T e c h n o p o l i s

Benchmarking Mechanisms and Strategies to attract Researchers to Ireland

A study for the Expert Group on Future Skills Needs and Forfás

Technopolis-Group

Patries Boekholt
Erik Arnold
Jari Kuusisto
Maureen Lankhuizen
Shonie McKibbin
Alexandra Rammer

Final Report
February 2001

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Executive summary

The Irish scientific research system is currently experiencing an unprecedented growth, following an investment programme launched in 2000. In order to underpin this growth the country is seeking to attract more research graduates from outside the country. The Expert Group for Future Skills Needs have established that the projected demand for graduate researchers can not be met by the current flow of Irish research graduates. Thus there is a need to attract research graduates from outside the country, whether Irish or foreign. But Ireland is not alone in its search for researchers. In the context of internationalisation of R&D and the mobility of researchers, attracting good researchers has become a major policy issue in all industrialised countries. There is an overall European concern about the scarcity of researchers and lack of skilled personnel. Europe is lagging behind its major competitors US and Japan in terms of researchers as a proportion of the workforce. Since many European countries have started to address this issue, Ireland will face even more competition in attracting research talent.

Therefore the Expert Group on Future Skills Needs seeks advice on what strategies to develop to attract more research graduates and post-doctoral researchers to Ireland. In order to learn from experiences developed elsewhere, the Technopolis study has looked at strategies and mechanisms that have been put in place in other countries, by national governments, science and technology organisations and universities.

We have selected five benchmark countries

- Two countries that are the top global competitors in the attraction of internationally mobile researchers: the United Kingdom and the United States of America
- Three 'competitor' countries in Europe that have similar small research systems with modest international reputation: The Netherlands, Finland and Denmark

The study found that the issue of attracting foreign researchers and the problem of research skills shortages was generally addressed in two ways:

1 Improvement of the national science research systems and the general working conditions for graduate researchers; This also involves improving the profile of certain science fields or centres of excellence
2 The launch of 'add-on' measures targeted to foreign researchers

The UK has the clearest division between on the one hand a research funding system that is attuned to domestic research graduates, particularly PhDs, and in parallel a number of 'add-on' measures to fund foreign graduates coming to the country. In the three smaller European countries the national funding systems as a whole do not differentiate between domestic and foreign students. Therefore the 'add-on' measures such as tax exemptions, flexible immigration rules, proactive marketing of universities, and help with accommodation, are designed to give foreign graduates extra incentives.

The key conclusions of the report are:

1 Despite the international reputation and attractiveness of universities in the UK and the US, both countries keep up efforts to attract even more research graduates. Particularly the UK has many funding opportunities for foreign research graduates from all over the world. Countries more similar to Ireland, i.e. The Netherlands, Denmark and Finland are not as successful in attracting foreign researchers and at the same time are less active in pursuing activities to improve this.
2 Both the literature and benchmark study revealed that regulatory barriers are a key obstacle for foreign researchers to move to another country. These are issues such as insufficient and intransparent information on funding opportunities and application rules, complex immigration procedures, and practical arrangements such as housing.
3 The amount and level of funding for research graduates and post-doctoral researchers vary enormously among the benchmark countries. In the smaller European countries, foreign research graduates and post-doctoral researchers are part of the university staff, do not pay any fees and receive a salary during their degree course or their post-doctoral employment. This is different from the UK and US where the foreign research graduates pay -sometimes high - fees and have to find their own sources of funding from various organisations offering grants and stipends.
4 The three smaller European countries all state in their key policy documents that internationalisation of research and improving mobility of researchers is important. But the attraction of foreign researchers is not an explicit or significant strategy to tackle their skills shortages problem. The expansion of the research system, the filling of vacancies in some science areas and the improvement of the career structure in all three countries are predominantly tackled through an internal improvement of the research system, and only marginally by pro-actively targeting foreign researchers.
5 The key strategies and mechanisms found in the benchmarking countries are:
   - Making the academic system more open and flexible (NL, FR, FI, DK)
   - Improving the regulatory conditions particularly on immigration (FR, US)
   - Better sign-posting and information at national level (FI, FR)
   - Dedicated grants for foreign researchers (UK, FI, NL, SK)
   - Adapting income situations to market forces (NL, FI)
   - Providing tax reductions specifically for researchers and knowledge workers (NL, DK, FR)
   - At university level: more active international marketing and support for international researchers (FI, NL , UK)
6 The universities themselves are the most active players in the search for foreign talent. In the cases that we observed, the universities had good liaison and support functions in place for foreign students. Proactive marketing is done on an intercontinental scale. International networks are used to exchange or identify potential candidates.

What lessons can we draw from this international experience for Ireland? The following **recommendations** are made:

1 Build up centres of excellence; The human mobility literature is very clear on the fact that for the best talents to move to another country, the main attraction is the possibility to work with internationally renowned professors, research groups and universities; Therefore the key long-term strategy is to strengthen Ireland's science system as a whole and its centres of excellence in particular
2 Improve international networks and visibility of Irish universities; This works both ways: through international networks senior Irish researchers can identify and get acquaint themselves with talented graduate researchers and the latter group will be made aware of opportunities in Ireland
3 Improve the status and remuneration of research graduates and post-doctorates; Up to recently remuneration levels in Ireland were not in line with those in the benchmark countries. This has improved dramatically with the new funding schemes, but needs to be broadcasted to the international science community
4 Make the move to Ireland as smooth as possible; If practical barriers make the move to Ireland a lengthy and complex process the decision to go to another country where this is much easier could make that Ireland loses out on talents. Ireland should exploit its advantages such as a good quality of life and English as main language.

1 Attracting research graduates to Ireland

1.1 Introduction

This report responds to a request by the 'Expert Group on Future Skills Needs', established in late 1997 as part of the Irish government's Business, Education and Training Partnership. The Expert Group has recently looked at the general area of research skills and has identified a potential shortage in this area in Ireland within the next few years, mainly due to a number of new initiatives by the government to support basic research. The group believes it will be necessary to augment local skills by attracting to Ireland people interested in an academic research career.

From 2000, a £IR1.95 billion (2.4 billion EUR) investment programme has been launched to strengthen Ireland's scientific research and technology base. About one quarter of the investment is to strengthen the research base in information and communication technology (ICT) and biotechnology, which were prioritised in the national Technology Foresight exercise. But other areas of science will also see an increase in expenditures.

Making a step-function increase in the size of a research community is no easy task, even if the community arguably has been under-funded in the past and may therefore be hungry for resources. There is a need to cultivate an increased pool of scientists to perform the intended greater volume of research, and the corresponding need to expand research-training capacity. The present Irish pool of researchers is not sufficient to handle the entire expansion intended. Scientists need to be attracted from elsewhere.

Therefore the Expert Group on Future Skills Needs is seeking advice on what strategies to develop to attract more researchers to Ireland. Ideally Ireland would not want to attract these scientists for a short period. They should form a resource of skilled researchers that pursue their careers in Irish academia or industry.

Ireland is not alone in its search for researchers. There is an overall European concern about the scarcity of researchers and lack of skilled personnel.[1] Europe is lagging behind its major competitors US and Japan in terms of researchers as a proportion of the workforce. Since many European countries have started to address this issue, Ireland will face even more competition in attracting research talent.

The Expert Group has asked Technopolis to conduct an international comparative study with the objective to

[1] See for instance : The ETAN Group Report on the Promotion of Employment in Research and Innovation through Indirect Measures, European Commission, Brussels

- Benchmark strategies and mechanisms, within the international market of researchers, to attract from abroad students to undertake postgraduate research leading to a higher degree and people to postdoctoral research positions.
- Identify lessons to be learned for Ireland from international practice.

In Chapter 2 we will discuss some of the literature and documentation that has been written on the subject of human mobility in science and technology and globalisation of research. In the following Chapters we discuss each benchmark country one by one, with respectively the UK (Chapter 3), US (Chapter 4), The Netherlands (Chapter 5), Finland (Chapter 6), and Denmark (Chapter 7). Each of these will start with a short introduction of the overall situation in relation to the key issues. We will give a characterisation of the research system and science population. We will then discuss the responses to the particular problems that each of these countries is facing. We will start with national policies and strategies, to continue with the actions, programmes and schemes of the intermediary organisations and then shortly describe two universities and their approach to attracting more (international) researchers. Chapter 8 shortly describes some good-practice initiatives found in France and Korea.

Finally Chapter 9 will synthesise the results that have come out of the country reports and comment on the relative position of Ireland on some of the key factors. We will sum up some good-practice examples where lessons could be learnt for the Irish situation. These will lead to recommendations for actions to be taken in Ireland.

1.2 Our approach

We have selected five benchmark countries:

- Two countries that are the top global competitors in the attraction of internationally mobile researchers: the United Kingdom and the United States of America.
- Three countries in Europe that compete for the same global and European researchers and have similar small research systems with modest international reputation: The Netherlands, Finland and Denmark

We have also included some interesting initiatives found in two other countries. The problems faced by France and Korea reflect certain concerns that are relative for this study and the resulting solutions are presented.

The study has focused on three organisational levels:

1 National policies and strategies to attract foreign researchers
2 Intermediary science organisations, responsible for funding research and developing strategies for (parts of) the science community
3 A selection of individual universities

In the case of the US we have not covered all national policy strategies because many policy initiatives are taken at State level. We have however, focussed on how the system is organised and how it allows for the integration of foreign researchers.

Additionally, we have looked at two universities in detail to highlight actions taken at this level to attract foreign researchers. The biomedical sector has been highlighted under the US report, this is due to the prominent position it holds in the US and the growing importance it is having in the UK and Ireland.

The national innovation systems in all these countries are very different which includes the channels for funding academic research and the individual researchers who conduct the work. In some countries funding for post-graduates and particularly post-doc researchers is allocated to the institutions, which subsequently recruit the researchers. In other countries post-graduates apply for funding individually and then find a matching institution.

The definition of research postgraduates and post-doctorates also vary from country to country. In the three benchmark countries of mainland Europe a research postgraduate would typically have a Masters degree and continue for a PhD degree. To make the international comparison possible we have mainly looked at those post-graduates aiming for a PhD degree.

