic R&D links constitute one of the most common forms of U-I interaction and are central to the promotion of industrial competitiveness. The evidence from this research indicates that basic R&D is not a key facet of U-I R&D links in Ireland. In relation to academics without links, one of the most significant findings was that 50% of this sample of respondents plan to engage in links with industry in the future. This suggests the existence of an untapped pool of academics with the willingness to engage in links with industry if they are provided with adequate support from HEIs.

12.7 POLICY RECOMMENDATIONS

Overall, the evidence would suggest greater potential for U-I interaction, based on more effective communication between both firms and HEIs. This can be achieved via six mechanisms.

First, HEIs need to become more pro-active in terms of marketing their capabilities to industry. The firms stated that they are not aware of the capabilities of HEIs in relation to research, consultancy and teaching/training. HEIs now have an obligation to market their activities to the industrial community in Ireland with a view to creating and sustaining viable interactions with industry. Furthermore, the ILOs of HEIs need substantial investment in terms of resources and personnel. Without such

investment, Irish HEIs cannot be considered to be fully integrated into Ireland's national innovation system.

Second, a database of information on the research capabilities of HEIs needs to be developed and made available to industry. Such a database would list the research interests and activities of S&T-based academics. One of the problems associated with such a list would be the willingness of academics to keep the information updated.

Third, EI should continue their range of financial initiatives designed to create U-I interaction. However, they must market such support schemes both to their client companies and to the S&T-based academic community in Irish HEIs.

Fourth, a dedicated enterprise officer should be appointed in each HEI working in partnership with EI and focused exclusively on developing and maintaining links with existing indigenous firms, particularly SMEs. This person would have direct responsibility for managing the interface between their HEI and indigenous SMEs. They would go out to industry, assess industry's needs in terms of what HEIs can provide and then market those capabilities of their HEI to the companies. Enterprise officers would also collaborate with EI and make companies aware of EI initiatives to foster U-I links.

Fifth, the GDA does not have a science park. In an area the size of Dublin with access to four universities (TCD, UCD, DCU and NUIM), the Royal College of Surgeons, the DIT and three ITs (IT Tallaght, ITB and IADT-DL) there should be a science park established with links to each of these third-level educational institutions. The onus is on the Irish Government to develop such a science park. In an article in the *International Journal of Technology Management*, McBrierty and O'Neill (1991) suggested that a science park should be built in Dublin as a location for campus-originated high-tech ventures after they have spun-out of the university sector. While the science park case study in this research highlighted a lack of interaction between UL and science park firms, this should not be used as a benchmark by which to assess the potential outcomes of a science park located in the GDA. A science park in Dublin, with links established with each of the universities and ITs in the GDA, would also serve as an access point for both indigenous and multinational firms to harness the appropriate research resources necessary for industrial development and competitiveness. According to McBrierty and O'Neill, the creation of a science park in the Dublin region, effectively interfaced to the reservoir of research competence in

the university sector, would lead to a number of positive outcomes for the region and the Irish economy. In particular, it would contribute to maximising the return to the state for its investment in education; it would enhance the competitiveness of the indigenous high-tech sector in Ireland; it would place Ireland as a key player in the global knowledge economy; and it would enhance the region's infrastructure and promote it as a viable location for potential FDI.

Sixth, Ireland needs to implement a number of programmes similar to those in Scotland. These should include: A Connect Ireland initiative; a Technology Ventures Ireland initiative; and an Irish institute for enterprise.

12.7.1 A Connect Ireland initiative?

Ireland currently does not have a Connect programme similar to that implemented in Scotland[1]. While a number of EI personnel engage in Connect-type activities within the remit of their assigned responsibilities, there is no dedicated unit in Ireland that mirrors the Connect Scotland initiative. It is important to note that while there is a Biotechnology Ireland maintained and promoted by BioResearch Ireland based in EI, this focuses exclusively on the biotechnology sector. EI, in conjunction with the university sector and high-tech industry as a whole, should assess the possibility of introducing a Connect Ireland. This initiative could be developed as a network facilitator and could focus on developing an active technology network encouraging collaboration between the academic community, industry, VCs and government bodies in an effort to promote the commercialisation of Ireland's science base. In order to be a success, Connect Ireland should be an independent autonomous body not attached to a university or government body and driven specifically by a focus on stimulating the development and support of new technology companies. It is likely that such autonomy could encourage more firms to participate in a Connect Ireland initiative. A Connect Ireland initiative could be crucial in a number of ways to the

[1] Ireland, does, however, have Bioconnect. Based on Connect at the UCSD, Bioconnect was set up in Ireland in February 2001 by an independent consultant and an individual from a VC company called Growcorp. Bioconnect is an informal networking organisation designed to create interaction between stakeholders in the biotechnology sector (VCs, academics, government development agencies, service providers and consultants) in Ireland. The purpose of creating networks of interaction is to promote the commercialisation of biotechnology in Ireland. Bioconnect has four meetings per year and has a mailing list of 1,500 people. Two important differences exist between Connect Scotland and Bioconnect. First, Bioconnect focuses exclusively on biotechnology while Connect Scotland includes all high-tech sectors. Second, Bioconnect does not have the management and organisational structure which Connect Scotland has developed. While Bioconnect does not operate at the same scale as

development of an entrepreneurial spirit in the Irish economy. In particular, Connect Ireland could:

- Facilitate entrepreneurial high-tech business development;
- Provide assistance to start-up companies in developing business plans and in assessing the market potential of new technologies;
- Provide opportunities for academics and industry personnel to interact with each other;
- Organise a variety of national and international financing forums which could provide entrepreneurs in Ireland with the opportunity to network with a range of potential VCs;
- Provide a crucial access point, a mentoring service and a business support structure for high-tech entrepreneurs as they meet a range of challenges associated with the development of their companies.

While AUA and TecNet are, to some extent, fulfilling this role, there is a need for an all-inclusive national programme with specialised personnel establishing linkages between firms in high-tech sectors and academics in S&T subjects in HEIs. However, while Scotland has Connect Scotland, it does not have the range of initiatives Ireland has in the form of those implemented by EI. It was found in this research, however, that the range of such programmes created problems for firms. Due to the fact that there is a large number of programmes aimed at various aspects of innovation, this often leads to a degree of complexity which hinders firms trying to access EI initiatives aimed at encouraging U-I links. One recommendation to redress this problem would be to set up a system whereby each technical development advisor (TDA) in EI would spend time with each firm for which he or she has responsibility and outline the suite of available EI initiatives to each. In directing and advising the firm on the range of programmes on offer from EI, the TDA should assess and match the initiatives which are relevant to the local and specific needs of the firm.

Connect Scotland, Bioconnect is currently the only network facilitator in Ireland focused on commercialisation.

12.7.2 A Technology Ventures Ireland initiative?

> *So that's really where TVS is as a mechanism, now we are unique no one has tried this and it's quite interesting, the English have picked up on this as well and although no one is quite sure what TVS is doing and that applies in Scotland as much as anywhere else because it is so new I think we are about to get to the stage where we can be recognised as having a useful function. It only works because we are independent and because it is strategic with very few resources (Interview with TVS, 2001).*

Ireland is currently without an initiative similar to that of TVS. There are a number of benefits which this type of initiative would bring to the commercialisation landscape in Ireland. First, such an initiative would provide firms with the knowledge of the capabilities of the university sector while highlighting the needs of industry to academia. Second, researchers seeking to commercialise their research would have an access point for seeking information on the availability of incubator space and venture capital support. Third, such an initiative would greatly facilitate the ILO function in Ireland, not only in terms of marketing the capabilities of the university sector but of enabling the process of commercialisation to develop more quickly both inside and outside the environment of HEIs.

12.7.3 An Irish institute for enterprise?

SIE is still in its early stages of development and only time will tell if it is successful in achieving its goals, particularly in terms of increasing the rate of commercialisation in Scotland. However, Ireland could benefit greatly from the implementation of a similar initiative in a number of ways. First, such an initiative should embed a culture of entrepreneurship on campus in Ireland's third-level educational sector. Second, it should create an awareness of the benefits of academic entrepreneurship, not only for academic staff but also for undergraduates and postgraduates. Third, an Irish Institute for Enterprise should be effective, not only in terms of consolidating the teaching skills base in entrepreneurship in each university, but it also would promote greater collaboration between HEIs in Ireland. This should create symbiotic relationships in the exchange of knowledge and experience in the crucial area of entrepreneurship education.

12.7.4 Summary on policy recommendations

The effective implementation of each of these measures would facilitate the development and sustainability of a competitive indigenous high-tech sector in Ireland. In developing a programme for sustainable industrial development in the future, one of the main objectives of the Irish government must be to develop a knowledge-based economy. The transfer of knowledge and diffusion of innovation is the new source of competitive advantage for high-tech firms. If Ireland is to become a key player in the knowledge-based economy, the government must focus on creating and sustaining a critical mass of expertise in technology-based sectors which will attract value-added high-tech activity into the economy and create sustainable industrial development in the future. The effective exploitation of the S&T base of Ireland's HEIs is crucial to the future competitiveness of the Irish economy.

12.8 RECOMMENDATIONS FOR FUTURE RESEARCH

There is need for further research on U-I links and on the impact of such collaboration on national and regional development. To date in Ireland, there has been no assessment of the economic and social spin-off effects of U-I in the regional economies of HEIs. The existing literature assumes that positive effects exist, but there has been no research completed to vindicate the hypothesis that U-I links enhance economic development or that they contribute to the development of a sustainable national innovation system. While the benefits of U-I links did not constitute the focus of this research, it is an area which warrants study particularly in the context of the role of HEIs in creating and sustaining regional development through links forged with industry. In particular, there is a need for an analysis of the level and types of benefits regional economies gain from U-I interaction.

Furthermore, there has been no assessment of individual case studies of academic-industry partners and the benefits they gain from interactions with each other. In particular, interviews with firms and academics engaged in particular partnerships would provide further information which a questionnaire survey may not elicit.

Linked to the issue of outcomes of U-I links, one important area of further research is the degree to which foreign companies located in Ireland engage in links with Irish HEIs. There is a perception that foreign companies located in Ireland are stand-alone units which refrain from embedding themselves fully in the local

economy through links with HEIs and indigenous companies. A comparison between foreign and indigenous companies and their level of interaction with HEIs was not included in this research due to the requirement of the scholarship body, EI, to focus exclusively on indigenous enterprise. An investigation of foreign and indigenous enterprise and their levels of interaction with Irish HEIs should be undertaken in order to provide comparisons with indigenous companies.

What is required is cross-disciplinary research taking into consideration the expertise of economic geographers, sociologists, psychologists, economists and policy makers. Research at both micro and macro levels is needed in order first to provide a conceptualisation of the field of U-I links and then to provide empirical evidence on how technology transfer from academia to industry can effectively enhance industrial innovation, encourage regional development and promote long-term sustainable growth in the Irish economy.

Appendices

Appendix 2.1

Classification of Firm Size
EU Definition of HPSUs and SMEs

1. HPSUs vary considerably – depending on the type of project, the entrepreneurial team involved, the sector and the technology. HPSUs are in the formative phase of development and having achieved significant growth, export potential and wealth generation, evolve into SMEs. HPSUs can be created by independent entrepreneurs not associated with a HEI. Alternatively, HPSUs can be established by academic entrepreneurs in HEIs to exploit the IP of research completed by the HEI and develop the research into a commercially viable business opportunity in the global market place. HPSUs[1] are companies which are:

   - starting in a growth product market (defined as markets with sales growing in the previous year at least 7% for food and consumer products, at least 10% for industry and at least 20% for international services);
   - are based on technological innovation or the exploitation of an identified rapidly developing market niche;
   - are founded and promoted by experienced managers, entrepreneurs, academics or highly skilled technical graduates, either from within Ireland or returning from abroad;
   - which have the potential (a) to grow to have annual sales of €1.6 million (£1.3 million) or more, and (b) will employ up to 10 people, within two years of starting operations;
   - have demonstrable capability to trade internationally and whose business plans are based on exports;
   - show clear evidence of being able to continue to grow substantially and of being in a position to fund such growth

2. A small enterprise is defined as an enterprise which has fewer than 50 employees and has either an annual turnover[2] of not exceeding €8.8. million (£7 million) or an annual balance sheet total not exceeding €6.3 million (£5 million) and is not 25% owned by one or more companies that are not SMEs. Excluded from the latter holding company threshold are public investment corporations, venture capital companies and institutional investors provided that they do not exercise control.

3. An SME is defined as a firm that has fewer than 250 employees and has either an annual turnover of not exceeding €50 million (£40 million) or an annual balance sheet total not exceeding €34 million (£27 million), and is not 25% owned by one or more companies that are not SMEs. Excluded from the latter holding company threshold are public investment corporations, venture capital companies and institutional investors provided that they do not exercise control.

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[1] EI has a HPSU unit that provides support for the development of these ventures. The time span for HPSUs is 5 years from the time they first receive financial support from EI.

[2] Turnover means 'net turnover' which is defined as the amounts derived from the sale of products and the provision of services falling within the company's ordinary activities after deduction of sales rebates and of value added tax and other taxes directly related to the turnover.

4. A large-sized firm is defined as a firm that employs more than 250 employees

Source: EI, Dublin, June (2001)

Appendix 3.1

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

18-2-2002

Dear Sir/Madam,

I am writing to ask for your help in a study that investigates the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland. The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography*, *Trinity College Dublin* for a Ph.D. degree. Details of this research are attached in a letter from *Enterprise Ireland.*

This research is being carried out at a time when indigenous industry in Ireland is experiencing increased international competition. The focus of this research is to highlight the educational and research needs of industry. The research will also focus on how the university sector can improve in terms of responding to the specific needs of industry.

The results of this research will be used to help the Irish Government develop university-industry links that will enhance the competitiveness of the indigenous high-tech sector in local and global markets. The final results of the study will be published by *Enterprise Ireland* following completion of this research.

In order to collect high quality information that is reliable I am totally dependent upon your co-operation and understanding. Enclosed you will find two questionnaires.