Our comparative study on the attractiveness of countries for research graduates, looks at the current position of foreign research graduates in terms of remuneration as well as at mechanisms and initiatives aimed at increasing their numbers. In our view a short description of the national academic research system is necessary to understand the position of and funding sources for post-graduates in each of the countries. This determines in how far additional measures are necessary to attract and fund foreign post-graduates. We can basically see two models:

1 "Dual track" academic systems where individual funding possibilities are basically for national post-graduates. This asks for separate funding mechanisms targeted at foreign post graduates. This description applies to the UK and to a lesser degree the US. It holds true particularly for post-graduates, and not so much for post-doctoral researchers. The latter group are predominantly paid through research funding sources allocated to departments and research groups rather than through individual research grants.
2 Academic systems that make no distinction between domestic and foreign post graduates in terms of remuneration. In these systems there is less need for "add on" funding mechanisms for foreigners. The same rules apply for both groups. This is the case for Finnish, Dutch and Danish post-graduates and post-docs.

In these countries we have looked for a broad set of measures to attract foreign researchers, not just those related to income but also other incentives to influence the graduates' location decision. Exhibit 21 in Chapter 9 gives an overview of the mechanisms that we identified in the study. Because of this 'dual system' situation in the UK and the US, at first glance it seems as if these countries have more instruments to support foreign post-graduates. As said their domestic grant system is less open to foreigners and therefore they have to have more scholarship programmes and separate funding mechanisms dedicated to foreign graduates.

Before dealing with the benchmark countries we provide a short description of the past and present situation in Ireland, particularly in terms of funding opportunities.

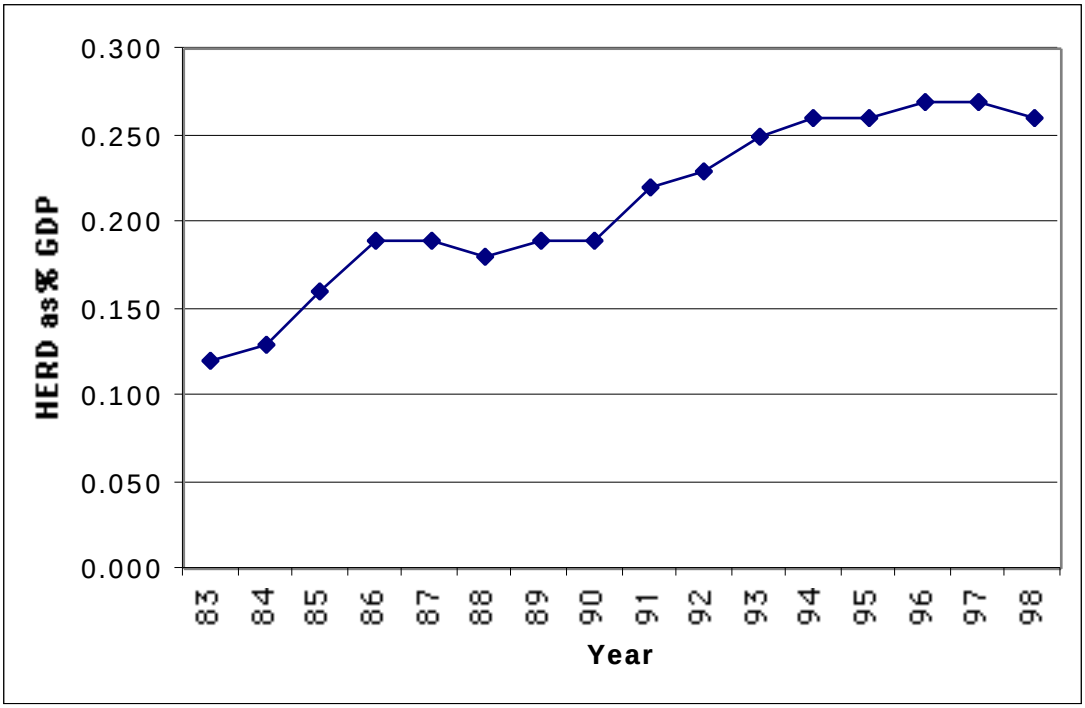
1.3 Irish funding for research graduates

This study did not include a systematic analysis of the situation in Ireland. We did however collect material that allows us to make some comparison between the benchmark countries and Ireland. However the science system in Ireland is changing drastically, including the remuneration and position of research graduates. The following short description of the situation in Ireland is therefore tentative insofar that the discussion is still ongoing as how to improve the position of domestic and foreign graduates.

Ireland, together with Finland, is often quoted as Europe's model country in terms of conducting an explicit policy strategy to boost economic performance through technology and innovation. A considerable increase of public investment has gone to the Higher Education sector research, although from a very low base.

The expenditures on HERD as a share of Gross Domestic Product have gone up considerably since the 1980s from 0.12% in 1983 to 0.26% in 1998. And this will show an even more dramatic jump if the current investments would be included in these figures. The average for Europe for that period was 0.35% showing that Ireland is coming from far behind.

Exhibit 1 Irish HERD as percentage of GDP



Source: OECD, EAS/MSTI database, May 2000

Outside the block grants to the universities, Irish spending on scientific research was minimal up to the late 1990s. Excluding medicine, the total available for project and postgraduate grants (that is, the equivalent of US National Science Foundation funding) to the entire university system in 1996 was under £I 5 million. Technopolis' evaluation study[2] of the Basic Research Grants Scheme in Ireland was one of a number of reports in the mid-late 1990s, which suggested it was time that the scale of Irish investment in science should rise, in order to underpin present and future industrial and economic development in Ireland. At that time, the basis for expanding the scientific research community was flawed. PhD student grants were small and hard to get. There was very little national funding for post-doctoral research, so that many of the 'post-docs' working in Ireland did so using European Union Training and Mobility of Researchers (TMR) funding.[3]

The Post-Graduate Funding Review[4] found it difficult to determine exactly how individual students were funded, since many students receive more than one source of funds and are paid through different offices. Science post-graduates (approximately 75% of the total post graduate population) received funding from:

- The £2000 fellowship from OST
- Local Authority Grants (fees (max £2400) and maintenance (£1800 p.a. or home £700 p.a.), or fees only)
- Demonstratorships (in some colleges)
- Project Funding (via Basic/ Strategic Grants or PATs at approx. £5000 p.a. for two years)

The outlook and environment for research in higher education in Ireland has improved considerably in recent years - particularly when compared with the very low historical levels of funding. The development of a research culture within the higher education sector is now an important challenge. The transformation of the research landscape is already underway, particularly with the implementation of Science Foundation Ireland and the Programme for Research in Third-Level Institutions.

The emerging structure for State funding of research within the higher education sector is as follows:

The **first pillar** is the existing unified teaching and research budget allocated by the Higher Education Authority (HEA) to the universities as a block grant. Funding under this heading is not "tagged". Each institution is free to decide on the distribution between teaching and research and within these categories.

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[2] Arnold E., B. Thuriaux, *Forbairt Basic Research Grants Scheme: An Evaluation*, Technopolis, Brighton, 1998

[3] This may now, of course, become an exploitable strength. Many of these people will have progressed in their careers, and some of them may find it attractive to return to Ireland, based on their earlier exposure

[4] Post-graduate Funding Review, National Research Support Fund Board, Enterprise Ireland, August 1997.

The **second** and vital pillar is the funding of individual research proposals and projects following competitive application processes and peer review assessments. This pillar would also encompass funding for research fellowships and other grants for individual researchers. Enterprise Ireland and the Health Research Board are two important agencies in this area. In the past funding has been very modest and we can now look forward to significant increases with additional funding from the National Development Plan. The establishment of the Research Council for the Humanities and the Social Sciences is a major advance. Furthermore the Minister announced the establishment of a Research Council for Science, Engineering and Technology in January 2001. These Councils will now provide funding for project research, scholarships and other support schemes.

The **third** pillar is the funding of institutional research strategies - again on a competitive, peer- reviewed evaluation basis. The Programme for Research in Third Level Institutions was launched in late 1998 and now involved a total planned allocation of £220 million to date - of which somewhat more than 50% will be provided by the Government. A further call for £160million of proposals has now been made. The programme, which is administered by the HEA on behalf of the Department of Education and Science, ensures that institutions have the capacity and incentives to formulate and implement research strategies which will give them critical mass and world level capacity in key areas of research. This programme built upon a smaller £4million programme in 1998 - the first ever such funding to give direct support to the research strategies of third-level institutions.

The **fourth** pillar can be described as "mission oriented" research where institutions and researchers respond to invitations for research proposals in priority areas identified by Government. The establishment of Science Foundation Ireland arises from reports prepared by the Irish Council for Science, Technology and Innovation (ICSTI), and is a very significant initiative under this heading. Announcements of the outcomes of its first call for proposals are expected in the near future.

The aim is that the funding mechanisms that are in place and those which are planned will complement each other to ensure that the research potential of higher education can be realised. With adequate funding these four "pillars" should enable a research structure which strikes a well- functioning balance between personal initiative and creativity (on the part of individual researchers including those pursuing their own interests and inquiries), institutional programmes and priorities and government priorities. It is difficult to be clear on the outcome of these funding mechanisms prior to the full implementation of all of these.

The increased investments in R&D has enabled the creation of two major new funding initiatives.

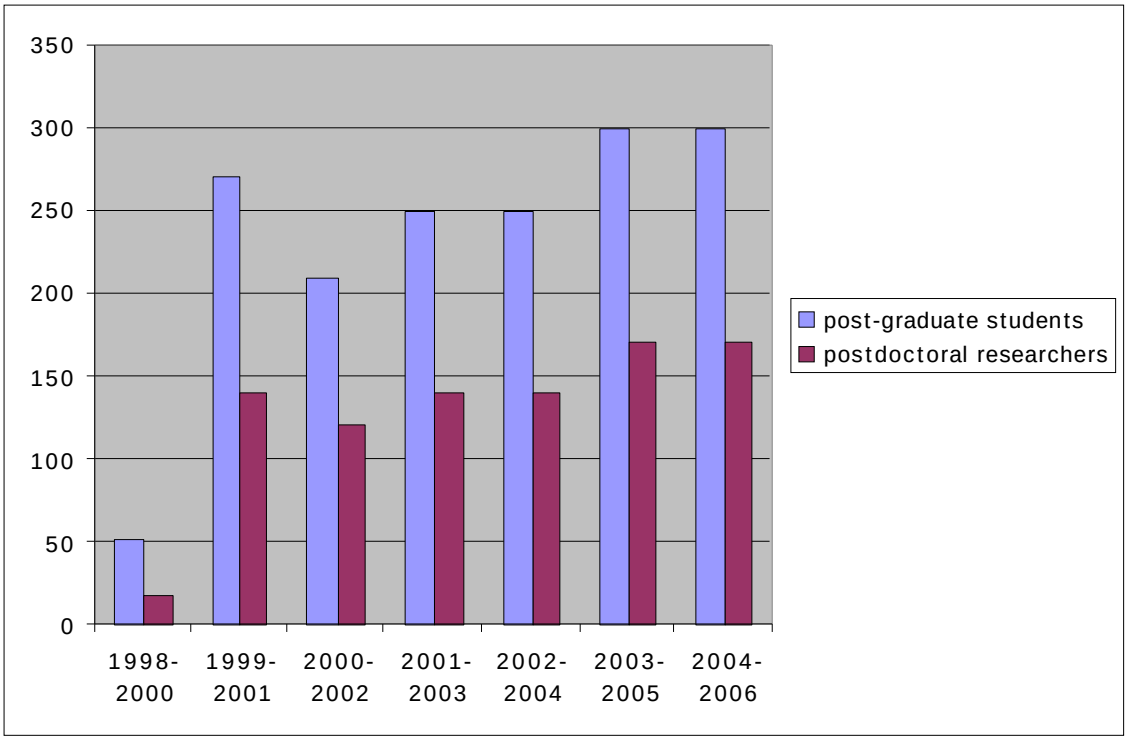
- The **Programme of Research for Third Level Institutions** (PSLRT) is significantly increasing the number of postgraduate and post-doctoral grants available in Ireland. These grants are available across all disciplines, and are awarded to the **institution**, which then selects suitable candidates. It can be estimated that 85% of the PRTLI researchers will be in science areas. PRTLI grants are intended to enable strategic development of fields and groups within the university system. At present, they cover a three-year period, but HEA will probably extend this to 5 years in order to allow greater flexibility for the universities – giving them more time, for example, to find PhD students
- The **Science Fund for Ireland** (SFI) provides more strategic research funding, focusing on IT and the bio-sciences. Here, too, there will be more post-graduate and post-doctoral research grant available. In SFI, however, the Principal Investigator applies for the grant, so the funding agency has some say in the choice of recipient

Under the PRTLI, the level of the stipend is not set and it is a matter for the institutions to make a proposal for the level of funds that they consider they will require. This is in order to try to keep pace with wage pressures in the private sector – a major competitor for skilled manpower, especially in the IT sector, which is particularly strong in Ireland. The offer to postgraduates is on average £IR9.9 K p.a. (plus fees) and to post-docs, £I 27K for the 2000-2002 graduates. This is dramatically better than was the case only a few years ago, when grants were of the order of £2k p.a. plus fees.

Under the PRTLI, eligible current expenditure includes support for research appointments, postgraduate and post-doctoral support, research equipment and supplies, travel and sabbatical leave, visiting researchers, books and journals, publicity, promotion and communications, conferences and workshops, subscriptions and membership costs, computer software and data bases, technical assistance and other research related services. To date, a large proportion of the funds has been sought for and allocated to postgraduate and post-doctoral support.

The following exhibit shows the number of post-doctoral researchers that are and post graduate student that will be funded under both programmes in the period 1998-2006.

Exhibit 2 Number of Post-Graduate Students and Post-Doctoral Researchers to be funded by the PRTLI and SFI programmes



Enterprise Ireland continues to fund 15-20 post-docs per year, but is phasing out its PhD support. The Humanities and Social Sciences Research Council (HSSRC) funds about 100 postgraduate places p.a., and from October 2001 the new Science Funding Council should have in place an equivalent scheme, aimed at individual PhD students. Students will apply to the Council for these, rather than getting them via the colleges.

Summarising, the funding situation for research graduates in Ireland is improving dramatically in the coming years, which is a crucial element for the strategy to improve attractiveness. Nevertheless, as the following chapters will show, there are other elements besides remuneration that decide what places are attractive for young researchers. That means there are more challenges for Ireland to meet the skill shortages issue.

2 Human Mobility and The Knowledge Economy

The issues of human mobility, internationalisation of research, and brain drain have caught the attention of many scholars, research managers and policy makers. International organisations such as the OECD, the European Commission as well as national governments have prompted various studies and debates on these subjects. As an OECD report states, "the move towards the knowledge-based economy has placed human resources in science and technology at the forefront of policy debate, not just in the area of education and labour markets but also in science, technology and innovation policy."[5] Technological progress is propelling demand for skilled labour and the need for improvement in skills across countries, although increase in demand is not being met equally across countries, despite overall increases in higher education graduates.

The OECD also highlights the global dimension to the demand for high skilled personnel and access to international sources of S&T personnel. Human capital is of growing importance to technology-led economic growth. The global market is increasingly becoming the main solution in meeting specific personnel and skill requirements. Hence, the openness of higher education and research systems, as well as an environment that promotes and enables research and innovation is vital in attracting top foreign talent. Additionally the public research sector must be ready to adapt to changes in research and employment, in particular the new types of competition/alliance they face with industry.

2.1 Europe and the Challenge of Brain Drain

Scholars on brain drain suggest that "increased demand for highly-skilled personnel world-wide and a broadening range of international education opportunities will inevitably exert pressure on the European stock of highly-skilled labour. Europe needs to be aware of these changes and other developments in supply and demand of international skills. Some scholars even state that Europe could be losing its brightest and best scientists, academics, managers and engineers. In particular it could be losing the younger S&T and managerial personnel, who are probably those with the most up-to-date training." [6]

This phenomenon has been coined 'brain drain', and is defined by the encyclopaedia Britannica as the "departure of educated or professional people from one country, economic sector, or field for another usually for better pay or living conditions". But what effect has/does this have on Europe? According to Mahroum brain drain fears in Europe centre on the so-called *la crème de la crème*, i.e. "star scientists" who are the brightest and best and whose talents can have many spill-over benefits for their host countries, which are therefore not available for their home country. The fact that

[5] OECD, Mobilising Human Resources for Innovation, 2000
[6] Mahroum, S., Europe and the Challenge of Brain Drain, IPTS report no 29. November 1998

significant numbers of top European scientists are abroad could pose a serious challenge for Europe in certain emerging sectors such as the biosciences.

Nevertheless, there is very little empirical research on the international flow of researchers and little empirical evidence what this brain drain really entails. Methodological and ethical problems related to tracking researchers along their career paths have prevented the development of any robust statistics on international mobility. The European Commission has recently launched some studies to study inter-European mobility patterns, but mobility statistics, if available at all, are usually restricted to national mobility patterns and lose track of researchers once they leave a country.

But despite the lack of data, the perception of the European science community is that much of their best talent goes to countries where opportunities for career development are best, i.e. The United States. Alongside geographical brain drain there is the attraction of the private sector with much better financial and career prospects. And within the science areas there seems to be a shift of graduates away from the hard sciences and towards more business oriented courses. Or as the European Research Area document states: "Every country in the Union is observing a disaffection for scientific study and a loss of interest among the young in careers in research. In Germany for example, the number of physics students has dropped by half since 1991."[7] The OECD has observed that countries are tapping into alternative sources (non S&T workers, women, older workers, minorities) to fill the skills gaps, particularly in the IT sector.

There are obviously policy implications that go hand in hand with the reversal of Brain Drain. One of the main problems is that once abroad Europe's scientists often find it difficult to return. The private and public sectors could play a bigger role in absorbing European repatriates and in encouraging them back. "The private sector can play a very useful role in joint ventures with the public sector whereby research and engineering centres of excellence could be set up across Europe".[8] This would inevitably change the situation from an eventual "brain drain" to what some have referred to as a "brain circulation".

The European Commission has given greater mobility of researchers in Europe a high priority in the European Research Area (ERA)[9]. The Commission has played a large role in stimulating inter-European mobility through the various exchange and mobility programmes, of which the Mary Curie Fellowship scheme is aimed at research graduates and post-doctorates. This was basically an answer to the lack of mobility within Europe as compared to within the US. The implementation of the ERA policy also aims at stimulating a European dimension to scientific careers, a greater place and role for women in research, and to increase the attractiveness of sciences to young

[7] European Commission, Towards a European research area, Brussels, January 2000.
[8] Johnson & Regets, 1998 in Mahroum 1998
[9] European Commission, Towards a European research area, Brussels, January 2000.

people. Ireland can benefit from these European actions by using the possibilities of European actions to the full.

2.2 International Migration of Human Capital

The aforementioned globalisation and the resulting concern about the future location of research, skill shortages, and the migration of highly skilled personnel have become major issues for policy makers.

Already in the 1960s the developing countries had a concern about 'brain drain' in the sense of a one-way flow of scientific and professional talent from the South to the North, but also within the North – especially towards the USA. This appears to comprise several elements

- Some degree of economic migration
- A confusion, where a movement of students and post-doctoral researchers to the North is interpreted as an intention to emigrate permanently
- 'Delayed return' – as, in recent years, has been the case with a large number of Chinese who were abroad as students during the Tienanmen Square incident, and who do not want to return home until there is a change of government
- 'Overflow,' where there is an over-supply of scientific or professional people compared with the ability of the home economy to absorb them[10]
-
- A mid-1970s study of 6 500 students in 11 countries showed that
-
- Students who stayed in their country of study on completion of their courses nonetheless intended to return to their home country
- Most of the students who had returned to their home country intended to stay there
- It was not necessarily the brightest students who stayed in the country of study[11]

Of course, the longer people stay abroad, the greater is the tendency for them to get 'stuck' in their new location, but it does appear that the 1960s concern about brain drain was over-blown. International mobility is increasingly understood as a normal part of scientific activity, and is actively fostered within the European Union by European Commission subsidies, in an effort to strengthen international research links. Also at this moment in Europe the empirical evidence is lacking to establish the seriousness of the brain drain situation.