- **If your firm engages in links with universities/Institutes of Technology in Ireland, you should fill in QUESTIONNAIRE NUMBER 1 (BLUE IN COLOUR).**
- **If your firm does not engage in links with universities/Institutes of Technology in Ireland, you should fill in QUESTIONNAIRE NUMBER 2 (YELLOW IN COLOUR).**

This questionnaire should be completed by the research director of your firm or by personnel with experience/knowledge of the corporate/R&D activities of the firm. Only one questionnaire should be completed, and the questionnaire is not as long as it may initially seem. I appreciate very much your effort to make this survey as complete and as accurate as possible, in order that I may complete my degree.

I would appreciate your co-operation in completing this questionnaire and returning it to me on or before **March 28 2002**. No stamp is required on the enclosed self-addressed envelope. **The majority of the questions can be answered with a 'tick', and it should not take more than 10-15 minutes to complete**. The information given will be treated in the strictest confidence. Each of the firms shall remain totally anonymous and under no circumstances will the identification of information relating to individual firms or to particular

questionnaires be released. This is an independent piece of research and I am the only person who will be reading your questionnaire. Each of the firms that participate will receive a report of the findings. If you have any queries regarding my research, please do not hesitate to contact me.

Thank you very much for helping with this very important study.

Yours sincerely,

Almar M. Barry

Almar M. Barry

DEFINITIONS

Definition 1: For the purposes of the study, the Frascati Manual definition of 'Research and Development' (R&D) is used. "Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. R&D is a term covering three activities: basic research, applied research and experimental development" (OECD, 1994, 7). R&D refers to efforts toward new knowledge, including the invention, design and development of processes and prototypes of products and services. R&D excludes: quality control, routine product testing, market research, sales promotions, sales service, research in the social sciences and psychology, and other non-technical activities or services.

Definition 2: ***Basic research (including strategic research)*** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Definition 3: ***Applied research*** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Definition 4: ***Experimental development*** is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

Definition 5: For the purposes of the study, an 'invention' is the creation of a new idea. An invention may or may not be patentable. A patent may or may not result in a saleable product or service or process. An 'innovation' is the introduction into the marketplace of the results of a new idea in products, services, processes or management.

Definition 6: For the purposes of the study, 'new technologies' enhance both product and process innovation. Product technologies refer to *what* is produced while process technologies are concerned with *how* a product is manufactured.

Definition 7: For the purposes of the study, High Potential Start-Ups (HPSUs) are companies which are starting in a growth product market, are based on technological innovation and are founded and promoted by experienced managers, entrepreneurs, academics or technical graduates. HPSUs should have the potential to grow to have annual sales of €1.6 million (£1.3 million) or more and employ up to 10 people, within two years of starting operations. HPSUs are in the formative phase of development and having achieved significant growth, export potential and wealth generation, evolve into Small and Medium Enterprises (SMEs).

Definition 8: For the purposes of the study, 'SME' refers to Small and Medium-sized Enterprise.

Definition 9: For the purposes of the study, 'HEI' refers to Higher Education Institution.

Definition 10: For the purposes of the study, 'IT' refers to Institute of Technology.

Definition 11: For the purposes of the study, 'ILO' refers to Industrial Liaison Office(r). In the Republic of Ireland, each university and IT has an Industrial Liaison Officer who has the responsibility to create and develop links between the HEI and industry.

Reference:

Organisation for Economic Co-operation and Development (1994) *The Proposed Standard Practice for Surveys of Research and Experimental Development: Frascati Manual 1993*. Paris, OECD.

Appendix 3.2

Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

4 November 2002

Dear Sir/Madam,

I am writing to ask for your help in a study that investigates the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland). This study is part of a research project designed to analyse the stimulants and barriers faced by the academic community in Ireland in terms of establishing links with industry. The research is part of a nation wide study on the establishment of links between universities/Institutes of Technology and industry. As part of this research, a survey of 1,980 indigenous high-tech companies in Ireland has been completed. To complete the research, it is now the turn of the academic community to provide their perspectives on the barriers and stimulants to the development of links with industry. The population of the study is academics from science and technology-based disciplines. The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography, Trinity College Dublin* for a Ph.D. degree. Details of this research are attached in a letter from *Enterprise Ireland.*

In order to collect high quality information that is reliable I am totally dependent upon your co-operation and understanding. Enclosed you will find two questionnaires.

- **If you engage in links with industry in Ireland, you should fill in QUESTIONNAIRE NUMBER 1 (GREEN IN COLOUR).**
- **If you do not engage in links with industry in Ireland, you should fill in QUESTIONNAIRE NUMBER 2 (PINK IN COLOUR).**

Only one questionnaire should be completed, and the questionnaire is not as long as it may initially seem. I appreciate very much your effort to make this survey as complete and as accurate as possible, in order that I may complete my degree.

I would appreciate your co-operation in completing this questionnaire and returning it to me on or before **December 11 2002** in the enclosed self-addressed envelope. **The majority of the questions can be answered with a 'tick', and it should not take more than 10-15 minutes to complete**. The information given will be treated in the strictest confidence. Each of the respondents shall remain totally anonymous and under no circumstances will the identification of information relating to individual academics or to particular questionnaires be released. This is an independent piece of research

and I am the only person who will be reading your questionnaire. If you have any queries regarding my research, please do not hesitate to contact me.

Thank you very much for helping with this very important study.

Yours sincerely,

Almar M. Barry

Almar M. Barry

Appendix 3.3

Industry Questionnaire
Questionnaire Number 1

Industry-Academic Links in the Republic of Ireland

QUESTIONNAIRE NUMBER 1

TO BE ANSWERED ONLY BY FIRMS THAT HAVE LINKS WITH UNIVERSITIES/ITs IN IRELAND

PLEASE ANSWER SECTIONS A AND B

All information will be treated in strict confidence and not published in any identifiable form.

ENTERPRISE IRELAND

Please return the completed questionnaire in the Business Reply envelope supplied, to Almar M. Barry, Department of Geography, Trinity College Dublin, Business Reply, Dublin 2.

Q.1. Does the firm engage in links with universities/Institutes of Technology (ITs) in the Republic of Ireland (hereafter referred to as Ireland)?

❑ Yes (Please go to question 2 SECTION A page 2)
❑ No (Please go to QUESTIONNAIRE NUMBER 2)

SECTION A

Q.2. Which of the following UNIVERSITIES and/or INSTITUTES OF TECHNOLOGY (ITs) does the firm engage in links with in the Republic of Ireland? *[Please tick the relevant box(es)]*

UNIVERSITIES

❑ Dublin City University
❑ Trinity College Dublin
❑ University College Cork
❑ University College Dublin
❑ University of Limerick
❑ National University of Ireland, Galway
National University of Ireland, Maynooth

INSTITUTES OF TECHNOLOGY (ITs)

❑ Athlone Institute of Technology
❑ Cork Institute of Technology
❑ Dublin Institute of Technology
❑ Dundalk Institute of Technology
❑ Dun Laoghaire Institute of Art, Design and Technology
❑ Galway-Mayo Institute of Technology
❑ Institute of Technology Blanchardstown
❑ Institute of Technology Carlow
❑ Institute of Technology Tallaght
❑ Institute of Technology Tralee
❑ Letterkenny Institute of Technology
❑ Limerick Institute of Technology
❑ Sligo Institute of Technology
❑ Tipperary Rural and Business Development Institute
❑ Waterford Institute of Technology

Q.3. Please indicate the importance to the firm of the following factors in encouraging the firm to establish links with universities/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Gain exposure to current academic research and expertise	1	2	3	4	5
Access to consultancy services	1	2	3	4	5
Access to specialist education and training programmes	1	2	3	4	5
Access to highly skilled graduates for recruitment	1	2	3	4	5
Access to management and marketing skills	1	2	3	4	5
Access to newly emerging technologies	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.4. Does the firm engage in Research and Development (R&D) links with universities/ITs?

❑ Yes ❑ No (If you answered NO, please go to question 5)

If you answered YES, please answer questions (A), (B), (C), (D), (E) and (F):

(A) Please tick the relevant box(es) to indicate the types of R&D links.

❑ Collaborative R&D
❑ Contract R&D
❑ Hold a license for university/IT technology
❑ Hold a license for a product developed by a university/IT
❑ Innovation Partnerships (formerly known as Applied Research Grants Scheme (ARGS))
❑ Research grants and donations to specific departments in universities/ITs
❑ Other (Please specify): _____

(B) Does the firm engage in any of the following R&D links with a university/IT? *[Please tick the relevant box(es)]*

❑ Basic research links (e.g. Creative stage/initial phase of research)
❑ Applied research links (e.g. Prototype development)
❑ Experimental research links (e.g. Adaptation and fine-tuning of products)

(C) Please indicate the importance to the firm of the following factors in motivating decisions to establish R&D links with universities/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Access specialist knowledge and support in industrial R&D	1	2	3	4	5
Increase the competencies/skills of the R&D staff of the firm	1	2	3	4	5
Increase the speed at which the firm produces products	1	2	3	4	5
Produce high-quality products that meet changing market demands	1	2	3	4	5
Secure answers to problems associated with production	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(D) Please indicate the importance to the firm of the following BARRIERS that make it difficult for the firm to establish R&D links with universities/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

R&D is expensive	1	2	3	4	5
R&D completed by universities/ITs is not always relevant	1	2	3	4	5
Universities/ITs are too slow to respond to the R&D demands of industry	1	2	3	4	5
Equipment base and facilities of universities/ITs are insufficient	1	2	3	4	5
R&D links increase risk of breech of confidentiality/risk of disclosures	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(E) What do you consider to be the POSITIVE outcomes of R&D links with universities/ITs for industry in general?

_____
_____
_____

(F) What do you consider to be the NEGATIVE outcomes of R&D links with universities/ITs for industry in general?

_____

_____

_____

Q.5. Does the firm engage in consultancy services provided by universities/ITs?

❑ Yes ❑ No (If you answered NO, please go to question 6)

If you answered YES, please answer questions (A), (B), (C), (D) and (E):

(A) If you answered YES, please tick the relevant box(es) to indicate the types of consultancy links.

❑ Appoint an academic advisor or an academic as a board member
❑ Appoint an academic as a consultant to the firm on a specific project
❑ Consult academic staff in production matters
❑ Consult academic staff over business plans
❑ Technical/laboratory analytical services
❑ Other (Please specify):_____

(B) Please indicate the importance to the firm of the following factors in motivating decisions to establish consultancy links with universities/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Access to appropriate business mentoring and development advice	1	2	3	4	5
Access to complementary research and technical expertise	1	2	3	4	5
Access to specialised knowledge in marketing and management	1	2	3	4	5
Access to university/IT-owned technologies for testing/analysis	1	2	3	4	5
Seek help in developing new and commercially viable business ideas	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(C) Please indicate the importance to the firm of the following BARRIERS that make it difficult for the firm to establish consultancy links with universities/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Consultancy services are too expensive	1	2	3	4	5
Getting in touch with relevant consultants is difficult	1	2	3	4	5
Universities/ITs are slow to respond to the consultancy needs of the firm	1	2	3	4	5
It is time-consuming to build a working relationship with consultants	1	2	3	4	5
Consultants are unaware of the specific and changing needs of industry	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(D) What do you consider to be the POSITIVE outcomes of consultancy links with universities/ITs for industry in general?

_____

_____

_____

(E) What do you consider to be the NEGATIVE outcomes of consultancy links with universities/ITs for industry in general?

_____

_____

_____

Q.6. Does the firm engage in teaching and training links with universities/ITs?

❑ Yes ❑ No (If you answered NO, please go to question 7)

If you answered YES, please answer questions (A), (B), (C), (D) and (E):

(A) If you answered YES, please tick the relevant box(es) to indicate the types of teaching and training links.

❑ Graduate placement programmes
❑ Industry-funded scholarship programmes for postgraduate research
❑ Joint university-industry co-operative scholarship programmes
❑ Sabbatical periods in industry for academics and university/IT researchers
❑ Specialist training of employees of firm
❑ Work experience placement for third-level undergraduate students
❑ Other (Please specify): _____

(B) Please indicate the importance to the firm of the following factors in motivating decisions to establish teaching and training links with universities/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Access to specialist education and training programmes	1	2	3	4	5
Maintain a high level of technical skills in the firm	1	2	3	4	5
Participate in student placement schemes with a university/IT	1	2	3	4	5
Access to high potential students early in the recruitment cycle	1	2	3	4	5
Recruit more experienced scientists and engineers	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(C) Please indicate the importance to the firm of the following BARRIERS that make it difficult for the firm to establish teaching and training links with university/ITs on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Lack of ability to pay university/IT students on work placement	1	2	3	4	5
Curriculum is not relevant to the educational and training needs of industry	1	2	3	4	5
It takes time and resources to train university/IT students in the firm	1	2	3	4	5
Following completion of work placement students return to university/IT	1	2	3	4	5
It is difficult for the firm to release staff to attend university/IT courses	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(D) What do you consider to be the POSITIVE outcomes of teaching and training links with universities/ITs for industry in general?

_____

_____

_____

(E) What do you consider to be the NEGATIVE outcomes of teaching and training links with universities/ITs for industry in general?

_____

_____

_____

Q.7. Are your links with universities/ITs FORMAL LINKS?

(Formal links involve structured agreements between academic and industry partners which are based on collaborative programmes, contracts and services in the areas of research, consultancy and commercialisation of university/IT research).

❑ Yes ❑ No (If you answered NO, please go to question 8)

If you answered YES, please answer question (A):

(A) Please tick the appropriate FORMAL LINKS that the firm has established with universities/ITs in Ireland. *[Please tick the relevant box(es)]*

❑ Collaborative research
❑ Commercialisation services
❑ Contract research
❑ Sponsored research
❑ Technical services/analysis and testing in university department
❑ University consultancy
❑ Other (Please specify): _____

Q.8. Are your links with universities/ITs INFORMAL LINKS?

(Informal links involve unstructured agreements between academic and industry partners, are based on informal personal contact between both partners and occur on an ad *hoc* basis).