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[10] For an early discussion, see G B Baldwin, 'Brain drain or overflow?' *Foreign Affairs*, Vol 48, No 2, 1970, pp 358 - 372

[11] W A Glaser and G C Habers, The Brain Drain: Emigration and Return, UNITAR Research Report, Oxford: Pergamon Press, 1978; cited from Jacques Gaillard and Anne Marie Gaillard, 'The international mobility of brains: exodus or circulation?' *Science, Technology and Society* Vol 2, No 2, 1997, pp 195 - 228

According to Mahroum[12], increasing opportunities for labour mobility across political borders, especially among highly skilled labour, provide a solution for the aforementioned concerns.

Mahroum argues that various groups of highly skilled persons are driven by different push and pull factors. In addition to immigration legislation, other factors, such as taxation, studying abroad, quality of work, openness in communication, business expansion overseas, labour market supply and demand signals, etc. play an important role in the choice of highly skilled migrants to relocate overseas. Additionally, the issue of migration and international mobility of highly skilled personnel is a complex and diverse one and requires highly tailored and diverse sets of policies. The following attempts to place together the set of incentives to migrate, along with certain push and pull factors of academics and scientists.

2.3 Incentives to International Mobility

The globalisation of R&D has seen increasing international alliances of scientists and levels of scientific co-operation across the different sectors. This global arena is where the bidding for human inputs into the R&D equation takes place, and therefore the maintenance of the domestic base, in terms of its attractiveness for national and international research, needs to be continually addressed. The focus here is the regulatory framework, tax systems and higher education systems that may encourage/discourage potential foreign researchers and R&D investors.[13]

Countries are becoming aware that to maintain a certain competitive edge they need to internationalise their education and research systems, and more importantly to make use of temporary and foreign S&T personnel to improve their research base and stock of qualified researchers/scientists. Further, there has been a realisation that the focus on 'push' and 'pull' factors of researcher mobility needs to be given special attention to stimulate this desired mobility of foreign scientists.

International mobility comes in a number of guises, from short-term visits to permanent migration, noteworthy is the increase in long term expatriation, said to be due to diminishing economic disparities between countries.[8] There are a number of common incentives/ disincentives for international mobility of S&T personnel.

Governmental policies or industrial policies, particularly incentives such as tax incentives, superior research infrastructures and preferred wages, are obvious. Less transparent are the effects of the National Innovation System (NIS), which play an important role in shaping the flow of highly skilled persons. For instance, countries whose NIS revolves around universities will primarily attract academics, and these will be the place where cutting edge national S&T activities take place.[14] While those

[12] Mahroum, S. Highly Skilled Globetrotters: The International Migration of Human Capital, Institute for Prospective Technological Studies, Joint Research Center of the European Commission, Seville 1999.
[13] OECD, Globalisation of S&T Personnel, 1999
[14] Mahroum, Sami, *Op Cit*, 1999

NIS that centre on industrial and large public research institutes will have a different set of outcomes. The differences in these NIS will, to a large extent, influence individual choices for mobility and the types of flows in and out of certain countries. A good example here is that of the US, where the NIS revolves around 'centres of excellence', here attractiveness is based on global recognition, which in fact attracts large numbers of scientists and academics. For instance, Massachusetts Institute of Technology (MIT) has around 50% of its post-doctorate science and engineering specialisations taken by foreign students.[15]

Overall, the flow of professionals is in line with cutting edge, activity intensive locations. The reputation of the workplace being the attraction point for scientists and engineers across industry academia and the service sector. According to Mahroum (1999), however, immigration legislation remains the first and utmost important legislation area where human mobility is concerned. Countries that have designated special legislation to allow highly skilled immigrants to take jobs in their local job markets stand better chances of benefiting from a growing international pool of high calibre human resources.

Further, a country is usually better in some disciplines than in others. The scientific strengths of a country are crucial factors in attracting foreign scientists. Most foreign researchers in the UK, for example, work in the fields of clinical medicine and biosciences. Both are fields where Britain plays a leading role in Europe.[16] There is a strong bioscience base in the country, both scientifically and industrially. An example is the Cambridge area.

Another factor mentioned in the literature is the quality of life in locations that are successful in attracting researchers. All of the UK's top recipient universities are located in attractive places, which is an additional factor that has a large input in the decisions of scientists to re-locate. Which would explain why Switzerland is among the top European countries attracting foreign scientists: Apart from hosting major research and academic centres (such as CERN and the IBM Lab near Zurich), it also enjoys living standards that are among the highest in Europe.

A number of countries have responded to research skills shortages by adapting the science system to the new demands. The OECD report on human mobility mentions a number of reforms that have taken place in the OECD science systems such as:

- Improving the quality of education to match societal needs
- Opening up the secure employment structure (which historically ensured low employment turnover, as well as concentrated age structures towards older workers) to promote more flexible arrangements. Pension arrangements have been cited as hampering mobility and measures to change them are also highlighted.
- Privatisation of parts of the research system to allow more market based employment conditions and at the same time bringing in more commercial incentives such as a share in the returns of research results

[15] NSF/SRS, Science and Engineering Indicators 1998 in Mahroum

[16] European Science & Technology Indicators Second Report, 1997, EUR 17639

2.3.1 Push and Pull Factors of International Migration

In order to know what actions would help to improve Ireland's attractiveness to research graduates; we need to understand better what reasons they would have to move country. Studies that have looked into this question distinguish between academics, scientists and students.

Academics & Scientists

Academics and scientists are a special group of highly skilled personnel. In the knowledge economy they provide a large amount of input into creating the competitive advantage through basic research. Their geographic mobility is influenced by a variety of mechanisms that have been outlined by Mahroum[17] as:

- Bottom up developments in academia and science, as the primary influence on diffusion of scientific ideas
- International reputation and prestige
- The nature of the work to be performed
- Scientific openness – usually resulting in publication
- Quality of research staff in the organisation,
- Working conditions and salary
- The organisations reputation of excellence, quality and originality – sometimes enhanced by 'star' scientists such as Nobel laureates

Focusing on the reputation of institutions it becomes clear that inflows are concentrated in a number of prestigious and large universities. Those are usually the 'top' universities, well known for their international reputation, size and excellence. In the UK, for instance, Oxford, Cambridge and Imperial College are among the main recipients of foreign academic staff. Similar findings can be found for the US, where the bulk of foreign researchers are concentrated in California, Massachusetts and New York.[18] This agglomeration of foreign talent around recognised centres of scientific excellence is no doubt one of several factors promoting the growing importance of certain 'super-University' clusters such as those in Cambridge, Massachusetts and Cambridge in the UK.

Students

Students are mostly affected by governmental, intergovernmental, and inter-institutional policies. Today's students have an increasing recognition of the global workplace, and an awareness of the usefulness of international study to enter it. Participation in international education and training, including the various international exchange schemes and fellowships, has further stimulated the interest of young scientists to work abroad and has helped internationalise domestic graduates (Stein et al. 1996 – in Mahroum). Host countries are often the main beneficiaries of these graduate flows, as stay rates after completion of study are often quite high. For instance, about 50% of all Europeans who finish their PhD training in the United

[17] Mahroum, Sami, *Op Cit*, 1999

[18] Johnson, J.M.: 'International Mobility of Scientists and Engineers to the US: Brain Drain or Brain Circulation?' NSF Issue Brief 98-316, June 22, 1998

States stay there for longer. Many stay there permanently (Finn, 1997 – in Mahroum).

There is growing evidence that post-graduate students are most influenced by the quality of the organisations they choose to enrol with (Lambert, 1992; Mahroum, 1999), and equally important, by the after training opportunities that exist in the host country. Further outlined are the recognition of the global workplace, accessibility problems in the home country, and inter-cultural experience.

Higher education has been said to be the major backdoor for international mobility. Mahroum points out that pull factors that effect the influx of foreign students can also be the existence of possibilities in the host countries after graduation, elements such as after-training and the availability of venture capital and a business friendly climate. These can both increase number of students and also their stay rates in the host country, resulting in the increase of the permanent science base. Factors which further influence student influx are, work permits for partners/spouses and immigration policy which allows the student to remain in the country under a different immigrant definition.

Thus, the literature suggests that for a country as Ireland elements of a strategy for attractiveness would include:

- The improvement of the international scientific reputation of its institutes
- Information on the after degree career opportunities
- Flexible immigration and work permit rules for foreign post graduates

3 United Kingdom

3.1 Introduction

The UK is in the fortunate position of not having to make huge efforts in order to attract foreign scientists, but can instead focus on selecting the very best of them. The current national policies in place to persuade international researchers to come to the UK consist mainly of efforts to ease rules of immigration and obtaining work permits. However, there is also a rather large budget allocated to the funding of foreign researchers in the UK, which improves the opportunity and in turn the numbers of researchers that gain positions within the UK research area.

The most active institution in the field of promotion is the British Council, whose task it is to promote education in the UK abroad, to advertise its grant schemes, to select people to come to the UK, and to assist UK scholars wanting to study abroad. The Royal Society and the British Academy also support foreign researchers in the natural and the social sciences respectively. In addition, the six UK Research Councils offer a limited number of grants to international students. However, most of their activities are geared towards assisting UK researchers. In addition to these national institutions, most universities individually offer support schemes for international students.

Britain's past and present efforts to support foreign students and graduates are strongly linked to its colonial history and its diplomatic missions. In a 1999 speech, the British Prime Minister Tony Blair confirmed his commitment to attracting more international researchers to the UK. In his view, foreign researchers *"promote Britain around the world, helping our trade and our diplomacy. It is easier for our executives and our diplomats to do business with people familiar with Britain."*

However, in the most recent Science and Technology Whitepaper issued by the Department of Trade and Industry (DTI) in July 2000, the attraction of foreign scientists and engineers is treated only as a minor point. It is merely stated that it is vital for the UK to recruit from a global pool of knowledge. The key strategy is a reduction of barriers for immigration and obtaining work permits. The most important points concern:

- The streamlining of the visa process
- The improvement of work permit applications: Researchers who qualify for a work permit should be able to get one without leaving the UK
- The removing of the requirements for separate permits for supplementary work: Foreign academics should be able to work more easily in the private sector, for example as consultants or entrepreneurs

3.2 Research System

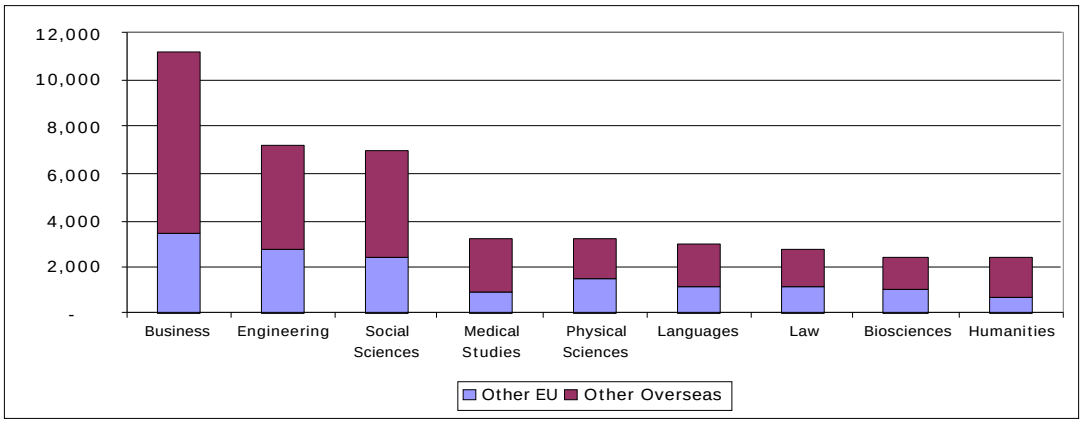
In the UK, the term postgraduate is used to describe students having completed their first degree and engaging in further studies towards either a Master's or a Doctoral

degree. A postdoctoral researcher is a member of academic staff involved in research who has completed their doctoral degree.

38% of all full-time postgraduates in the UK are foreign and 36% of these come from other EU-countries. The bulk of non-EU international researchers come from the Commonwealth. More than 7000 foreign postgraduates pursue studies in both Engineering and the Social Sciences, followed by lesser numbers in Medical Studies, Physical Sciences, Languages, Law, Bio-sciences and the Humanities (Exhibit 3 shows this distribution).

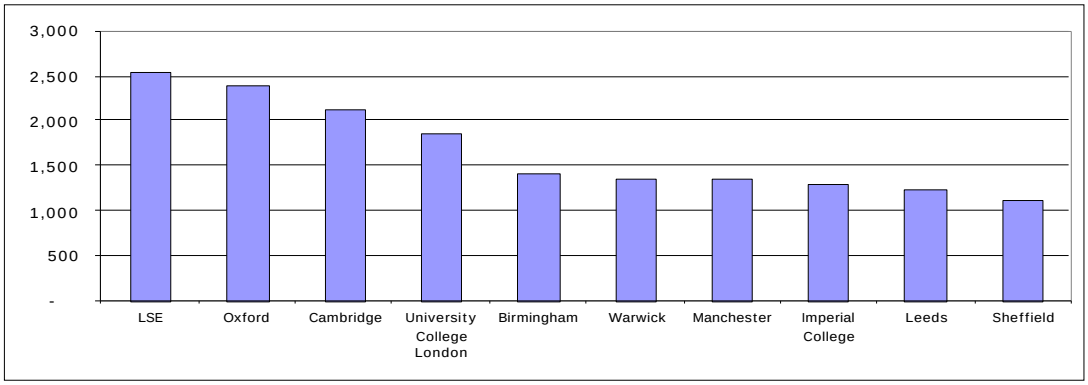
In terms of the institutions attracting the most international postgraduates, the London School of Economics is the pre-eminent institution in the UK, followed by Oxford and Cambridge. However, universities such as Birmingham, Warwick and Manchester also rank high in that respect. Exhibit 4 shows the top 10 universities in attracting foreign students.

Exhibit 3 Number of International Full-Time Postgraduates by Subject of Study



Source: Higher Education Statistics Agency (HESA)

Exhibit 4 Top Ten Recipient Universities (by Total Number of International Postgraduates)



Source: HESA

Foreign students in the UK usually pay higher fees than UK and EU students, who pay a 'home fee'. The international fee is sometimes considerably higher than the home fee. At Cambridge University, for example, postgraduates from the UK and the EU have to pay £ 2,740 (4,300 EUR) in tuition fees. However, non-EU overseas students are charged between £7,000 (11,000 EUR) or more, depending on the subject.

An exception is being made for citizens of non-EU countries who have resided in the UK for a minimum of three years for a purpose other than full-time education, they are charged the home-fee as well. All other overseas students have to pay higher fees. In general, overseas fee levels for postgraduate courses vary between £4,500 (7,070 EUR) and 9,000 (14,140 EUR), making foreign students a major source of income for their prospective universities. Funding is thus very important, as only a few international students can afford to study in the UK without financial assistance.

The provision of higher education in the UK is at risk because of the age profile of academic staff. And in many institutions the proportion of staff approaching retirement heavily outnumbers young entrants into the profession. Provision in a number of key areas, particularly education, science, engineering and technology, is under threat because of the numbers of staff approaching retirement age.

Nearly one third of academics in UK higher education are over 50 years old[19], and institutions are not recruiting sufficient academics to take the place of those due to retire. This is chiefly because of the poor pay and career prospects faced by those considering an academic career, for which starting pay is as low as £14,902 (23,400 EUR)[20]. Overall, one fifth of academics are under 35 years old and 22% of UK universities have a ratio of more than two staff aged over 50 for every one member of staff up to 35.

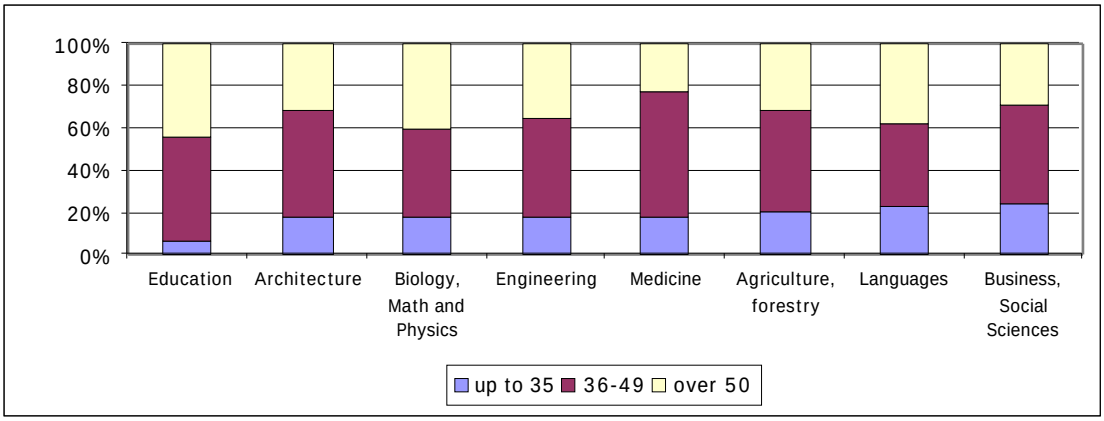
Exhibit 5 looks at the age profile of academic staff broken down by their subject groups, each subject group is further broken down by staff pay scales. The area of education is particularly affected, and the figures indicate there will soon be a crisis in teacher training provision. The age profile of academic staff in subjects needed for the 'knowledge based economy' – such as biological, mathematical and physical science, and engineering and technology – is also of particular concern.

However, at this point not much has been done, and the only solid initiative has been early retirement packages, which have been introduced at some universities. This apparent lack of will to address the problem is manifested in the most recent Science and Technology Whitepaper, which does not mention the problems related to the age profile of academic staff, the level of their pay or their increasingly casualised careers.

[19] This age group is significant, because staff in a number of institutions become eligible for early retirement from 50. Although the contractual age of retirement for academic staff varies, the average age of retirement for staff in the pre-1992 sector has recently fallen to 60. And the average age of retirement for staff covered by the Teachers' Superannuation Scheme, which includes academics in the post-1992 sector as well as schoolteachers is 56.

[20] Bottom of lecturer scale, post-1992 sector, from September 1999.

Exhibit 5 UK Academic Staff Age Profile 1997-1998



Source: Association of University Teachers, 2000

If a postgraduate student is in need of financial assistance, the application process is usually two-tiered: They need to apply to both the university of their choice and the funding institution, except in cases where funding is provided by the university itself. If the scholarship obtained includes the payment of the tuition fee, the university will be paid directly from the funding institution. Maintenance and travel grants will be paid to the recipient's directly.

The amount of money offered by the different grants varies enormously, and depends on the nature of the scheme, the country of origin of the applicant, the recipient university, the course of study, and the financial background of the applicant. Some grants cover all or part of the tuition only, others cover only maintenance, some only travel, and others all fees incurred during the stay. However, full maintenance (living) fees seem to be around £ 6,000 (9,400 EUR) per annum for most schemes, which is not taxable.

Exhibit 6 shows the salary structure for researchers of various levels. From this it can be seen that the average gross salary of a post-doc, who would correspond to the lowest grade, is £ 23,100(36,290 EUR) per year.

Exhibit 6 Salary Structure of Academic Staff by Grades

Grades	Annual Gross Salary (EUR)
Professors	77290
Senior Lecturers	57650
Senior Researchers	57650
Lecturers	43515
Researchers	36290

3.3 Mechanisms to attract research graduates

3.3.1 National level

The Department for Education and Employment (DfEE) is the main source of funding for international researchers. It offers scholarships through the Overseas Research Students Awards Scheme (ORSAS) for full-time overseas postgraduate students registered as research students at British universities. In the current financial year, they are providing £12.5m (19.6 MEUR)

There are also other Government schemes to support overseas students. The Commonwealth Scholarship and Fellowship Plan is jointly funded by the Foreign and Commonwealth Office and the Department for International Development. It will receive £12m (18.8 MEUR) this financial year. The Shared Scholarship Scheme is funded by DFID and will receive £2m (3.1 MEUR) this financial year. And the British Chevening Scholarship Scheme, where FCO is providing £30m (47 MEUR) this financial year.

Non-fiscal initiatives are being undertaken by The Department of Trade and Industry's (DTI) Education and Training Sector Group which aims to help the UK education and training industry to maximise its share of international markets. And a series of marketing plans for a number of countries is being developed in association with the British Council.

In January of this year The Department for Education and Employment launched the UK Education Brand which marked the beginning of a three-year programme to raise the profile overseas of UK education. The Brand, together with generic marketing materials, supports promotion activities overseas of UK higher education institutions. The budget put towards this initiative is 7.8 million EUR.