❑ Yes ❑ No (If you answered NO, please go to question 9)

If you answered YES, please answer question (A):

(A) Please tick the appropriate INFORMAL LINKS that the firm has established with universities/ITs in Ireland. *[Please tick the relevant box(es)]*

❑ Access to equipment owned by the university/IT
❑ Access to university department research
❑ Attendance at conferences or seminars organised by universities/ITs
❑ Attendance at university/IT workshop/education/training programmes
❑ Informal contact with university academic staff
❑ The firm has provided an employee as a guest lecturer to the university/IT
❑ Other (Please specify): _____

Q.9. Have any of the following been problems that make it difficult for the firm to maintain existing relationships with universities/ITs? *[Please tick the relevant box(es)]*

- ❑ Maintaining links with universities/ITs is expensive
- ❑ Universities/ITs are not aware of the specific needs of industry
- ❑ University/IT institutions are unable to meet the needs of industry on time
- ❑ University/IT technology is not innovative
- ❑ University/IT courses are not focused on the educational needs of industry
- ❑ Universities/ITs do not provide adequate consultancy services
- ❑ Other (Please specify): _____

Q.10. What do you think the universities/ITs should do in order to contribute to the development of more successful relationships between industry and universities/ITs? *[Please tick the relevant box(es)]*

- ❑ Change undergraduate and postgraduate curriculum to meet the needs of industry
- ❑ Create user-friendly databases on the research capabilities of universities/ITs
- ❑ Develop new business support systems for industry in universities/ITs
- ❑ Focus more on developing customer relationships with industry
- ❑ Create and maintain centres of excellence in specific areas of R&D
- ❑ Other (Please specify): _____

Q.11. What do you think ENTERPRISE IRELAND should do to encourage the development of more successful relationships between industry and universities/ITs? *[Please tick the relevant box(es)]*

- ❑ Continue a range of financial support schemes to support the development of links
- ❑ Establish an independent networking agency to create links with universities/ITs
- ❑ Organise meetings to enable industrialists and academics to meet
- ❑ Provide industry with information on the capabilities of universities/ITs
- ❑ Provide universities/ITs with information on the specific requirements of industry
- ❑ Other (Please specify): _____

SECTION B

This section is designed to acquire general information on the activities of the firm

Q.12. How many people are employed in the firm (full-time and part-time)? *(Please tick the relevant box)*

- ❑ 1-9
- ❑ 10-49
- ❑ 50-249
- ❑ 250+

Q.13. In what year was the firm founded? _____

Q.14. The origins of the firm were: *[Please tick the relevant box(es)]*

- ❑ Corporate spin-off
- ❑ New independent start-up firm
- ❑ Spin-out from a university
- ❑ Spin-out from an IT

Q.15. Is the firm: *(Please tick the relevant box)*

- ❑ A campus company in a university/IT
- ❑ A firm owned by a university/IT
- ❑ A Private Limited Company
- ❑ A Public Limited Company (Plc)

Q.16. Is the firm: *(Please tick the relevant box)*

- ❑ A foreign-owned firm
- ❑ An Irish-owned firm

Q.17. Please indicate the importance of the following factors that influenced the choice of location for the firm on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Proximity to markets/customers/suppliers	1	2	3	4	5
Good infrastructure (transport/telecommunications technology)	1	2	3	4	5
Higher regional grant incentives	1	2	3	4	5
Existence of strong subcontracting networks in the region	1	2	3	4	5
Access to good business services and growth opportunities	1	2	3	4	5
Proximity to R&D at a university/IT	1	2	3	4	5
Access to skilled labour force/graduates from a university/IT	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.18. Please answer questions (A) and (B):

(A) How far is the firm from the nearest university?_____
(B) How far is the firm from the nearest IT?_____

Q.19. Do you consider that geographical proximity facilitates the establishment of links between industry and the universities/ITs?

❑ Yes ❑ No

Q.20. Please indicate the appropriate high-tech sector or sectors in which the firm falls. *[Please tick the relevant box(es)]*

- ❑ Digital Media/E-Commerce
- ❑ Electronics and Precision Components
- ❑ Engineering
- ❑ Financial/Healthcare Services
- ❑ Healthcare Pharmaceuticals
- ❑ Information/Communication/Telecommunications Services

Q.21. In what activities does the firm engage? *[Please tick the relevant box(es)]*

- ❑ Distribution
- ❑ Manufacturing
- ❑ Marketing
- ❑ Provision of Services
- ❑ R&D
- ❑ Software Development
- ❑ Other (Please specify): _____

Q.22. Do you consider that your firm engages in high-tech activities?

❑ Yes ❑ No

Q.23. Does the firm engage <u>ONLY</u> in R&D?

❑ Yes ❑ No

Q.24. Does the firm have its own formal R&D department?

❑ Yes ❑ No (If you answered NO, please go to question 25)

If you answered YES, please answer questions (A) and (B):

(A) Which of the following does the firm conduct? *[Please tick the relevant box(es)]*

- ❑ Basic research (e.g. Creative stage/initial phase of research)
- ❑ Applied research (e.g. Prototype development)
- ❑ Experimental research (e.g. Adaptation and fine-tuning of products)
- ❑ Service provision
- ❑ Development of managerial techniques

(B) In what year did the firm start its R&D programme within the firm?

_____

Q.25. Does the firm engage in new product development activities?

❑ Yes ❑ No (If you answered NO, please go to question 26)

(A) If you answered YES, what are the main factors that encourage the firm to engage in new product development activities? *[Please tick the relevant box(es)]*

- ❑ Market/Customers
- ❑ Competitors
- ❑ Suppliers
- ❑ Sources internal to the firm
- ❑ Universities/ITs
- ❑ State-sponsored development agencies
- ❑ Consultants
- ❑ Patent disclosures

Q.26. Has the firm introduced new technologies since the beginning of the year 1999?

❑ Yes ❑ No (If you answered NO, please go to question 27)

If you answered YES, please answer questions (A) and (B):

(A) Could you please indicate the type of new technologies that the firm introduced. *(Please tick the relevant box)*

TYPE

❑ New or improved product
❑ New or improved manufacturing process
❑ New or improved service
❑ New or improved management practice

(B) Please indicate the source of innovations referred to above. *[Please tick the relevant box(es)]*

❑ Developed internally within the firm
❑ Developed in a university
❑ Developed in an IT
❑ Developed jointly by the firm and Third-Level Institute
❑ Licensed from competitors

Q.27. What are the BARRIERS to establishing university-industry links in Ireland? *[Please tick the relevant box(es)]*

❑ Collaboration is problematic due to industry's short-term product development focus versus the university/IT's longer-term research objectives
❑ Cost of research and consultancy links is expensive
❑ Lack of knowledge of the capabilities of universities/ITs
❑ Perception of the university/IT as an 'Ivory Tower' by industry
❑ Equipment base/facilities of universities/ITs are insufficient
❑ Work completed by universties/ITs is not always relevant to Irish industry
❑ Universities/ITs can be too slow to respond to the demands of industry
❑ Other (Please specify): _____

Q.28. What are the STIMULANTS in the universities/ITs that have facilitated the development of university-industry links in Ireland? *[Please tick the relevant box(es)]*

❑ Good working relationships with individual academics
❑ Dynamic academic entrepreneurial climate of universities/ITs
❑ Excellence in academic research
❑ Increased commercialisation of university/IT research
❑ Increased government funding in university/IT research
❑ Rapidly evolving technology incubation facilities in universities/ITs
❑ Support schemes provided by ENTERPRISE IRELAND to encourage collaboration between industry and universities/ITs
❑ Other (Please specify): _____

Q.29. Does the firm have links with universities/Higher Education Institutions (HEIs) located <u>OUTSIDE</u> Ireland?

❑ Yes ❑ No

Thank you for your time, help and assistance in completing this questionnaire.

Yours sincerely,
Almar M. Barry

If you have any queries or require clarification on any points please contact Almar M. Barry, Department of Geography, Trinity College Dublin, Dublin 2. Tel: 01-6082865; Fax: 01-6713397; E-mail: mbarry3@tcd.ie

Please return your completed questionnaire in the Business Reply self-addressed envelope supplied, to:

Almar M. Barry
Department of Geography,
Trinity College Dublin,
Business Reply, Dublin 2

Appendix 3.4

Industry Questionnaire
Questionnaire Number 2

Industry-Academic Links in the Republic of Ireland

QUESTIONNAIRE NUMBER 2

TO BE ANSWERED ONLY BY FIRMS THAT DO NOT HAVE LINKS WITH UNIVERSITIES/ITs IN IRELAND

PLEASE ANSWER SECTIONS A AND B

All information will be treated in strict confidence and not published in any identifiable form.

ENTERPRISE IRELAND

Please return the completed questionnaire in the Business Reply envelope supplied, to Almar M. Barry, Department of Geography, Trinity College Dublin, Business Reply, Dublin 2.

Q.1. Does the firm engage in links with universities/Institutes of Technology (ITs) in the Republic of Ireland (hereafter referred to as Ireland)?

❑ Yes (Please go to QUESTIONNAIRE NUMBER 1)
❑ No (Please go to question 2 SECTION A page 2)

SECTION A

Q.2. Does the firm plan to engage in links with universities/ITs in the future?

❑ Yes ❑ No

Q.3. What factors would encourage the firm to establish links with universities/ITs? Please indicate the importance to the firm of the following factors on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Gain exposure to current academic research and expertise	1	2	3	4	5
Access to consultancy services	1	2	3	4	5
Access to specialist education and training programmes	1	2	3	4	5
Access to highly skilled graduates for recruitment	1	2	3	4	5
Access to management and marketing skills	1	2	3	4	5
Access to newly emerging technologies	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.4. Has the firm engaged in links with university/IT institutions in the last 5 years but no longer engages in links?

❑ Yes ❑ No (If you answered NO, please go to question 5)

(A) If you answered YES, why did the firm stop engaging in links with universities/ITs? *[Please tick the relevant box(es)]*

❑ The project finished
❑ Maintaining links with universities/ITs was too expensive
❑ Universities/ITs were not aware of the specific needs of industry
❑ University/IT institutions were unable to meet the needs of industry on time
❑ Research and development (R&D) completed by the universities/ITs did not meet the needs of the firm
❑ University/IT technology was not innovative
❑ University/IT courses were not focused on the educational needs of industry
❑ Universities/ITs did not provide adequate consultancy services
❑ Other (Please specify): _____

Q.5. What OBSTACLES do you think the firm has or would have in establishing links with universities/ITs? Please tick the relevant obstacles.

❑ Lack of appropriate sources of finance to engage in links with universities/ITs
❑ R&D conducted in the universities/ITs is expensive
❑ Lack of information on the capabilities of the universities/ITs
❑ It is time-consuming to establish links with universities/ITs
❑ Organisational rigidities within the firm make if difficult to establish links with universities/ITs
❑ Other (Please specify): _____

Q.6. What do you think the universities/ITs should do to encourage firms such as yours to establish links with universities/ITs? *[Please tick the relevant box(es)]*

- ❑ Change undergraduate and postgraduate curriculum to meet the needs of industry
- ❑ Create user-friendly databases on the research capabilities of universities/ITs
- ❑ Develop new business support systems for industry in universities/ITs
- ❑ Focus more on developing customer relationships with industry
- ❑ Create and maintain centres of excellence in specific areas of R&D
- ❑ Other (Please specify): _____

Q.7. What do you think ENTERPRISE IRELAND should do to encourage your firm to establish links with universities/ITs? *[Please tick the relevant box(es)]*

- ❑ Continue a range of financial support schemes to support the development of links
- ❑ Establish an independent networking agency to create links with universities/ITs
- ❑ Organise meetings to enable industrialists and academics to meet
- ❑ Provide industry with information on the capabilities of universities/ITs
- ❑ Provide universities/ITs with information on the specific requirements of industry
- ❑ Other (Please specify): _____

Q.8. Why does the firm not engage in links with university/IT institutions?

_____

_____

_____

SECTION B

This section is designed to acquire general information on the activities of the firm

Q.9. How many people are employed in the firm (full-time and part-time)? *(Please tick the relevant box)*

- ❑ 1-9
- ❑ 10-49
- ❑ 50-249
- ❑ 250+

Q.10. In what year was the firm founded?_____

Q.11. The origins of the firm were: *[Please tick the relevant box(es)]*

- ❑ Corporate spin-off
- ❑ New independent start-up firm
- ❑ Spin-out from a university
- ❑ Spin-out from an IT

Q.12. Is the firm: *(Please tick the relevant box)*

- ❑ A campus company in a university/IT
- ❑ A firm owned by a university/IT
- ❑ A Private Limited Company
- ❑ A Public Limited Company (Plc)

Q.13. Is the firm: *(Please tick the relevant box)*

- ❑ A foreign-owned firm
- ❑ An Irish-owned firm

Q.14. Please indicate the importance of the following factors that influenced the choice of location for the firm on the scale of 1 to 5.

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Proximity to markets/customers/suppliers	1	2	3	4	5
Good infrastructure (transport/telecommunications technology)	1	2	3	4	5
Higher regional grant incentives	1	2	3	4	5
Existence of strong subcontracting networks in the region	1	2	3	4	5
Access to good business services and growth opportunities	1	2	3	4	5
Proximity to R&D at a university/IT	1	2	3	4	5
Access to skilled labour force/graduates from a university/IT	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.15. Please answer questions (A) and (B):

(A) How far is the firm from the nearest university?_____
(B) How far is the firm from the nearest IT?_____

Q.16. Do you consider that geographical proximity facilitates the establishment of links between industry and the universities/ITs?

❑ Yes ❑ No

Q.17. Please indicate the appropriate high-tech sector or sectors in which the firm falls. *[Please tick the relevant box(es)]*

- ❑ Digital Media/E-Commerce
- ❑ Electronics and Precision Components
- ❑ Engineering
- ❑ Financial/Healthcare Services
- ❑ Healthcare Pharmaceuticals
- ❑ Information/Communication/Telecommunications Services

Q.18. In what activities does the firm engage? [*Please tick the relevant box(es)]*

- ❑ Distribution
- ❑ Manufacturing
- ❑ Marketing
- ❑ Provision of Services
- ❑ R&D
- ❑ Software Development
- ❑ Other (Please specify): _____

Q.19. Do you consider that your firm engages in high-tech activities?

❑ Yes ❑ No

Q.20. Does the firm engage ONLY in R&D?

❑ Yes ❑ No

Q.21. Does the firm have its own formal R&D department?

❑ Yes ❑ No (If you answered NO, please go to question 22)

If you answered YES, please answer questions (A) and (B):

(A) Which of the following does the firm conduct? *[Please tick the relevant box(es)]*

❑ Basic research (e.g. Creative stage/initial phase of research)
❑ Applied research (e.g. Prototype development)
❑ Experimental research (e.g. Adaptation and fine-tuning of products)
❑ Service provision
❑ Development of managerial techniques

(B) In what year did the firm start its R&D programme within the firm?