As a consequence of the measures set forth in the Science and Technology White Paper, The Immigration and Nationality Directorate has introduced service targets for processing visa applications of international students and researchers. The targets for dealing with straightforward and non-straightforward student visa applications are 24 hours and 10 working days respectively. Also, where foreign researchers previously had to apply for the extension of their visa throughout their stay in the UK, they now will be granted leaves to remain in the UK for the full duration of their study or research period.

3.3.2 Intermediate Level

British Council

The British Council is the foremost UK institution in promoting education and research in the UK. Its task is to administer a range of grants as well as to raise the profile of UK education abroad. The joint research programmes of the British Council have been developed to promote links between British and other European higher

education institutions, research institutions, and laboratories. Joint research programmes operate in most European countries with partner organisations. Programmes are designed to facilitate research and teaching collaboration, and provide opportunities for young researchers by awarding grants as well as small sums for travel and subsistence. The following grants are administered by the British Council:

British Chevening Scholarships aim to bring to the UK able researchers from countries with whom the UK's economic relations are expected to develop. Awards are given annually and can cover all or part of the cost. The selection of international candidates is carried out by British Embassies and High Commissions in consultation with the local British Council Director. The Chevening Scholarships are funded through the Foreign Commonwealth Office, and sometimes jointly funded with private companies, universities, trusts, foundations and other grant-making organisations.

Commonwealth Scholarship and Fellowship Plan is funded by the Department for International Development and the Foreign and Commonwealth office and is designed exclusively for citizens of the Commonwealth or of a British independent territory. Grants are exclusively for postgraduate research, are available for the duration of one to three years, and usually cover the cost of travel, tuition fees and living expenses. In some cases, additional allowances may be available for help with books or clothes, and may be paid to help with the cost of maintaining spouses.

Overseas Research Students Awards Scheme are funded by the Department for Education and Employment and are designed for postgraduate students undertaking full-time study for a higher degree who are registered research students at British universities. Selection of candidates is based solely on academic merit and research potential. Awards meet the difference between the home and overseas level of tuition fees only, and do not cover maintenance costs. They are initially made for one year but can be continued for a second or third year, subject to the progress of the award-holder.

British Marshall Scholarships are funded by the Foreign and Commonwealth Office and are open to US citizens under twenty-six years of age who are graduates of US universities to undertake study in any subject leading to a degree at a UK university. The selection of candidates is made by a US committee on a competitive basis for two years in the first instance, renewable for a third year in certain circumstances. The awards cover fares, tuition fees, maintenance, and book, thesis and travel allowances.

Fulbright Scholarships are funded by the Department for Education and Employment and the US government, and are open to US graduate students for study in the UK. Awards are for nine months, but renewals for one year can be offered to a limited number of students. The awards cover round-trip travel, a maintenance allowance, approved tuition fees where applicable, and an incidental expense allowance.

Awards are also available for lecturing or advanced research for a minimum of three months. There are two types of awards: Programmed awards in response to specific requests from UK institutions and grant-in-aid made on a competitive basis.

Royal Society

The Society supports and promotes science across six continents funding research activity grants, which enable high quality scientists to move to and from the UK. Overseas scientists apply through the Society's partner organisations overseas where formal exchange arrangements exist. Grants are for individuals and the main criteria are the quality of the individual and the proposed scientific research. In terms of eligibility, scientists must be of PhD or equivalent status. Grants are intended to provide for accommodation and subsistence. Some will also include the cost of international airfare.

There are three different types of schemes:

1 Study visit grants are short-term visits generally between two weeks and three months, the key objective being to enhance the research capabilities of individual scientists, develop international collaborative links, enable participation in international programmes and preserve high-quality science.
2 Fellowship grants are aimed at young scientists and provide an opportunity to do research in a different country for up to two years. Fellowships are available under a variety of schemes operated in association with NATO, the Foreign and Commonwealth Office, and other national and international institutions.
3 Joint grants provide funding over 24 months for exchange visits to take place in connection with bilateral research collaboration between the UK and an overseas research group.

British Academy

The British Academy is the counterpart of the Royal Society, which exists to serve the natural sciences. The Academy, among others, aims to represent the interests of scholarships nationally and internationally, and to further international collaboration and exchange.

All research grants are available exclusively to UK researchers. However, there is a substantial number of exchange and collaborative programmes, under which funding is available to cover research visits by British scholars to the partner country, visits by scholars from the partner country to the UK, and attendance at joint seminars, conferences or workshops. Conditions attached to those funds and the amounts of money available vary from country to country.

In addition, funds are available to support international joint activities, involving British scholars in collaboration with foreign partners, in one, or possibly two other countries. Grants are offered to support travel and maintenance costs for individual visits, or for workshops and symposia. However, the funding is not intended to cover major research expenses, for which support must be sought elsewhere.

There is also a Visiting Professorship and Fellowship and a Visiting Lectureship scheme. The Visiting Professorship and Fellowship scheme enables distinguished scholars from overseas to be invited to spend between two and four weeks in the United Kingdom. The level of award is £700 (1,100 EUR) per week plus a contribution to international travel. The Visiting Lectureship scheme enables a limited number of distinguished international scholars (normally up to four a year) to be invited to spend between ten days and two weeks in the United Kingdom. The level of award is £1000 (1.570 EUR) per week plus a contribution to international travel.

Research Councils

The UK Research Councils are autonomous, non-departmental public bodies principally funded by the science budget of the Office of Science and Technology (OST). The Councils support research in the higher education sector directly through the provision of research grants, fellowships and postgraduate studentships. Most funding is to enable UK scientists to go abroad rather than vice versa. But there are a number of schemes are available for international scientists, such as:

- The Underwood Fund, which provides travel and living expenses to senior overseas scientists to visit the UK to work with current Biotechnology and Biological Sciences Council (BBRRC) grant-holders in UK universities and BBRRC sponsored institutes. Visits should normally be for a period of three to twelve months.
- A limited number of Visiting Fellowships are provided by the Engineering and Physical Sciences Research Council. These enable scientists or engineers of acknowledged standing from abroad to give advice and assistance in research fields in which they are eminent, to introducing new techniques and developments that may advance research work in the UK, and/or work in connection with specific research projects supported by the EPSRC. Support is provided for salary, travel and subsistence. Funding is limited to 12 months per individual.

3.3.3 University/institutional response

The University of Oxford

With over 2,400 foreign postgraduates enrolled Oxford ranks second in the UK, behind the London School of Economics. Responsibility for attracting and assisting foreign students and postgraduates lies with the International Office, which administers the University's scholarship and bursary schemes for international students. The most important scholarship for international students is the Oxford Overseas Bursary, which is open to all students paying Oxford fees at foreign student rates. Priority is given to postgraduates, and the award covers up to half the tuition fee.

Other scholarships are designed for students from specific countries. The Oxford Kobe Scholarship is open to citizens of Japan for postgraduate study and covers full fees and maintenance. Similarly, the Felix Scholarships are targeted at Indian graduates and equally cover full fees and maintenance.

The office also co-ordinates the University's participation in the Socrates (Erasmus) programme and other exchange programmes. It maintains a library of information on overseas universities and can provide information on funds and opportunities for Oxford students wishing to study abroad. It also serves as the University's link to various international bodies, such as the Coimbra Group and the Conference of European Rectors (CRE), and has been active in a number of European Tempus projects.

The University of Cambridge

The University of Cambridge is the third most popular destination for foreign postgraduates. It is active in trying to attract foreign academics, mostly through offering financial support, the most important schemes are:

1. The Cambridge Commonwealth Trust for students from Commonwealth countries
2. The Cambridge Overseas Trust for non-EU international students
3. The Cambridge European Trust mainly but not exclusively for students of the European Union

The Trusts offer scholarships and part-cost bursaries to overseas students who have been accepted for admission. The amount of money offered under those schemes varies from country to country. In addition, there are a variety of smaller schemes. European Union students, for example, are eligible for the Isaac Newton Trust European Research Scholarship, which pays a fixed fee of £ 2,000 (3,150 EUR) to thirty-three students annually.

In addition to the administration of scholarships, Cambridge University entertains a range of contacts with other academic institutions overseas. The most notable of these contacts is the Cambridge-MIT Institute (CMI), a strategic alliance between the University of Cambridge and the Massachusetts Institute of Technology (MIT). The goals of this partnership are among others to bring about cultural changes through the student and faculty exchanges between CU and MIT areas of mutual

3.4 Summary

The UK is already in a strong position in terms of attracting international students/researchers. The strength of the science system, along with the presence of both reputable universities and centres of excellence has meant a steady inflow of researchers into the system.

Policies to attract international researchers consist mainly of efforts to ease rules of immigration and obtaining work permits. However, there is a rather large budget allocated to the funding of foreign researchers in the UK, which improves the opportunity and in turn the numbers of researchers that gain positions within the UK research area. This is a much needed direction, as the amount of tuition fees paid by foreigners is somewhat higher than the national fee.

The UK is spending roughly £270 million[21] (423 MEUR) on 'national' students (which include students from other EU countries, which have to be treated as nationals due to EU non-discrimination rules). However, statistics show that 6% of all 'national' students come from other European countries, thus, by removing 6% out of the £270 million British students receive approximately £254 million (398 MEUR). This is for students in total, not only PhDs.

Adding up the amounts spent on foreign students, (roughly £57 million per year (or 89 MEUR) plus £5m (7.8 MEUR) pounds over three years for the international marketing campaign), we can deduce that the UK spends £ 62 million on foreign students compared to £254 million on home students, which is a ratio of nearly 1:4. This means that despite having universities with a world class reputation, and its attractiveness to researchers from many nationalities, Britain is prepared to put a serious financial effort in supporting foreign graduates.

In the UK foreign research graduates can apply for dedicated funding schemes such as the Overseas Research Students Awards Scheme as described in the UK country report. Very often they will be paid by grant schemes in their home countries, or on the basis of bilateral exchange schemes.

[21] Information made available from the Department for Education and Employment and the British Council

4 United States

4.1 Introduction

Foreign born scientists and engineers contribute significantly to the brain-power of the United States (US). According to a National Science Foundation (NSF) brief[22] 29 percent of doctorates conducting R&D in 1993 were immigrants, the following Exhibit 7 shows the breakdown of the sector and location of these scientists. What comes to attention is the large percentage (overall 68%) of foreign born scientists engaged in R&D that gained their education at an American institution. The large foreign component of US human intellectual capital can therefore be linked to the ability of US higher education to attract, support, and retain foreign students.