_____

Q.22. Does the firm engage in new product development activities?

❑ Yes ❑ No (If you answered NO, please go to question 23)

(A) If you answered YES, what are the main factors that encourage the firm to engage in new product development activities? *[Please tick the relevant box(es)]*

❑ Market/Customers
❑ Competitors
❑ Suppliers
❑ Sources internal to the firm
❑ Universities/IT
❑ State-sponsored development agencies
❑ Consultants
❑ Patent disclosures

Q.23. Has the firm introduced new technologies since the beginning of the year 1999?

❑ Yes ❑ No (If you answered NO, please go to question 24)

If you answered YES, please answer questions (A) and (B):

(A) Could you please indicate the type of new technologies that the firm introduced. *(Please tick the relevant box)*

TYPE

❑ New or improved product
❑ New or improved manufacturing process
❑ New or improved service
❑ New or improved management practice

(B) Please indicate the source of innovations referred to above. *[Please tick the relevant box(es)]*

- ❑ Developed internally within the firm
- ❑ Developed in a university
- ❑ Developed in an IT
- ❑ Developed jointly by the firm and Third-Level Institute
- ❑ Licensed from competitors

Q.24. What are the BARRIERS to establishing university-industry links in Ireland? *[Please tick the relevant box(es)]*

- ❑ Collaboration is problematic due to industry's short-term product development focus versus the university/IT's longer-term research objectives
- ❑ Cost of research and consultancy links is expensive
- ❑ Lack of knowledge of the capabilities of universities/ITs
- ❑ Perception of the university/IT as an 'Ivory Tower' by industry
- ❑ Equipment base/facilities of universities/ITs are insufficient
- ❑ Work completed by universties/ITs is not always relevant to Irish industry
- ❑ Universities/ITs can be too slow to respond to the demands of industry
- ❑ Other (Please specify): _____

Q.25. What are the STIMULANTS in the universities/ITs that have facilitated the development of university-industry links in Ireland? *[Please tick the relevant box(es)]*

- ❑ Good working relationships with individual academics
- ❑ Dynamic academic entrepreneurial climate of universities/ITs
- ❑ Excellence in academic research
- ❑ Increased commercialisation of university/IT research
- ❑ Increased government funding in university/IT research
- ❑ Rapidly evolving technology incubation facilities in universities/ITs
- ❑ Support schemes provided by ENTERPRISE IRELAND to encourage collaboration between industry and universities/ITs
- ❑ Other (Please specify): _____

Q.26. Does the firm have links with universities/Higher Education Institutions (HEIs) located <u>OUTSIDE</u> Ireland?

❑ Yes ❑ No

Thank you for your time, help and assistance in completing this questionnaire.

Yours sincerely,
Almar M. Barry

If you have any queries or require clarification on any points please contact Almar M. Barry, Department of Geography, Trinity College Dublin, Dublin 2. Tel: 01-6082865; Fax: 01-6713397; E-mail: mbarry3@tcd.ie

Please return your completed questionnaire in the Business Reply self-addressed envelope supplied, to:

Almar M. Barry
Department of Geography,
Trinity College Dublin,
Business Reply, Dublin 2

Appendix 3.5

Academic Questionnaire
Questionnaire Number 1

Academic-Industry Links in the Republic of Ireland

QUESTIONNAIRE NUMBER 1

TO BE ANSWERED ONLY BY ACADEMICS WHO HAVE LINKS WITH INDUSTRY IN IRELAND

PLEASE ANSWER SECTIONS A AND B

All information will be treated in strict confidence and not published in any identifiable form.

ENTERPRISE IRELAND

Please return the completed questionnaire in the Business Reply envelope supplied, to Almar M. Barry, Department of Geography, Trinity College Dublin, Business Reply, Dublin 2.

Q.1. As an academic do you have links with industry in the Republic of Ireland (hereafter referred to as Ireland)?

- ❑ Yes (Please go to Section A question 2 below)
- ❑ No (Please go to QUESTIONNAIRE NUMBER 2)

SECTION A

Q.2. In which of the following UNIVERSITIES or INSTITUTES OF TECHNOLOGY(ITs) are you currently employed? *(Please tick the relevant box)*

UNIVERSITIES

- ❑ Dublin City University
- ❑ Trinity College Dublin
- ❑ University College Cork
- ❑ University College Dublin
- ❑ University of Limerick
- ❑ National University of Ireland, Galway
- National University of Ireland, Maynooth

INSTITUTES OF TECHNOLOGY (ITs)

- ❑ Athlone Institute of Technology
- ❑ Cork Institute of Technology
- ❑ Dublin Institute of Technology
- ❑ Dundalk Institute of Technology
- ❑ Dun Laoghaire Institute of Art, Design and Technology
- ❑ Galway-Mayo Institute of Technology
- ❑ Institute of Technology Blanchardstown
- ❑ Institute of Technology Carlow
- ❑ Institute of Technology Tallaght
- ❑ Institute of Technology Tralee
- ❑ Letterkenny Institute of Technology
- ❑ Limerick Institute of Technology
- ❑ Sligo Institute of Technology
- ❑ Tipperary Rural and Business Development Institute
- ❑ Waterford Institute of Technology

Q.3. Please indicate what you consider to be the level of importance to the university/IT of the following factors in encouraging a university/IT to establish links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Increases the prestige associated with the college	1	2	3	4	5
Contributes to the diffusion of knowledge	1	2	3	4	5
Facilitates exposure to industrial environments	1	2	3	4	5
Enhances local/regional/national economic development	1	2	3	4	5
Creates employment for graduates of the college	1	2	3	4	5
Provides additional source of income for the college	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.4. Do you conduct Research and Development (R&D) with industry?

❑ Yes ❑ No *(If you answered NO, please go to question 5)*

If you answered YES, please answer questions (A), (B), (C) and (D):

(A) Please tick the relevant box(es) to indicate the types of R&D links.

❑ Collaborative R&D
❑ Contract R&D
❑ Provide a license to industry for university/IT technology
❑ Provide a license to industry for a product developed by the university/IT
❑ Innovation Partnerships [formerly known as Applied Research Grants Scheme (ARGS)]
❑ Receive research grants and donations from industry
❑ Other (Please specify):_____

(B) Do you engage in any of the following R&D links with industry? *[Please tick the relevant box(es)]*

❑ Basic research links (e.g. Creative stage/initial phase of research)
❑ Applied research links (e.g. Prototype development)
❑ Experimental research links (e.g. Adaptation and fine-tuning of products)

(C) Please indicate as an academic the importance of the following factors in motivating your decision to establish R&D links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

To find an exploitation outlet for research capabilities	1	2	3	4	5
To access industrial funding for research	1	2	3	4	5
To find complementary expertise in industry	1	2	3	4	5
To access state-of-the-art equipment and facilities	1	2	3	4	5
Provides additional source of income for the college	1	2	3	4	5
Provides additional source of income for me	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(D) Please indicate as an academic the importance of the following BARRIERS that make it difficult for you to establish R&D links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

The work needed by industry is not always interesting/relevant to us	1	2	3	4	5
Equipment base/facilities are insufficient to meet needs of industry	1	2	3	4	5
Working with/for industry leads to delay of publications	1	2	3	4	5
Working with/for industry has little influence on academic promotions	1	2	3	4	5
Industry links have little influence on institutional base-line funding	1	2	3	4	5
College workload takes up much of your time	1	2	3	4	5
Little interest shown by industry	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.5. Do you provide consultancy services for industry?

❑ Yes ❑ No *(If you answered NO, please go to question 6)*

If you answered YES, please answer questions (A), (B) and (C):

(A) If you answered YES, please tick the relevant box(es) to indicate the types of consultancy links.

❑ I am a board member on a firm located outside the college campus
❑ I am a board member on a firm located on the college campus
❑ I am an academic consultant to industry on specific projects
❑ I am an academic consultant to industry in relation to production matters
❑ I am an academic consultant to industry in relation to business planning
❑ I provide industry with technical/laboratory analytical services
❑ Other (Please specify): _____

(B) Please indicate as an academic the importance of the following factors in motivating your decision to establish consultancy links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Consultancy often leads to research and training partnerships	1	2	3	4	5
Increase in personal income	1	2	3	4	5
Increase in academic expertise in a broad spectrum of research areas	1	2	3	4	5
Improves college's knowledge of industry and commercial reality	1	2	3	4	5
Provides additional source of income for the college	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(C) Please indicate as an academic the importance of the following BARRIERS that make it difficult for you to establish consultancy links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Lack of time due to heavy teaching/admin/research commitments	1	2	3	4	5
The rate of tax you pay on earnings from consultancy is too high	1	2	3	4	5
Industry's needs are often basic with little need for scholarly research	1	2	3	4	5
Consultancy activities have little influence on academic promotions	1	2	3	4	5
No incentives in college for academics to engage in consultancy	1	2	3	4	5
Do not like consultancy/have little interest in consultancy	1	2	3	4	5
Little interest shown by industry	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.6. Do you engage in teaching and training links with industry?

❑ Yes ❑ No *(If you answered NO, please go to question 7)*

If you answered YES, please answer questions (A), (B) and (C):

(A) If you answered YES, please tick the relevant box(es) to indicate the types of teaching and training links.

❑ Graduate placement programmes
❑ Industry-funded scholarship programmes for postgraduate research
❑ Joint university-industry co-operative scholarship programmes
❑ Sabbatical periods in industry for academics and university/IT researchers
❑ Specialist training of employees of firm
❑ Work experience placement for third-level undergraduate students
❑ Other (Please specify): _____

(B) Please indicate as an academic the importance of the following factors in motivating your decision to establish teaching and training links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Provides college with the knowledge of skills required by industry	1	2	3	4	5
Diversifies the college's teaching and training capabilities	1	2	3	4	5
Facilitates the transfer of human resources from college to industry	1	2	3	4	5
Creates additional employment of teaching staff in the college	1	2	3	4	5
Provides additional source of income for the college	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

(C) Please indicate as an academic the importance of the following BARRIERS that make it difficult for you to establish teaching and training links with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Teaching workload in college is already too heavy	1	2	3	4	5
Teaching and training needs of industry are short-term	1	2	3	4	5
Lack of resources in college to develop industry-relevant courses	1	2	3	4	5
Attitudes/age profile of staff contribute to a lack of interest	1	2	3	4	5
Mismatch between what college can provide and industry's needs	1	2	3	4	5
Little interest shown by industry	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.7. Are your links with industry FORMAL LINKS?

(Formal links involve structured agreements between academic and industry partners which are based on collaborative programmes, contracts and services in the areas of research, consultancy and commercialisation of university/IT research).

❑ Yes ❑ No *(If you answered NO, please go to question 8)*

If you answered YES, please answer question (A):

(A) Please tick the appropriate FORMAL LINKS.

❑ Collaborative research
❑ Commercialisation of research
❑ Contract research
❑ Sponsored research
❑ Technical services/analysis and testing in university department
❑ University/IT consultancy
❑ Other (Please specify): _____

Q.8. Are your links with industry INFORMAL LINKS?

(Informal links involve unstructured agreements between academic and industry partners, are based on informal personal contact between both partners and occur on an *ad hoc* basis).

❑ Yes ❑ No *(If you answered NO, please go to question 9)*

If you answered YES, please answer question (A):

(A) Please tick the appropriate INFORMAL LINKS.

❑ Access to equipment owned by industry
❑ Access to R&D completed by a firm
❑ Attendance at conferences or seminars organised by industry
❑ Attendance at workshops/education/training programmes organised by industry
❑ Informal contact with industry personnel
❑ Provide guest lectures and seminars to firms
❑ Other (Please specify): _____

Q.9. Overall, in your opinion, how would you rate the positive outcomes for your college of the links that you have established with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Enhanced the expertise of the college in research, teaching and consultancy	1	2	3	4	5
Created a culture of academic entrepreneurship on the college campus	1	2	3	4	5
Increased the prestige associated with the college	1	2	3	4	5
Contributed to the diffusion of knowledge	1	2	3	4	5
Facilitated exposure to industrial environments	1	2	3	4	5
Enhanced local/regional/national economic development	1	2	3	4	5
Created employment for graduates of the college	1	2	3	4	5
Provided additional source of income for the college	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.10. Overall, in your opinion, how would you rate the negative outcomes for your college of the links that you have established with industry on a scale of 1 to 5?

(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

University/IT has become too dependent on industry for funding	1	2	3	4	5
Links with industry create internal conflicts of interest in college	1	2	3	4	5
Perception that industry is driving the agendas of the college	1	2	3	4	5
Industry's confidentiality needs conflict with academic's need to publish	1	2	3	4	5
Leads to disagreements concerning intellectual property rights	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.11. Have any of the following been problems that make it difficult for you as an academic to maintain existing relationships with industry? *[Please tick the relevant box(es)]*

- ❑ Industry is not aware of the specific capabilities of the university/IT sector
- ❑ Lack of communication between academic and industry partners
- ❑ Lack of participation by firms in early stages of project design
- ❑ Unrealistic requirements of industry
- ❑ Excess of college bureaucracy adds to workload of maintaining links
- ❑ Perceptions of cultural differences between academia and industry
- ❑ Other (Please specify): _____

Q.12. What do you think the universities/ITs should do to encourage the development of more successful relationships between universities/ITs and industry? *[Please tick the relevant box(es)]*

- ❑ Change undergraduate and postgraduate curricula to meet the needs of industry
- ❑ Create user-friendly databases on the research capabilities of universities/ITs
- ❑ Develop new business support systems for industry in universities/ITs
- ❑ Focus more on developing customer relationships with industry
- ❑ Create and maintain centres of excellence in specific areas of R&D
- ❑ Other (Please specify): _____

Q.13. What additional measures do you think the state-sponsored development agency ENTERPRISE IRELAND should do to encourage the development of more successful relationships between universities/ITs and industry? *[Please tick the relevant box(es)]*

- ❑ Continue a range of financial support schemes to support the development of links
- ❑ Establish an independent networking agency to create links with universities/ITs
- ❑ Organise meetings to enable industrialists and academics to meet
- ❑ Provide industry with information on the capabilities of universities/ITs
- ❑ Provide universities/ITs with information on the specific requirements of industry
- ❑ Other (Please specify): _____

Q.14. What are the BARRIERS to establishing university-industry links in the Republic of Ireland? *[Please tick the relevant box(es)]*

- ❑ Collaboration is problematic due to industry's short-term product development focus versus the university/ITs longer-term research objectives
- ❑ There is an inadequate culture of entrepreneurship in universities/ITs
- ❑ Industry's lack of knowledge on the capabilities of universities/ITs
- ❑ Perception of the university/IT as an 'Ivory Tower' by industry
- ❑ Equipment base/facilities of universities/ITs are insufficient
- ❑ Work completed by universties/ITs is not always relevant
- ❑ Universities/ITs are too slow to respond to the demands of industry
- ❑ Other (Please specify): _____

Q.15. What are the STIMULANTS in the universities/ITs that have facilitated the development of university-industry links in Ireland? *[Please tick the relevant box(es)]*

- ❑ Collaboration with individual academics
- ❑ Dynamic academic entrepreneurial climate of universities/ITs
- ❑ Excellence in academic research
- ❑ Increased commercialisation of university/IT research
- ❑ Increased government funding in university/IT research
- ❑ Rapidly evolving technology incubation facilities in universities/ITs
- ❑ Support schemes to encourage collaboration with universities/ITs
- ❑ Other (Please specify): _____

Q.16. Do you have links with industry located <u>OUTSIDE</u> Ireland?

❑ Yes ❑ No

SECTION B
This section is designed to acquire general information

Q.17. Which of the following categories describes the department where you currently work? *(Please tick the relevant box)*

- ❑ Chemical and Physical Sciences
- ❑ Engineering
- ❑ Health and Life Sciences
- ❑ Information Technology
- ❑ Other (Please specify): _____

Q.18. Which of the following categories describes your current post? *(Please tick the relevant box)*

- ❑ Research assistant/research fellow
- ❑ Postdoctoral researcher
- ❑ Lecturer
- ❑ Senior lecturer
- ❑ Professor
- ❑ Other (Please specify): _____

Q.19. Is your post:

- ❑ Permanent
- ❑ Temporary

Q.20. Please indicate the highest level of education that you have completed to date? *(Please tick the relevant box)*

- ❑ Doctorate (Ph.D.; D.Phil.)
- ❑ Masters Degree (M.Phil.; MSc.)
- ❑ Postgraduate Certificate or Diploma (Dip. in Stats.; H.Dip. in Ed.)
- ❑ Both a degree and a professional qualification
- ❑ Professional qualification
- ❑ Primary Degree (B.A.; BSc.)
- ❑ Other (Please specify): _____

Q.21. How many years have you been employed in the university/institute?

Number of Years:_____

(A) Please indicate whether you are employed full-time or part-time. *(Please tick the relevant box)*

- ❑ Full-time
- ❑ Part-time

Q.22. Have you previously been employed in a full-time capacity outside of the third-level educational sector?

❑ Yes ❑ No *(If you answered NO, please go to question 23)*

(A) If you answered YES, please tick the appropriate sector in which you previously worked.

❑ Agriculture
❑ Manufacturing
❑ Service Sector
❑ Public Sector (NOT university/institute of technology)
❑ Other (Please specify): _____

Q.23. Please indicate your gender. *(Please tick the relevant box)*

❑ Male
❑ Female

Q.24. Please specify your age group. *(Please tick the relevant box)*

❑ ≤25
❑ 26-35
❑ 36-45
❑ 46-55
❑ 56-65
❑ 66+

Q.25. Which of the following is your main work activity? *[Please tick the relevant box(es)]*

❑ Research
❑ Teaching
❑ Administration
❑ Consultancy
❑ Other (Please specify): _____

Thank you for taking the time to complete this questionnaire.

Yours sincerely,
Almar M. Barry

If you have any queries or require clarification on any points please contact Almar M. Barry, Department of Geography, Trinity College Dublin, Dublin 2. Tel: 01-6082865; Fax: 01-6713397; E-mail: mbarry3@tcd.ie

Please return your completed questionnaire in the self-addressed envelope supplied, to:

Almar M. Barry
Department of Geography,
Trinity College Dublin,
Dublin 2

Appendix 3.6

Academic Questionnaire
Questionnaire Number 2

Academic-Industry Links in the Republic of Ireland

QUESTIONNAIRE NUMBER 2

TO BE ANSWERED ONLY BY ACADEMICS WHO DO NOT HAVE LINKS WITH INDUSTRY IN IRELAND

PLEASE ANSWER SECTIONS A AND B

All information will be treated in strict confidence and not published in any identifiable form.

ENTERPRISE IRELAND

Please return the completed questionnaire in the Business Reply envelope supplied, to Almar M. Barry, Department of Geography, Trinity College Dublin, Business Reply, Dublin 2.

Q.1. Do you engage in links with industry in the Republic of Ireland (hereafter referred to as Ireland)?

❑ Yes (Please go to QUESTIONNAIRE NUMBER 1)
❑ No (Please go to SECTION A question 2 below)

SECTION A

Q.2. Do you plan to engage in links with industry in the future?

❑ Yes ❑ No

Q.3. Please indicate what you consider to be the level of importance to the university/IT of the following factors in encouraging a university/Institute of Technology (IT) to establish links with industry on a scale of 1 to 5?
(1) very important factor; (2) important factor; (3) moderate factor; (4) minor factor; (5) not a factor

Increases the prestige associated with the college	1	2	3	4	5
Contributes to the diffusion of knowledge	1	2	3	4	5
Facilitates exposure to industrial environments	1	2	3	4	5
Enhances local/regional/national economic development	1	2	3	4	5
Creates employment for graduates of the college	1	2	3	4	5
Provides additional source of income for the college	1	2	3	4	5
Other (Please specify):	1	2	3	4	5

Q.4. Have you engaged in links with industry in the last 5 years but no longer do so?

❑ Yes ❑ No (If you answered NO, please go to question 5)

(A) If you answered YES, why did you stop engaging in links with industry?
[Please tick the relevant box(es)]

❑ The project finished
❑ Maintaining links with industry was too time consuming
❑ Lack of communication between academic and industry partners
❑ Lack of participation by firms in early stages of project design
❑ Unrealistic requirements of industry
❑ Excess of college bureaucracy adds to workload of maintaining links
❑ Perceptions of cultural differences between academia and industry
❑ Other (Please specify): _____

Q.5. What OBSTACLES do you think exist that would make it difficult for you to establish links with industry? Please tick the relevant obstacles.

❑ Lack of appropriate sources of support in college to engage in links with industry
❑ Perception in college that industry may drive the agendas of college
❑ No incentives in college for an academic to engage in links with industry
❑ Lack of information on the needs of industry
❑ It is time-consuming to establish links with industry
❑ Industry's confidentiality needs conflict with academia's need to publish
❑ Organisational rigidities within college make it difficult to establish links with industry
❑ Other (Please specify): _____

Q.6. What do you think the universities/ITs should do to encourage academics such as yourself to establish links with industry? *[Please tick the relevant box(es)]*

- ❑ Change undergraduate and postgraduate curricula to meet the needs of industry
- ❑ Create user-friendly databases on the research capabilities of universities/ITs
- ❑ Develop new business support systems for industry in universities/ITs
- ❑ Focus more on developing customer relationships with industry
- ❑ Create and maintain centres of excellence in specific areas of R&D
- ❑ Other (Please specify): _____

Q.7. What additional measures do you think the state-sponsored development agency ENTERPRISE IRELAND should do to encourage academics such as yourself to establish links with industry? *[Please tick the relevant box(es)]*

- ❑ Continue a range of financial support schemes to support the development of links
- ❑ Establish an independent networking agency to create links with universities/ITs
- ❑ Organise meetings to enable industrialists and academics to meet
- ❑ Provide industry with information on the capabilities of universities/ITs
- ❑ Provide universities/ITs with information on the specific requirements of industry
- ❑ Other (Please specify): _____

Q.8. Why do you not engage in links with industry? *[Please tick the relevant box(es)]*

- ❑ I have little interest in establishing links with industry
- ❑ The work needed by industry is not always interesting/relevant to me
- ❑ Working with/for industry leads to delay of publications
- ❑ Working with/for industry has little influence on academic promotions
- ❑ Links with industry have little influence on institutional base-line funding
- ❑ College workload takes up much of my time
- ❑ Industry's needs are often basic with no need for scholarly research
- ❑ Little interest shown by industry in my research
- ❑ The rate of tax you pay on earnings from links with industry is too high
- ❑ Other (Please specify): _____

SECTION B
This section is designed to acquire general information

Q.9. Which of the following categories describes the department where you currently work? *(Please tick the relevant box)*

- ❑ Chemical and Physical Sciences
- ❑ Engineering
- ❑ Health and Life Sciences
- ❑ Information Technology
- ❑ Other (Please specify): _____

Q.10. Which of the following categories describes your current post? *(Please tick the relevant box)*

- ❑ Research assistant/research fellow
- ❑ Postdoctoral researcher
- ❑ Lecturer
- ❑ Senior lecturer
- ❑ Professor
- ❑ Other (Please specify): _____

Q.11. Is your post:

- ❑ Permanent
- ❑ Temporary

Q.12. Please indicate the highest level of education that you have completed to date? *(Please tick the relevant box)*

- ❑ Doctorate (Ph.D.; D.Phil.)
- ❑ Masters Degree (M.Phil.; MSc.)
- ❑ Postgraduate Certificate or Diploma (Dip. in Stats.; H.Dip. in Ed.)
- ❑ Both a degree and a professional qualification
- ❑ Professional qualification
- ❑ Primary Degree (B.A.; BSc.)
- ❑ Other (Please specify): _____

Q.13. How many years have you been employed in the university/institute?

Number of Years:_____

(A) Please indicate whether you are employed full-time or part-time. *(Please tick the relevant box)*

- ❑ Full-time
- ❑ Part-time

Q.14. Have you previously been employed in a full-time capacity outside of the third-level educational sector?

❑ Yes ❑ No *(If you answered NO, please go to question 15)*

(A) If you answered YES, please tick the appropriate sector in which you previously worked.

- ❑ Agriculture
- ❑ Manufacturing
- ❑ Service Sector
- ❑ Public Sector (NOT university/institute of technology)
- ❑ Other (Please specify): _____

Q.15. Please indicate your gender. *(Please tick the relevant box)*

- ❑ Male
- ❑ Female

Q.16. Please specify your age group. *(Please tick the relevant box)*

- ❑ ≤25
- ❑ 26-35
- ❑ 36-45
- ❑ 46-55
- ❑ 56-65
- ❑ 66+

Q.17. Which of the following is your main work activity? *[Please tick the relevant box(es)]*

- ❑ Research
- ❑ Teaching
- ❑ Administration
- ❑ Consultancy
- ❑ Other (Please specify): _____

Thank you for taking the time to complete this questionnaire.

Yours sincerely,
Almar M. Barry

If you have any queries or require clarification on any points please contact Almar M. Barry, Department of Geography, Trinity College Dublin, Dublin 2. Tel: 01-6082865; Fax: 01-6713397; E-mail: mbarry3@tcd.ie

Please return your completed questionnaire in the self-addressed envelope supplied, to:

Almar M. Barry
Department of Geography,
Trinity College Dublin,
Dublin 2

Some of the questions in this questionnaire were adapted from Questionnaire Number 1 of PREST (1998).

Appendix 3.7

OECD Classification of High Technology Sectors

Technology Level	Frascati Sectors
High	Aerospace
	Computers, office machinery
	Electronics-communications
	Pharmaceuticals
Medium High	Scientific instruments
	Electrical machinery
	Motor vehicles
	Chemicals
	Non-electrical machinery
Medium Low	Shipbuilding
	Rubber and plastic products
	Other transport equipment
	Stone, clay and glass
	Non-ferrous metals
	Other manufacturing
	Fabricated metal products
Low	Petroleum refining
	Ferrous metals
	Paper and printing
	Textiles and clothing
	Wood and furniture
	Food, beverages

Source: OECD (1995a)

Appendix 3.8

EI Classification of High Technology Sectors

Sector
Digital Media/E-Commerce
Electronics and Precision Components
Engineering
Financial/Healthcare Services
Healthcare Pharmaceuticals
Information/Communication/Telecommunications Services

Source: EI, Dublin, June (2001)

Appendix 3.9

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

25-10-2001

[Name of Research Director,
Address of Firm]

Dear [Name of Research Director],

A few days from now you will receive in the post a request to complete a brief questionnaire for an important research project being conducted by *Enterprise Ireland* in conjunction with *Trinity College Dublin*.

The project focuses on the links between industry and universities/Institutes of Technology in the Republic of Ireland (hereafter referred to as Ireland).

I am writing to you in advance as many people like to know ahead of time that they will be contacted. The study is an important one that will help the Irish Government to develop initiatives that will create and develop links between industry and universities/Institutes of Technology in Ireland. In particular, the study will enable the government and third-level educational institutions in Ireland to understand how the universities/Institutes of Technology can meet the needs of industry.

Thank you for your time and consideration. It is only with the help of people like you that a study like this can be successful.

Yours sincerely,

Almar M. Barry
Almar M. Barry

Appendix 3.10

Ms. Vanessa Barcroft,
Policy and Planning Department,
Enterprise Ireland,
Glasnevin,
Dublin 9.
Tel: (01) 8082000
Fax: (01) 8082020
E-mail: vanessa.barcroft@enterprise-ireland.com

1-11-2001

Dear Client,

Ms. Almar M. Barry was awarded *The Enterprise Ireland Millennium Scholarship Award* in August 2000. She is presently undertaking a Ph.D. research project that analyses whether or not firms have established links with the universities/institutes of technology in Ireland. The research is being carried out under the supervision of Professor Desmond A. Gillmor, Department of Geography, TCD.

In order for Ms. Barry to examine the links between universities and/or Institutes of Technology it is essential that she should receive high quality information from all Enterprise Ireland-assisted firms. We would, therefore, greatly appreciate your co-operation in completing the enclosed questionnaire.

Thanking you in advance,

Yours sincerely,

Vanessa Barcroft

Vanessa Barcroft

Ms. Vanessa Barcroft

Appendix 3.11

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

[Name of Research Director,
Address of Firm]

1-11-2001

Dear Sir/Madam,

I am writing to ask for your help in a study that investigates the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland). The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography*, *Trinity College Dublin* for a Ph.D. thesis. Details of this research are attached in a letter from *Enterprise Ireland.*

This research is being carried out at a time when indigenous industry in Ireland is experiencing increased international competition. The focus of this research is to highlight the educational and research needs of industry. The research will also focus on how the university sector can improve in terms of responding to the specific needs of industry.