Exhibit 7 US and foreign-born scientists & engineers in R&D, in the US by sector and location of S&E degree (1993)

	Total		Education		Industry		Government	
Scientists & Engineers in US R&D	All degree levels	PhDs	All degree levels	PhDs	All degree levels	PhDs	All degree levels	PhDs
Total engaged in US R&D	2685000	345000	592000	179000	1747000	135000	346000	31000
US born	2254000	244000	470000	128000	1477000	90000	307000	26000
Foreign Born	431000	101000	122000	51000	270000	45000	39000	5000
Location of S&E Degree								
Foreign School	138000	32000	41000	16000	87000	14000	9000	2000
US School	293000	70000	81000	35000	183000	31000	29000	4000
Foreign born as % of total in R&D	16.1	29.3	20.7	28.5	15.5	33.2	11.2	17.3
US school as % of foreign born	67.9	68.7	66.1	67.9	67.6	69.6	75.8	69.2

Source: NSF Issue Brief, 98-316, June 22, 1998.

Foreign S&E doctoral recipients remaining in the United States do so mainly by entering postdoctoral study. (NSF 1998) Of the 55,000 foreign students from the major countries of origin who earned S&E doctoral degrees between 1988 and 1996, about 22 percent (12,000) stayed on for postdoctoral study, and 17 percent (9,000) accepted employment in the United States. A recent study of foreign doctoral recipients working and earning wages in the United States (Finn, 1997) shows that about 47 percent of the foreign students on temporary student visas who earned doctorates in 1990 and 1991 were working in the US in 1995.

4.2 Research System

The number of foreign graduate students (Bachelor) between 1990-1997 has been on average around 25% of all S&E students. The foreign percentage of S&E Masters

[22] National Science Foundation, Divisions of Science Resource Studies, International Mobility of Scientists & Engineers to the United States – Brain Drain or Brain Circulation, Issue Brief, NSF 98-316, June 22, 1998.

degrees recipients in the same period is similar at 24%. This situation has provided a strong interest from students wishing to continue study in the US, and developed an environment that promotes the US as a choice of foreign students.[23] The number of foreign S&E doctoral recipients that graduated from US universities has doubled from over 5,000 in 1986 to 10,000 in 1996, translating into an 8% average annual increase.[24]

For the period 1992-96, the NSF Brief showed that the proportions of foreign doctoral recipients planning to remain in the United States had increased: over 68 percent planned to locate in the United States, and nearly 44 percent had firm offers to do so. To a large extent, the definite plans of foreign doctoral recipients to remain in the United States revolve around postdoctoral study rather than employment. Among students born in those countries accounting for the largest numbers of foreign doctoral awards, the majority of definite plans to remain in the United States were for further study (58 percent on average between 1988 and 1996). This was followed by employment in R&D (27 percent), teaching (7 percent), and other professional employment (8 percent).

Before starting it is useful to outline that in the American case students are not provided an across the board payment for tuition and living expenses. The system provides for a large number of funding possibilities through a large number of agencies. These funds can be for tuition, living expenses, or both. They are available from Federal institutions, but can also be made available from university funds. According to the employment department at UCLA, the university, as in most universities in the US, is highly departmentalised. In a number of instances the departments receive their own federal funding – usually for research projects, and in this case have funding to support post-doctorates etc. in the form of researchers posts specific projects.

Graduate students generally incur greater expenses than undergraduates, with most attending for a calendar year rather than for an academic year, increasing tuition costs. In 1999-2000, nine-months' tuition at Massachusetts Institute of Technology (MIT) cost $25,000 (26,7000 EUR). Graduate students' costs for housing, food, books, medical insurance, and incidentals vary greatly, depending on marital status, quality-of-life expectations, and housing arrangements. Typical monthly expenses range from as low as $1,500 (1,600 EUR) to $2,500 (2,670 EUR).

“Growth in academic employment over the past half a century in the US reflected both the need for teachers, driven by the increasing enrolments, and an expanding research function, largely supported by federal funds.”[25] The average age of doctoral academic science and engineering faculty and postdoctoral positions continues to rise, those 55 years or older constituted 13% of the total in 1973, and 26% in 1997. This

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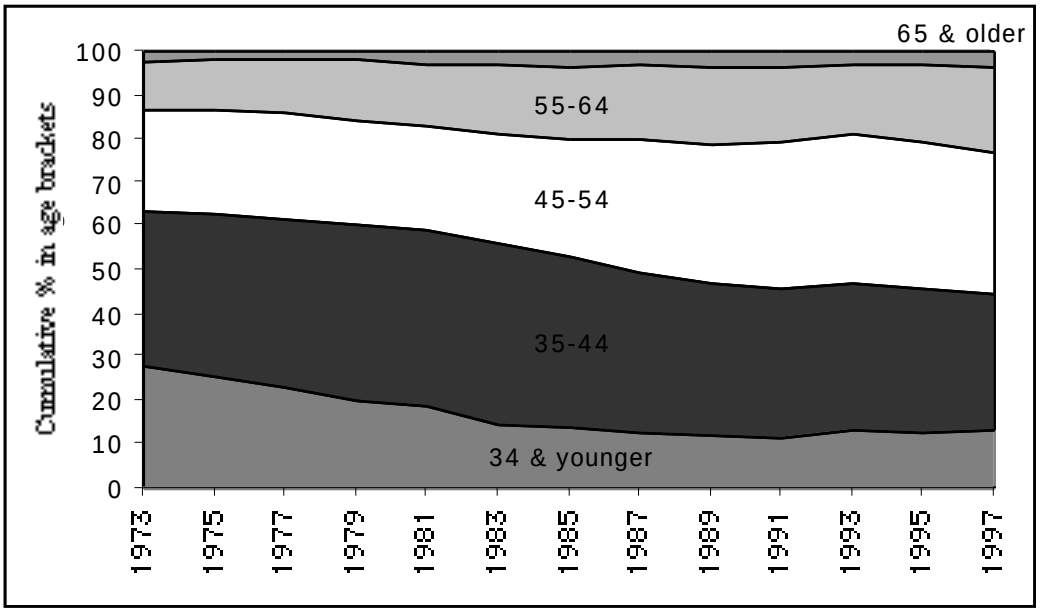
[23] Johnson, Rapoport & Regets, U.S. Graduate Education, 2000

[3] NSF, Division of Science Resource Studies, Graduate Education Reform in Europe, Asia, & the Americas & International Mobility of Scientists & Engineers: Proceedings of a NSF Workshop, NSF, 00-318, April 2000.

[25] National Science Board, Science & Engineering Indicators – 2000. Chapter 6. Academic Research and Development: Financial and Personnel Resources, Support for Graduate Education, and Outputs, Arlington, VA: National Science Foundation, 2000 (NSB-00-1)

was due to the rapid pace of hiring young PhDs into academic faculty positions during the 1960's to accommodate increasing enrolments, combined with lower rates in the later years, Exhibit 8 clearly shows this. In this respect it is important to continue to attract young researchers to academic faculty positions to ensure that there will continue to be suitable levels of teaching staff in the future, to in turn ensure an expanding the pool of trained manpower for the future.

Exhibit 8 Age Distribution of academic doctoral scientists and engineers



Source: National Science Board 2000, Science & Engineering Indicators - 2000

This ageing of R&D faculty is even more problematic in that university scientists are increasingly performing a major part of basic research. And the Science and Engineering Indicators report showed that US universities and colleges are an indispensable resource in the R&D system, they conduct 12 percent of the national total R&D, 27% of its basic and applied research, and 48% of its total basic research. And in 1997 an estimated 164,000 S&E doctorate holders employed by universities were engaged in some sort of R&D, a 7% growth since 1995, with 86,000 identifying research as their primary work responsibility.

Financial support available from academic research activities appears to be a major factor associated with attracting foreign students to U.S. doctoral programs. The NSF brief on international mobility (1998) reports than 75 percent of the 10,000 foreign doctoral recipients at U.S. universities in 1996 reported universities as the primary source of support for their graduate training. Further, of those who did so, the majority reported their primary support came in the form of research assistantships. The financial resources for these research assistantships are provided to universities by Federal Government agencies, industry, and other non-federal sources in the form of research grants. This funding has been growing and from 1985-96, academic research expenditures increased from $13 to $21 billion in constant (1992) dollars (13.8 22.4 billion EUR). During the same period, the number of foreign doctoral

students primarily supported as research assistants more than tripled—from 2,000 in 1985 to 7,600 in 1996.

Support comes from a number of sources whose relative contribution has been changing over the past several decades. The NSF has shown[26] that the main sources of financial support for academic R&D are at the federal and institutional level. The federal government is a major financial supporter of both academic research and development, and science and engineering graduates. In 1998 it provided an estimated 60% of academic R&D funds, and was the primary source of financial support for 30% all full-time S&E graduates (excluding those who were self-funded).[27] And in 1997, 39% of the academic doctoral scientists and engineers reported receiving federal funding for their research.

The NSF report of December 1998 on sources of funding for academically performed R&D showed that institutional funds constitute the second largest source of academic R&D funding. The major sources of institutional R&D funds are: general-purpose state or local government appropriations, particularly for public institutions; general-purpose grants from industry, foundations, or other outside sources; tuition and fees; and endowment income. Other potential sources of institutional funds are income from patents or licenses and income from patient care revenues.

Financial aid for graduate students is provided in most cases by individual departments, and the amount of aid available varies significantly among disciplines. Financial support includes fellowships, traineeships, teaching and research assistantships, and loans. The definitions and terminology of these financial supports are:

- Fellowships – which include any competitive award (often from a national competition) made to a student that requires no work of the recipient.
- Traineeships - educational awards given to students selected by the institution.
- Research assistantships - support given to students for which assigned duties are primarily devoted to research.
- Teaching assistantships - support given to students for which assigned duties are primarily devoted to teaching.
- Other mechanisms of support include work/study, business or employer support, and support from foreign governments that is not in the form of one of the earlier mechanisms.
- Self-support is support derived from any loans (including Federal loans) or from personal or family contributions.