The results of this research will be used to help the Irish Government develop university-industry links that will enhance the competitiveness of the indigenous high-tech sector in local and global markets. The final results of the study will be published by *Enterprise Ireland* following completion of this research.

In order to collect high quality information that is reliable I am totally dependent upon your co-operation and understanding. Enclosed you will find two questionnaires.

- **If your firm engages in links with universities/Institutes of Technology in Ireland, you should fill in QUESTIONNAIRE NUMBER 1 (BLUE IN COLOUR).**
- **If your firm does not engage in links with universities/Institutes of Technology in Ireland, you should fill in QUESTIONNAIRE NUMBER 2 (YELLOW IN COLOUR).**

This questionnaire should be completed by the research director of your firm or by personnel with experience/knowledge of the corporate/R&D activities of the firm. Only one questionnaire should be completed, and the questionnaire is not as long as it may initially seem. I appreciate very much your effort to make this survey as complete and as accurate as possible.

I would appreciate your co-operation in completing this questionnaire and returning it to me on or before **November 16 2001**. No stamp is required on the enclosed self-addressed envelope. **The majority of the questions can be answered with a 'tick', and it should not**

take more than 10-15 minutes to complete. The information given will be treated in the strictest confidence. Each of the firms shall remain totally anonymous and under no circumstances will the identification of information relating to individual firms or to particular questionnaires be released. This is an independent piece of research and I am the only person who will be reading your questionnaire. Each of the firms that participate will receive a report of the findings. If you have any queries regarding my research, please do not hesitate to contact me.

Thank you very much for helping with this very important study.

Yours sincerely,

Almar M. Barry

Almar M. Barry

DEFINITIONS

Definition 1: For the purposes of the study, the Frascati Manual definition of 'Research and Development' (R&D) is used. "Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. R&D is a term covering three activities: basic research, applied research and experimental development" (OECD, 1994, 7). R&D refers to efforts toward new knowledge, including the invention, design and development of processes and prototypes of products and services. R&D excludes: quality control, routine product testing, market research, sales promotions, sales service, research in the social sciences and psychology, and other non-technical activities or services.

Definition 2: ***Basic research (including strategic research)*** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Definition 3: ***Applied research*** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Definition 4: ***Experimental development*** is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

Definition 5: For the purposes of the study, an 'invention' is the creation of a new idea. An invention may or may not be patentable. A patent may or may not result in a saleable product or service or process. An 'innovation' is the introduction into the marketplace of the results of a new idea in products, services, processes or management.

Definition 6: For the purposes of the study, 'new technologies' enhance both product and process innovation. Product technologies refer to *what* is produced while process technologies are concerned with *how* a product is manufactured.

Definition 7: For the purposes of the study, High Potential Start-Ups (HPSUs) are companies which are starting in a growth product market, are based on technological innovation and are founded and promoted by experienced managers, entrepreneurs, academics or technical graduates. HPSUs should have the potential to grow to have annual sales of €1.6 million (£1.3 million) or more and employ up to 10 people, within two years of starting operations. HPSUs are in the formative phase of development and having achieved significant growth, export potential and wealth generation, evolve into Small and Medium Enterprises (SMEs).

Definition 8: For the purposes of the study, 'SME' refers to Small and Medium-sized Enterprise.

Definition 9: For the purposes of the study, 'HEI' refers to Higher Education Institution.

Definition 10: For the purposes of the study, 'IT' refers to Institute of Technology.

Definition 11: For the purposes of the study, 'ILO' refers to Industrial Liaison Office(r). In the Republic of Ireland, each university and IT has an Industrial Liaison Officer who has the responsibility to create and develop links between the HEI and industry.

Reference:

Organisation for Economic Co-operation and Development (1994) *The Proposed Standard Practice for Surveys of Research and Experimental Development: Frascati Manual 1993*. Paris, OECD.

Appendix 3.12

City and County Enterprise Boards

Carlow Enterprise Board
Cavan Enterprise Board
Clare County Enterprise Board
Cork City Enterprise Board
Cork North Enterprise Board
Donegal County Enterprise Board
Dublin City Enterprise Board
Dublin South County Enterprise Board
Dun Laoghaire-Rathdown County Enterprise Board
Fingal County Enterprise Board
Galway City and County Enterprise Board
Kerry County Enterprise Board
Kildare County Enterprise Board
Kilkenny County Enterprise Board
Laois County Enterprise Board
Leitrim County Enterprise Board
Limerick City Enterprise Board
Limerick County Enterprise Board
Longford County Enterprise Board
Louth County Enterprise Board
Mayo County Enterprise Board
Meath County Enterprise Board
Monaghan County Enterprise Board
Offaly County Enterprise Board
Roscommon County Enterprise Board
Sligo County Enterprise Board
South Cork County Enterprise Board
Tipperary North Riding Enterprise Board
Tipperary South Riding Enterprise Board
Waterford City Enterprise Board
Waterford County Enterprise Board
West Cork County Enterprise Board
Westmeath County Enterprise Board
Wexford County Enterprise Board
Wicklow County Enterprise Board

Source: Dublin City Enterprise Board, June (2001)

Appendix 3.13

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

[Address of CEB]

1-8-2001

Dear Sir/Madam,

I am writing to ask for your help in a nationwide survey of indigenous high-tech firms that investigates the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland). The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography*, *Trinity College Dublin* for a Ph.D. thesis.

This research is being carried out at a time when indigenous industry in Ireland is experiencing increased international competition. The focus of this research is to highlight the educational and research needs of industry. The research will also focus on how the university sector can improve in terms of responding to the specific needs of industry.

The results of this research will be used to help the Irish Government develop university-industry links that will enhance the competitiveness of the indigenous high-tech sector in local and global markets. The final results of the study will be published by *Enterprise Ireland* following completion of this research.

In order to collect high quality information on the indigenous sector, it is important that all Irish-owned firms are included in the survey. Enterprise Ireland and Shannon Development have already provided lists of the names and addresses of client companies. As the firms that come under the remit of the County Enterprise Boards comprise a critical component of the indigenous sector in Ireland, I would be most grateful if you could at your convenience provide me with a list of the names and addresses of your client companies. Should you have any questions, please do not hesitate to get in contact with me.

Thank you for your time and consideration. It is only with the help of people like you that a study like this can be successful.

Yours sincerely,

Almar M. Barry
Almar M. Barry

Appendix 3.14

Ms. Vanessa Barcroft,
Policy and Planning Department,
Enterprise Ireland,
Glasnevin,
Dublin 9.
Tel: (01) 8082000
Fax: (01) 8082020
E-mail: vanessa.barcroft@enterprise-ireland.com

18-2-2002

Dear Client,

Ms. Almar M. Barry was awarded *The Enterprise Ireland Millennium Scholarship Award* in August 2000. She is presently undertaking a Ph.D. research project that analyses whether or not firms have established links with the universities/institutes of technology in Ireland. The research is being carried out under the supervision of Professor Desmond A. Gillmor, Department of Geography, TCD.

In order for Ms. Barry to examine the links between universities and/or Institutes of Technology it is essential that she should receive high quality information from all Enterprise Ireland-assisted firms. We would, therefore, greatly appreciate your co-operation in completing the enclosed questionnaire.

Thanking you in advance,

Yours sincerely,

Vanessa Barcroft

Vanessa Barcroft
Ms. Vanessa Barcroft

Appendix 3.15

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

18-2-2002

Dear Sir/Madam,

I am writing to ask for your help in a study that investigates the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland). The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography*, *Trinity College Dublin* for a Ph.D. degree. Details of this research are attached in a letter from the *Manager of the National Technological Park,* Mr. Eugene Brennan.

This research is being carried out at a time when indigenous industry in Ireland is experiencing increased international competition. The focus of this research is to highlight the educational and research needs of industry. The research will also focus on how the university sector can improve in terms of responding to the specific needs of industry.

The results of this research will be used to help the Irish Government develop university-industry links that will enhance the competitiveness of the indigenous sector in local and global markets. The final results of the study will be published by *Enterprise Ireland* following completion of this research.

In order to collect high quality information that is reliable I am totally dependent upon your co-operation and understanding. Enclosed you will find two questionnaires.

- **If your firm engages in links with universities/Institutes of Technology in Ireland, you should fill in QUESTIONNAIRE NUMBER 1 (BLUE IN COLOUR).**
- **If your firm does not engage in links with universities/Institutes of Technology in Ireland, you should fill in QUESTIONNAIRE NUMBER 2 (YELLOW IN COLOUR).**

This questionnaire should be completed by the research director of your firm or by personnel with experience/knowledge of the corporate/R&D activities of the firm. Only one questionnaire should be completed, and the questionnaire is not as long as it may initially seem. I appreciate very much your effort to make this survey as complete and as accurate as possible, in order that I may complete my degree.

I would appreciate your co-operation in completing this questionnaire and returning it to me on or before **April 30 2002**. No stamp is required on the enclosed self-addressed envelope. **The majority of the questions can be answered with a 'tick', and it should not take more than 10-15 minutes to complete**. The information given will be treated in the strictest confidence. Each of the firms shall remain totally anonymous and under no circumstances will the identification of information relating to individual firms or to particular questionnaires be released. This is an independent piece of research and I am the only person

who will be reading your questionnaire. Each of the firms that participate will receive a report of the findings. If you have any queries regarding my research, please do not hesitate to contact me.

Thank you very much for helping with this very important study.

Yours sincerely,

Almar M. Barry

Almar M. Barry

DEFINITIONS

Definition 1: For the purposes of the study, the Frascati Manual definition of 'Research and Development' (R&D) is used. "Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. R&D is a term covering three activities: basic research, applied research and experimental development" (OECD, 1994, 7). R&D refers to efforts toward new knowledge, including the invention, design and development of processes and prototypes of products and services. R&D excludes: quality control, routine product testing, market research, sales promotions, sales service, research in the social sciences and psychology, and other non-technical activities or services.

Definition 2: ***Basic research (including strategic research)*** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Definition 3: ***Applied research*** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Definition 4: ***Experimental development*** is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

Definition 5: For the purposes of the study, an 'invention' is the creation of a new idea. An invention may or may not be patentable. A patent may or may not result in a saleable product or service or process. An 'innovation' is the introduction into the marketplace of the results of a new idea in products, services, processes or management.

Definition 6: For the purposes of the study, 'new technologies' enhance both product and process innovation. Product technologies refer to *what* is produced while process technologies are concerned with *how* a product is manufactured.

Definition 7: For the purposes of the study, High Potential Start-Ups (HPSUs) are companies which are starting in a growth product market, are based on technological innovation and are founded and promoted by experienced managers, entrepreneurs, academics or technical graduates. HPSUs should have the potential to grow to have annual sales of €1.6 million (£1.3 million) or more and employ up to 10 people, within two years of starting operations. HPSUs are in the formative phase of development and having achieved significant growth, export potential and wealth generation, evolve into Small and Medium Enterprises (SMEs).

Definition 8: For the purposes of the study, 'SME' refers to Small and Medium-sized Enterprise.

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Definition 10: For the purposes of the study, 'IT' refers to Institute of Technology.

Definition 11: For the purposes of the study, 'ILO' refers to Industrial Liaison Office(r). In the Republic of Ireland, each university and IT has an Industrial Liaison Officer who has the responsibility to create and develop links between the HEI and industry.

Reference:

Organisation for Economic Co-operation and Development (1994) *The Proposed Standard Practice for Surveys of Research and Experimental Development: Frascati Manual 1993*. Paris, OECD.

Appendix 3.16

Mr. Eugene Brennan,
Manager – National Technological Park,
The National Technological Park Plassey Ltd.,
Park House, National Technological Park,
Limerick, Ireland.
Tel: +353-61-336555
Fax: +353-61-336545
E-mail: Brennane@shannon-dev.ie

18 February 2002

Dear Client,

Ms. Almar Barry is a Ph.D. student currently developing a research project on links between industry and universities/Institutes of Technology in Ireland. The research is being funded by Enterprise Ireland and is being supervised by Professsor Desmond A. Gillmor, Department of Geography, Trinity College Dublin.

A key component of Ms. Barry's research is the National Technological Park, due to its close partnership with the University of Limerick and its uniqueness as Ireland's only science and technology park.

In order for Ms. Barry to examine the links between the University of Limerick and the firms located on the National Technological Park, it is important she receive high quality information from the firms located on the park. The results of this research will be critical in terms of providing an understanding of the barriers and stimulants to the development of university-industry relationships in Ireland. We would, therefore, greatly appreciate your co-operation in completing the enclosed questionnaire.

Thanks for your consideration,

With best wishes,

Eugene Brennan
Eugene Brennan
Manager – National Technological Park

Appendix 3.17

Interview Respondents in Ireland

ROLE AND INSTITUTION

The ILOs

Director of Innovation Services, Innovation Centre, O'Reilly Institute, TCD, Dublin 2
Director, University Industry Programme, UCD, Belfield, Dublin 4
External Services Manager, AIT, Dublin Road, Athlone, Co. Westmeath.
External Services Manager, IT-Carlow, Kilkenny Road, Carlow
Head of Development, The Development Office, DKIT, Dublin Road, Dundalk, Co. Louth
Head of Development, The Development Office, IT-Tralee, Co. Kerry
Head of Industry Development, DIT, Fitzwilliam House, 30 Upper Pembroke Street, Dublin 2
Head of Innovation and Business Development, Science, Industrial Liaison Office, DIT, Kevin Street, Dublin 8
Industrial Liaison Manager, Development and External Services, IT Tallaght, Dublin 24
Industrial Liaison Officer, CIT, Cork.
Manager External Services, WIT, Waterford

EI Personnel

Business Development Executive, BioResearch Ireland, EI, Glasnevin, Dublin 9
Campus Companies Programme Manager, EI, Dublin 9
Divisional Manager, Science and Innovation, EI, Dublin 9
General Manager, National Pharmaceutical Biotechnology Centre (NPBC), Bioresearch Ireland, O'Reilly Institute, TCD, Dublin 2
Manager of Regional/North-South Innovation Initiatives and Research Training, EI, Dublin 9
Manager, Regional and North-South Initiatives, EI, Dublin 9
Manager, Regional Technology and Innovation, EI, The Granary, Michael Street, Limerick
Programme Manager–Institutes of Technology, Science and Innovation, EI, Glasnevin, Dublin 9
Programme Manager–Universities, Science and Innovation, EI, Glasnevin, Dublin 9
Senior Research Scientist, National Cell and Tissue Culture Centre (NCTCC), Bioresearch Ireland, DCU, Glasnevin, Dublin 2
Technical Operations Manager, AMT Ireland and Materials Ireland, EI, Glasnevin, Dublin 9

Key Actors in Innovation, Technology Transfer and Entrepreneurship in Ireland

Centre Manager, Project Development Centre, Docklands Innovation Park, 128-130 East Wall Road, Dublin 3
Chairman and Member of the National Executive Council of ISME, ISME Head Office, 17 Kildare Street, Dublin 2

Chief Executive, Growcorp, 3015 Lake Drive, National Digital Park, Citywest, Dublin 24.
Chief Executive, TecNet, Glanmire, Co. Cork
Dean of Research, TCD, Dublin 2/Nutriton Unit, Department of Clinical Medicine, Trinity College Medical School, St. James Hospital, Dublin 8
Director of Enterprise, IBEC, Confederation House, 84/86 Lower Baggott Street, Dublin 2
Director, Industry Access, NMRC, UCC, Cork
Director, NMRC, UCC, Cork
Enterprise Executive, Trinity College Enterprise Centre, Pearse Street, Dublin 2
Head of Department, Department of Management, NUI Galway, Galway
Head of School, School of Business Studies, TCD, Dublin 2
Lecturer, Department of Business Administration, UCD, Dublin 4
Programme Manager, Project Development Centre, Docklands Innovation Park, 128-130 East Wall Road, Dublin 3
Project Manager, DBIC, The Tower, Enterprise Centre, TCD, Dublin 2
Project Officer, The Development Office, IADT-DL, Kill Avenue, Dun Laoghaire, Co. Dublin
Provost of TCD/Former Dean of Research, Department of Physics, TCD, Dublin 2
Registrar of NUI Galway/Deputy Director of CIMRU, NUI Galway, Galway
Vice President, Experimental Biology, Élan Corporation plc, Biotech Building, TCD, Dublin 2

The Campus Companies

The names of the three campus companies have not been disclosed as the companies wish to remain anonymous.

UL and the National Technological Park, Plassey, Limerick

Campus Industry Programme Manager, Shannon Development, Park House, National Technological Park, Plassey, Limerick
Centre Manager, Technology Transfer Initiative, Foundation Building, UL, Limerick
Director – Knowledge Enterprise, Shannon Development, Shannon, Co. Clare.
Director, Materials Ireland Research Centre, UL, National Technological Park, Plassey, Limerick
Executive with New Enterprise Development, The Innovation Centre, National Technological Park, Plassey, Limerick
General Manager, AMT Ireland, UL, National Technological Park, Plassey, Limerick
Industry Manager, Shannon Development, Shannon, Co. Clare
Marketing Executive, Shannon Development, Park House, National Technological Park, Plassey, Limerick
Planning and Research Manager, Shannon Development, Shannon, Co. Clare
University Industry Programme Manager, Shannon Development, Park House, National Technological Park, Plassey, Limerick

The Science Park Companies

The names of the three science park companies have not been disclosed as the companies wish to remain anonymous.

Appendix 3.18

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

8 July 2002

Dear [Name of academic],

A few days from now you will receive in the post a request to complete a brief questionnaire for an important research project being conducted by *Enterprise Ireland* in conjunction with *Trinity College Dublin.*

The project focuses on the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland).

I am writing to you in advance as many people like to know ahead of time that they will be contacted. The study is an important one that will help the Irish Government to develop initiatives that will create and develop links between universities/Institutes of Technology and industry in Ireland. In particular, the study will enable the government to understand academic-industry links from the perspective of the academic community in Ireland and to direct appropriate support to the universities/Institutes of Technology in order to establish more effective links with industry.

Thank you for your time and consideration. It is only with the help of people like you that a study like this can be successful.

Yours sincerely,

Almar M. Barry
Almar M. Barry

Appendix 3.19

Ms. Vanessa Barcroft,
Policy and Planning Department,
Enterprise Ireland,
Glasnevin,
Dublin 9.
Tel: (01) 8082000
Fax: (01) 8082020
E-mail: vanessa.barcroft@enterprise-ireland.com

15 July 2002

Dear Sir/Madam,

Ms. Almar M. Barry was awarded *The Enterprise Ireland Millennium Scholarship Award* in August 2000. She is presently undertaking a Ph.D. research project that analyses university-industry links in Ireland. The research is being carried out under the supervision of Professor Desmond A. Gillmor, Department of Geography, TCD.

In order for Ms. Barry to examine the links between universities/Institutes of Technology and industry it is essential that she should receive high quality information from the academic community as well as from all Enterprise Ireland-assisted firms. We would, therefore, greatly appreciate your co-operation in completing the enclosed questionnaire.

Thanking you in advance,

Yours sincerely,

Vanessa Barcroft
Ms. Vanessa Barcroft

Appendix 3.20

Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

15 July 2002

Dear [Name of academic],

I am writing to ask for your help in a study that investigates the links between universities and industry in the Republic of Ireland (hereafter referred to as Ireland). This study is part of a research project designed to analyse the stimulants and barriers faced by the academic community in Ireland in terms of establishing links with industry. The research is part of a nation wide study on the establishment of links between universities and industry. As part of this research, a survey of 1,980 indigenous high-tech companies in Ireland has been completed. To complete the research, it is now the turn of the academic community to provide their perspectives on the barriers and stimulants to the development of links with industry. The population of the study is academics from science and technology-based disciplines. The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography*, *Trinity College Dublin* for a Ph.D. degree. Details of this research are attached in a letter from *Enterprise Ireland*.

In order to collect high quality information that is reliable I am totally dependent upon your co-operation and understanding. Enclosed you will find a questionnaire. If you are an academic who has established links with industry, I would appreciate your co-operation in completing this questionnaire and returning it to me on or before **August 15th 2002**. No stamp is required on the enclosed self-addressed envelope. **The majority of the questions can be answered with a 'tick', and it should not take more than 10-15 minutes to complete**. The information given will be treated in the strictest confidence. Each of the respondents shall remain totally anonymous and under no circumstances will the identification of information relating to individual academics or to particular questionnaires be released. This is an independent piece of research and I am the only person who will be reading your questionnaire. If you have any queries regarding my research, please do not hesitate to contact me.

Thank you very much for helping with this very important study.

Yours sincerely,

Almar M. Barry
Almar M. Barry

Appendix 3.21

Ms. Vanessa Barcroft,
Policy and Planning Department,
Enterprise Ireland,
Glasnevin,
Dublin 9.
Tel: (01) 8082000
Fax: (01) 8082020
E-mail: vanessa.barcroft@enterprise-ireland.com

4 November 2002

Dear Sir/Madam,

Ms. Almar M. Barry was awarded *The Enterprise Ireland Millennium Scholarship Award* in August 2000. She is presently undertaking a Ph.D. research project that analyses university-industry links in Ireland. The research is being carried out under the supervision of Professor Desmond A. Gillmor, Department of Geography, TCD.

In order for Ms. Barry to examine the links between universities/Institutes of Technology and industry it is essential that she should receive high quality information from the academic community as well as from all Enterprise Ireland-assisted firms. We would, therefore, greatly appreciate your co-operation in completing the enclosed questionnaire.

Thanking you in advance,

Yours sincerely,

Vanessa Barcroft
Ms. Vanessa Barcroft

Appendix 3.22

Ms. Almar M. Barry,
Enterprise Ireland Millennium Scholar,
Government of Ireland Scholar,

Department of Geography,
Trinity College Dublin, Dublin 2.
Tel: (01) 6082865
Fax: (01) 6713397
E-mail: mbarry3@tcd.ie

10-9-2002

Dear [Name of ILO],

I am writing to ask for your help in a study that investigates the links between universities/Institutes of Technology and industry in the Republic of Ireland (hereafter referred to as Ireland). The research is being funded by *Enterprise Ireland* and is being carried out under the direction of Professor Desmond A. Gillmor at the *Department of Geography*, *Trinity College Dublin* for a Ph.D. degree.

My research is focused on analysing the barriers and stimulants to the development of university-industry links in Ireland. The research is focusing in four areas; (1) indigenous high-tech firms that have and do not have links established with universities/Institutes of Technology, (2) academics who have and do not have links established with industry, (3) the creation of campus companies and (4) the role of Research and Innovation Offices in the universities/Institutes of Technology in managing the interface between academia and industry.

I would be most grateful if I could at your convenience arrange to meet with you at a time that suits your schedule to discuss your role and experiences as an interface agent between academia and industry. Should you have any questions, please do not hesitate to get in contact.

Thank you for your time and consideration. It is only with the help of people like you that a study like this can be successful.

Yours sincerely,

Almar M. Barry
Almar M. Barry

Appendix 3.23

Interview Respondents in Scotland

ROLE AND INSTITUTION

The ILOs

Director, ERI, The University of Edinburgh, Edinburgh
Director, Research and Consultancy Services, University of Strathclyde, Glasgow
Director, Research and Innovation Services, University of Dundee, Dundee
Director, Technology and Research Services, Heriot-Watt University, Edinburgh
Manager of Strategic Business Development, Research and Enterprise, University of Glasgow, Glasgow

SE Personnel

Business Development Manager, SE, Edinburgh and Lothian
Head of Commercialisation, Competitive Business Directorate, SE, Glasgow
Head of Research and Evaluation, Knowledge Management Directorate, SE, Glasgow
Programme Manager, Competitive Business Directorate, SE, Glasgow

Scottish Executive Personnel

Director of Innovation Policy Unit, Scottish Executive, Enterprise and Lifelong Learning Department, Glasgow
Director of Science and Technology Unit, Scottish Executive, ELLD, Higher Education, Science and Student Support Division, Glasgow
SPUR Programme Manager, Scottish Executive, ELLD, Innovation Policy and Support Division, Glasgow

Key Actors in Innovation, Technology Transfer and Entrepreneurship in Scotland

Business Development Executive, Targeting Technology, Kelvin Campus, West of Scotland Science Park, Glasgow
Business Development Manager, Physical Sciences, Informatics and Engineering, ERI, The University of Edinburgh, Edinburgh
Chief Executive, Technology Ventures Scotland Ltd., Business Innovation Centre, Rosyth Europarc, Rosyth, Fife
Consultancy Services Manager, Edinburgh Research and Innovation, The University of Edinburgh, Edinburgh
Department of Business Studies, Management School, The University of Edinburgh, Edinburgh
Director of TechMaPP, Department of Business Studies, The University of Edinburgh, Edinburgh
Director, Centre for Enterprise Management, University of Dundee, Dundee
Director, Connect Scotland, The University of Edinburgh Management School, Edinburgh
Director, Hunter Centre for Entrepreneurship at Strathclyde, University of Strathclyde, Glasgow
Director, Kornerstone (UK) Ltd., Glasgow

Director, Training and Employment Research Unit (TERU), University of Glasgow, Glasgow
EngD Centre Administrator, Institute for System Level Integration, The Alba Centre, Simpson Parkway, Kirkton Campus, Livingston
European Policies Research Centre, University of Strathclyde, Glasgow
Managing Director, Strathclyde University Incubator, University of Strathclyde, Glasgow
Policy Officer, Universities - Scotland, Edinburgh
Public Affairs Officer, Universities - Scotland, Edinburgh
Research Centre for Social Sciences/Technology Studies, The University of Edinburgh, Edinburgh
Researcher, TechMapp, Department of Business Studies, The University of Edinburgh, Edinburgh
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Commercialisation Facilitator, SIE, Technology and Research Services, Heriot-Watt University, Edinburgh
Commercialisation Facilitator, SIE, Research and Innovation Services, University of Dundee, Dundee
Commercialisation Facilitator, SIE, Research and Enterprise, University of Glasgow, Glasgow
Director, SIE, Head Office, Allan House, Glasgow

Appendix 3.24

Interview Schedule with Industrial Liaison Officers[3]

(A) General information

Is industry represented on your institution's governing body?

If 'yes', what is the

Number of members on governing body	
Number that are from business	

How many individuals are employed full-time at your Industrial Liaison Office (or equivalent) who provide services for industrial liaison?

Managerial Executive Staff _____
Administrative Support Staff _____
Total Staff _____

(B) The regional role of the university/IT in economic development

In what areas do you see the university/IT as whole making the greatest contribution to economic development?

Does the HEI have a strategic plan for business support? Please indicate which of the following statements most closely accords with your state of implementation in 2000-2002.

☐ No strategic plan in place. Ad hoc approach to business support
☐ Strategic plan developed and only partially implemented, or restricted to certain departments or central functions only
☐ Strategic plan developed as a result of an inclusive process across the whole HEI. Accepted across almost all units and recommendations implemented. Use of plan to set targets and monitor achievement.

What are the main business sectors or clusters with which the university/IT has established links?

If you answered question, please indicate how these priority sectors were determined (tick all boxes that apply).

- The HEI is a specialist institution focused on sector specific areas ☐
- The HEI took its cue from priorities in regional development strategies ☐
- Response to demand from companies in these sectors ☐
- The HEI identified important business clusters in its region ☐
- These sectors had best fit with the institution's expertise ☐
- The HEI focused on a 'gap in the market' left by other HEIs ☐
- Other (please specify) ☐

[3] Some of the questions used in this interview schedule were adapted from Charles and Conway (2001).

In the context of your overall institutional mission, what importance would you attach to the economic development of your region?

- High priority ☐
- Medium priority ☐
- Low priority ☐

What are the incentives for academic staff in your university/IT to engage in links with industry?

How would you rate the level of incentives for your staff to engage with industry and commerce? (Please grade your institution on the following scale from 1-3 for the situation during 2001-2002)

☐ Barriers outweigh any incentives offered. Collaboration with industry seen by staff as detrimental to career progression.
☐ Some incentives in place, but with some barriers remaining. Typically policy may be generally supportive but there is a lack of understanding across the institution.
☐ Strong positive signals given to all staff to encourage appropriate levels of industrial collaboration. Incentive procedures well established and clearly understood and applied

(C) University-Industry Links

Now I would like to ask you some questions about the links that may exist between your university/IT and industry.
I have listed a number of possible links on this card (PLEASE, SEE CARD)

GROUP I FORMAL LINKS

☐ Collaborative research
☐ Commercialisation services
☐ Contract research
☐ Sponsored research
☐ Technical services/analysis and testing in university department
☐ Consultancy
☐ Other (Please specify):

_____

GROUP I INFORMAL LINKS

☐ Enable industry access to equipment owned by the university/IT
☐ Enable industry access to university department research
☐ Industry conferences or seminars organised by university/IT
☐ Organise university/IT workshop/education/training programmes for industry
☐ Informal contact with between industry personnel and university academic staff
☐ The university/IT provide academic staff as guest speakers to firms
☐ Other (Please specify):

_____

Links between universities/ITs and industry can be categorised in three categories. In which of the following categories has your university/IT established links with industry? Please grade your institution on the following scale from 1-3 in terms of the volume of the activity (i.e. place 1 for the link with the highest level of activity between the university/IT and industry)

YES	NO	RANK (1-3)	
☐	☐	☐	Teaching and Training
☐	☐	☐	Research and Development
☐	☐	☐	Consultancy Services

(D) Teaching and Training Links with Industry.

Please indicate the types of teaching and training links your university/IT has established with industry?

- ☐ Graduate placement programmes
- ☐ Industry-funded scholarship programmes for postgraduate research
- ☐ Joint university-industry co-operative scholarship programmes
- ☐ Sabbatical periods in industry for academics and university/IT researchers
- ☐ Specialist training of employees of firms
- ☐ Work experience placement for third-level undergraduate students
- ☐ Other (Please specify): _____

What were the factors that motivated your university/IT to engage in teaching and training links with industry?

What were the BARRIERS that made it difficult for your university/IT to establish teaching and training links with industry?

What do you consider to be the POSITIVE outcomes of teaching and training links with industry for your university/IT?

What do you consider to be the NEGATIVE outcomes of teaching and training links with industry for your university/IT?

Do individual courses actively involve employers in the development of content and regular reviewing of the curriculum?

☐ No links with employers in development of locally oriented courses or overall shaping of the curriculum

☐ Some dialogue with employers and other bodies about the nature of courses, but limited e.g. to specific vocational areas, or one-off exercises.

☐ All departments regularly consult with employers and other partners on curriculum where relevant. Specialist subjects are kept up to date and relevant to the labour market. More generic skills developed in all courses as required.

How are these placements organised? (Please tick all that apply).

Via a central placement department	☐
Individual school or department level	☐
Via careers service	☐
Via students union	☐
Ad hoc between students and businesses	☐
Via external intermediary organisation (please specify)	☐

Does your institution run courses that were specifically designed to meet the needs of a particular firm or group of firms?

	Yes
Undergraduate degree modules	☐
Undergraduate degree	☐
Masters degree	☐
Diploma	☐
Non-accredited course	☐

Does your institution provide the following?

Distance learning for businesses	☐
Continuous work-based learning	☐
Short bespoke courses for business on campus	☐
Short bespoke courses at companies' premises	☐

Is education in entrepreneurship a feature of the teaching and training activities of the university/IT?

☐ Yes
☐ No

(E) Consulting Activities with Industry

Please indicate the types of consultancy services that your university/IT provides industry with in general? Industry would;

☐ Appoint an academic advisor or an academic as a board member
☐ Appoint an academic as a consultant to the firm on a specific project
☐ Consult academic staff in production matters
☐ Consult academic staff over business plans
☐ Require Technical/laboratory analytical services
☐ Other (Please specify): _____

What were the factors that motivated your university/IT to engage in consultancy services with industry?

What were the BARRIERS that made it difficult for your university/IT to establish consultancy links with industry?

What do you consider to be the POSITIVE outcomes of consultancy links with industry for your university/IT?

What do you consider to be the NEGATIVE outcomes of consultancy links with industry for your university/IT?

Does the university/IT have a central dedicated unit which provides the following:

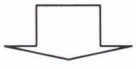
An enquiry point for industry	☐
Assistance to industry in specifying their needs	☐
A required contracting system for all staff-business consulting activities	☐

How many firms have been assisted through consulting activities and what percentage have been based in the region?

	2000-2001
Number of firms assisted through consulting activities	
Percentage based in the region	

Does the HEI have a commercialisation company or department to manage consulting links and other external interactions?

No ☐ Yes, university/IT exploitation company ☐
Yes, internal department that specialises in commercialisation ☐



Date established .....

How much consultancy is completed by academics at the university/IT?
What types of academics engage in consultancy activities in general?
In what areas of expertise in the university/IT is consultancy practiced?
How is the income allocated (university, faculty, emplyee)
What is the universities attitude and strategy in relation to consultant activity
How much time can employees use on consultant activity (max/min)
How should commissions be charged (calculating overhead)
Who is receiving and passing further inquiries from industry
How is contact with industry managed
To what extent can employees have their own consultant business
What is the general attitude and experience of the university towards consultancy, is this a priority area?
What is the potential for improvement in the provision of consultancy services by the university/IT?

(F) Research and Development Links with Industry

Does the university/IT engage in any of the following R&D links with industry? ***(Please tick the relevant box(es))***

YES	NO	RANK (1-3)	
☐	☐	☐	Basic research links (e.g. Creative stage/initial phase of research)
☐	☐	☐	Applied research links (e.g. Prototype development)
☐	☐	☐	Experimental research links (e.g. Adaptation and fine-tuning of products)

Please indicate the types of R&D links your university/IT has established with industry?

☐ Collaborative R&D
☐ Contract R&D
☐ Licence university/IT technology
☐ License a product developed by your university/IT to industry
☐ Innovation Partnerships (formerly known as Applied Research Grants Scheme (ARGS))
☐ Industry provide research grants and donations to specific departments in universities/ITs
☐ Other (Please specify): _____

What were the factors that motivated your university/IT to engage in R&D with industry?
What were the BARRIERS that made it difficult for your university/IT to establish consultancy links with industry?
What do you consider to be the POSITIVE outcomes of consultancy links with industry for your university/IT?
What do you consider to be the NEGATIVE outcomes of consultancy links with industry for your university/IT?

Please indicate the number of occurrences (research projects) of the following activities (excluding services and consultancy) in your university/IT (2000-2001).

Type	No.
Research commissioned by industry	_____
Collaborative research with industry undertaken in the context of national collaborative programmes (e.g.EI programmes)	_____
Collaborative research with industry undertaken in the context of European collaborative programmes (Framework, EUREKA)	_____
Collaborative research with industry undertaken in the context of regional collaborative arrangement	_____
Other research with/for industry (Please specify)	_____

(G) Commercialisation of University Research

What is the policy of your university/IT towards commercialisation?

What is the policy of your university/IT towards the publication of research results and/or the patenting of products developed from university research?

Does your organisation have wholly or partially-owned firms commercially exploiting research results achieved by researchers working in universities/ITs?

If you answered YES, how many of these companies are:

- ☐ Umbrella organisations or holding companies for the exploitation of IPRs
- ☐ Spin-out companies for commercialisation of research results
- ☐ Other

What is the percentage of the research conducted by your university/IT is commissioned research?

What is the percentage of the research conducted by your university/IT is non-commissioned research?

Does your office contribute to the commercialisation of university research?

- **If so, how does your office facilitate the comercialisation of university research?**

What, in your opinion, are the three main problems most commonly associated with the commercialisation of university/IT research results?

In relation to your organisation, what policies or practical steps could be introduced to increase the rate of commercialisation in Ireland?

What has the role of EI been in relation to the commercialisation of university research in Ireland?

What policies has EI implemented that have been effective in terms of increasing the rate of commercialisation in Ireland?

What policies or practical steps could be introduced by EI to increase the rate of commercialisation in Ireland?

How many commercialisation projects have you been involved in?

How do you facilitate commissioned[4] and non-commissioned[5] research and how do you commercialise it?

Do you have any general comments or recommendations regarding commercialisation of university/IT research?

How you see commercialistion developing in the future?

What in your opinion are the major challenges facing the commercialisation of university research in Ireland over the next 5 years?

Campus Companies

How many campus companies are currently located in your university/IT?

What is the number of campus companies set up by

Faculty Staff _____
Researchers _____
Students _____

What research areas do they belong to?

What support is given by your office to support campus companies?

(H) Spin off firms

In the following table please insert the required information concerning each of these groups of firms.

	Number established 2000-2001	Number established in previous five years (1995-2000)
Spin offs with some HEI ownership		
Formal spin offs, not HEI-owned		
Staff start ups		
Graduate start ups		

Does the HEI provide support for spin offs through the following mechanisms, either provided by the HEI or in collaboration with a partner organisation? (You may tick both column one and two if appropriate)

	HEI provided	Partner provided	None
• On campus incubators	☐	☐	☐
• Other incubators in the locality	☐	☐	☐
• Science park accommodation	☐	☐	☐
• Entrepreneurship training	☐	☐	☐
• Seed corn investment	☐	☐	☐
• Venture capital	☐	☐	☐
• Business advice	☐	☐	☐

[4] Commissioned research is research financed by industry.

[5] Non-commissioned research is research financed by the state with no presupposed outputs.

What business sector(s) do most of your spin-offs belong?
What support is given in the spin-off phase
Relation between university and spin-off afterwards
License
Ownership
Co-operation (research, technical development, consulting....)
What is the universities income from spin-offs
How is the money generated by spin-off activity allocated within the university/IT
Is there a large demand for products and services from spin-offs
Are there competent investors in the area
What is the general attitude and experience, is this a priority area
Potential for improvements

(I) The University Sector

What specific types of knowledge do universities contribute to innovation?
How effective is the university sector in terms of providing a commitment to company innovation?
What are the main BARRIERS in the university sector in relation to the creation and development of links with industry?
What are the main STIMULANTS/DRIVERS in the university sector to the creation and development of links with industry?
Do you think that the university sector is effective in terms of meeting the needs of industry?
Could you describe briefly, some of the best practices (with examples) of companies that have successfully engaged in links with the university sector through your office?
In what ways could your office change to create more successful links between industry and the university sector?
What are the benefits to the university/IT in building links with industry?

- **How might interactions between universities and industry be enhanced to improve knowledge management and increase innovation in the indigenous high-tech sector.**

(J) Academic Entrepreneurship

Does your office have an involvement with campus companies from the university/IT sector?
Does office have an involvement with spin-offs from the university/IT sector?
Does your office promote the development of academic entrepreneurship?

- **If so, what support systems does your organisation have in place to support the development of academic entrepreneurship?**

Is your office reactive or proactive in terms of establishing and developing links with industry?
What is your perception of industry's view of its relationship with the university sector?
Do you think that the universities are effective in terms of creating a culture of academic entrepreneurship.
What are the main barriers to the development of academic entrepreneurship in the universities/ITs?

Could you describe briefly, some of the best practices (with examples) of universities and/or ITs in the development of academic-industry relationships?

(K) Industry

What are the main BARRIERS in industry in relation to the creation and development of links with the university sector?

What are the main STIMULANTS/DRIVERS in industry in relation to the creation and development of links with the university sector?

Do you think that industry is aware of the capabilities of the university sector in terms of the services that the university sector can provide for industry?

Do you think that universities should market their capabilities to industry?

Is there a perception in industry that universities are nothing more than 'ivory towers' that are inaccessible to the needs of industry?

What is your perception of the university/IT sectors view of its relationship with industry?

Should the university sector implement changes/strategies to meet the needs of industry in Ireland.

- **If YES, what should be these changes/strategies?**

What role have state-sponsored development agencies such as Enterprise Ireland undertaken to encourage industry to foster the creation and development of links with the university sector?

- **To what extent has the role of Enterprise Ireland been positive or negative?**

Do you think that Enterprise Ireland could do more to encourage industry to engage in links with the university sector?

(L) Intellectual Property

Do you monitor the number of invention disclosures made each year?

Yes ☐ No ☐

If yes, how many disclosures have been made in each of the last two years?

1999-2000		2000-2001	

Does the HEI exert ownership over intellectual property by filing patents?

Yes, patents filed by the HEI in-house ☐
Yes, patents filed on behalf of the HEI by another organisation ☐
No action taken ☐

How many patents have been filed by or on behalf of the university/IT in each of the last two years? (NB Count as one patent either a UK patent or a European patent, but do not count multiple filings of the same patent in different countries)

	2000-2001
Number of total Irish patents filed	
Number of Irish patents granted	
Number of licences produced	

Does the HEI have an in-house capability to seek out licensing opportunities for its IP, or does it use an external agency? (please indicate the principal method only)

Yes, in-house capability ☐
Yes, external agency ☐
No action taken ☐

Is there a requirement within the HEI to report the creation of the following types of intellectual property

	Always	Usually	Rarely/Never
Inventions	☐	☐	☐
Computer software or databases	☐	☐	☐
Literary or artistic works	☐	☐	☐
Educational software and multimedia	☐	☐	☐
Industrial designs	☐	☐	☐
Trademarks	☐	☐	☐
Integrated circuit topographies	☐	☐	☐
New plant or animal varieties	☐	☐	☐

How are intellectual property management activities usually initiated in cases of new intellectual property?

- The discoverer/researcher reports the discovery to the institution and requests consideration for protection and/or commercialisation ☐
- The institution monitors the activities of the researchers and notes which discoveries should be considered for protection and/or commercialisation ☐
- Other (please specify) ☐

Are individuals rewarded by the institution for their intellectual property?

Yes ☐ No ☐

If so, what percentage of net revenues is given to inventors if cumulative income exceeds £100,000? (please explain policy briefly)

(M) U-I Links in General

What, in your opinion, are the main PROBLEMS in ESTABLISHING links between industry and the university sector in Ireland?

What, in your opinion, are the main PROBLEMS in MAINTAINING existing links?

What, in your opinion, are the factors associated with SUCCESSFUL relationships between industry and the university sector?

(N) The Future

What, in your opinion, are the main opportunities for developing and strengthening links between industry and the university sector in the future?

What, in your opinion, are the major challenges facing the development of successful links between industry and the university sector over the next 5 years?

How do you see the role of the ILO function evolving in Irish universities/ITs in the next 5 years?

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