At UCLA "Academic Apprentice Personnel" is the term applied to registered graduate students who have fulfilled the University's established criteria for appointment to teaching or research assistantships. These apprenticeships are intended to provide qualified students with relevant training experience for academic and academic-related careers in teaching and research and to augment limited resources from within the University for graduate student support. As a matter of University policy, apprentice

[26] NSF, Division of Science Resources Studies, What are the Sources of Funding for Academically performed R&D?, Issue Brief, December 23, 1998.

[27] NSF, Division of Science Resource Studies, What is the Federal Role in Supporting Academic Research and Graduate Research Assistants?, Issue Brief, April 16 1999.

personnel in both the teaching and research series are considered primarily as students being professionally trained.

Teaching assistants receive a monthly salary of approximately 1815 Euro whereas research assistants receive from nearly 1400 Euro up to 1784 Euro depending on their experience.

Postdoctoral fellow standing is normally for a period of one to three years. At UCLA it is limited to a period not to exceed five years. Postdoctoral scholars are eligible to receive University administered funds in the form of a fellowship or traineeship award, or a salaried appointment. The type of support is determined by the terms stipulated by the funding agency and is categorised as either a stipend or salary. The following annual stipend rates apply to individuals receiving support through institutional or individual National Research Service Awards:

Exhibit 9 Postdoctoral Trainee Salary Scale for 2000-2001

Postdoctoral Years of Experience	Annual	Monthly	Yrs.	Annual	Monthly
0	$26,916	$2,243	4	$36,936	$3,078
1	$28,416	$2,368	5	$38,628	$3,219
2	$33,516	$2,793	6	$40,332	$3,361
3	$35,232	$2,936	7+	$42,300	$3,525

Exhibit 10 Postdoctoral Associate Salary Scales for 2000-2001

Step	Annual	Monthly	Step	Annual	Monthly
1	$30,888	$2,574	6	$38,460	$3,205
2	$32,208	$2,684	7	$40,308	$3,359
3	$33,696	$2,808	8	$41,736	$3,478
4	$35,124	$2,927	9	$43,692	$3,641
5	$36,732	$3,061	10	$45,828	$3,819

Postdoctoral fellowships are considered taxable income by the Internal Revenue Service (IRS), travel and health insurance payments issued as fellowship reimbursements are also fully subject to federal and state income taxation.

4.3 Mechanisms to attract research graduates

4.3.1 Federal level

On the Federal level the main policy strategies focus on the regulatory framework: immigration rules and taxes.

Foreign graduates have tax exemptions during their stay in the US. The United States imposes a payroll tax on most wages to pay for old-age pensions and medical benefits.

This tax is known as the "social security tax"; its technical name is the Federal Insurance Contribution Act Tax (FICA). All persons who earn income in the US are required to pay social security taxes on that income. The current rate is 15%, half of which is paid by the employer and half by the employee.

There are two important exceptions: foreign students are exempt from Social Security Taxes for the period of time they are non-resident aliens for tax purposes, and if their employment is directly related to their purpose for being in the US. Generally, this means that authorised employment of foreign students, including practical and academic training, is exempt from social security taxes, provided they are a non-resident for tax purposes (i.e. they have been in the US for less than 5 years).

The US also has a "Specialty Occupation Workers and Immigration Possibility"[28]. This immigration rule provides the possibility of employing special occupation workers for US employers (classified as H-1B workers). The H-1B is a non-immigrant classification used by an alien who will be employed temporarily in a specialty occupation. A specialty occupation requires theoretical and practical application of a body of specialised knowledge along with at least a bachelor's degree or its equivalent. For example, architecture, engineering, mathematics, physical sciences, social sciences, medicine and health, education, business specialities, accounting, law, theology, and the arts are specialty occupations.

In June 2000, the INS released a report that showed the leading employers of specialty workers between October 1999 and February 2000.[29] This showed that universities were making use of speciality workers, with seven universities listed in the leading 100. In actual terms this represents 113 workers for the highest-ranking university (position 42) and 61 workers for the university ranked as number 99.

4.3.2 The National Science Foundation

The National Science Foundation funds research and education in science and engineering, through grants, contracts, and co-operative agreements. The Foundation accounts for about 20 percent of federal support to academic institutions for basic research, with approximately 80% of its funding going to research projects.

The NSF has no direct policy for funding foreign students and/or researchers. However, through its research grants to a large number of universities and research institutions it indirectly allows for the utilisation of foreign scientists. There are no statistics available on the share of NSF funding that goes to foreign research graduates. It is up to the institutions to recruit the staff for their NSF funded projects, and the NSF does not require information on the individuals conducting the research.

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[28] Information found on the Immigration and Naturalisation Service (INS) web pages

[29] INS Leading Employers of Specialty Occupation Workers (H-1B): October 1999 to February 2000, June 2000.

NSF does focus on the internationalisation of American scientists by providing a number of grants and awards, one in particular is the International Research Fellow Awards Program (IRFAP).

4.3.3 University response

· **Biotechnology and the American Situation**

The U.S. biotechnology industry leads, or is at least competitive with the rest of the world in terms of its size and the development of innovative products and processes. During the past few years venture capital funds have directed additional funds toward the European biotechnology industry as academics and governments there adopt a more entrepreneurial approach to the exploitation of basic scientific findings. Although the situation in 1996 saw the U.S. biotechnology industry at least four times larger than the European biotechnology in terms of revenues, R&D expenses, and number of employees, it was only twice as large in terms of the number of companies.[30]

In 1998, the number of people working in the biotechnology industry in the United States was estimated to be 153,000, a 9 percent increase over the preceding year[31] and according to NRC information is currently estimated at approximately 172,000. Employment has been growing at between 9 and 17 percent per year over the past 4 years and is expected (conservatively) to grow annually at 8.5 percent for the next decade.

The intellectual backgrounds needed to develop biotechnology products or processes need to come from a large pool of experts, biotechnology is therefore built upon a strong scientific foundation. As a result, the general biotechnology workforce responsible for product development requires a relatively high level of education than does for instance the IT workforce. In most cases, biotechnology scientists must have years of training in experimental work. It is estimated that at least half of the employees in the biotechnology industry are scientists and/or technicians and involved in R&D or production.[32] In the smaller, more research-intensive companies, the proportion of scientific/technical skills of the workforce may be even higher.

The biotechnology industry has used H-1B visas to recruit staff in the areas of skill shortages, and according to data presented by the Committee on Workforce Needs in IT[33] the use of H-1B visa holders is much higher in the biotechnology industry than

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30 National Research Council, Committee on Workforce Needs in IT, Building a Workforce for the Information Economy, Appendix A – Biotechnology, 2000.

31 Ernst & Young. 1998. Biotech 99: Bridging the Gap. 13th Biotechnology Industry Annual Report, Palo Alto, p.4. in National Research Council 2000 – footnote 12 - Available online at http://www.ey.com/global/vault.nsf/International/Biotech99:BridgingTheGap/$file/biotech99.pdf

32 Dibner, Mark D. 1999. "Career Alternatives for Scientists." Nature Biotechnology 17(8):825. In National Research Council 2000 – footnote 54

33 Steve Dahms, San Diego State University, interview on March 8, 2000, and testimony at the meeting of the Committee on Workforce Needs in Information Technology, September 22-24, 1999, Santa Clara, Calif. In National Research Council 2000 – footnote 54

first thought. Of the 25,000 employees who work in San Diego biotechnology/ biopharmaceutical companies, 6.4 percent are H-1B visa holders. The information further shows smaller companies have reported up to 17 percent of their workforce as foreign nonimmigrant workers, and in a number of cases have sponsored staff for resident status. These figures reflect the affect immigration rules can have on reducing skills shortages, particularly in specialty areas such as biotechnology.

· Whitehead Institute for Biomedical Research[34]

Background on the Institute

The Whitehead institute is one of a number of institutes that are affiliated with MIT. All Whitehead Members have faculty appointments at MIT, but carry out their research programs at the Whitehead Institute, which is solely responsible for their support. The annual budget of the Whitehead Institute is approximately $30 million. Endowment funds from a variety of sources provide the seed money necessary to develop new directions in science. And according to the institute the flexibility resulting from these resources has played a central role in their development.

According to the Public Affairs Office of the Institute it has been a pioneer in science education, and the Whitehead Fellows Program allows promising young scientists with exceptional research agendas to pursue independent research programs as an alternative to traditional post-doctoral positions. The programme is seen as a successful model for bringing the very best young scientists to maturity ahead of their time, allowing increased flows into the workplace.

International Researchers at the Whithead Institute[35]

Whitehead does not specifically target international candidates, although some of the media they use internationally is accessible. Overall they use various professional publications and other print and electronic media resources for position opening advertisements. However, due to the reputation of both the institute and its faculty members, international researchers frequently contact the institute for research possibilities. Faculty members are often seen as the draw card for this international interest.

The Whitehead Institute is however active in promoting international researchers once contact has been established. In some circumstances they pay for candidates to travel to Whitehead to interview for a position, as well as pay for relocation expenses. They also have an immigration specialist on staff who guides international candidates and employees through the process of determining eligibility for, and acquiring work authorisation visas. They do not have a practice, however, of paying for the process involved in gaining Permanent Resident ("green card") status for employees, although they will work together with the attorney that a researcher/fellow has hired to assist however they can.

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[34] Information found on the Whitehead web pages and interviews

[35] Information for Whithead Institute – Public Affairs Office

The University of California (UCLA)

What began in 1919 as the southern branch of the University of California is today one of the leading universities in the world—renowned for education and innovation. UCLA offers a graduate course of study and research and postdoctoral studies. The following information gives some indication of the levels of financial support for its graduate students, (of which international students are eligible) and more specifically additional mechanisms directed at international students/researchers.

Firstly UCLA offers a number of fellowships and grants to cover tuition fees. Further, if a graduate takes the opportunity to serve in teaching assistant or graduate student researcher title for at least 25 percent of an entire academic quarter they are eligible to receive paid medical insurance coverage.

To encourage and support the academic careers of students in all academic areas, the University of California Office of the President and the UCLA Graduate Division provides funds for graduate research fellowships. Applicants must be U.S. citizens or permanent residents. This program is intended for doctoral students who are not advanced to candidacy, to assist them in acquiring and developing sophisticated research skills under faculty mentorship. Students selected for this program for 2001-2002 will receive a stipend of $15,000, plus mandatory fees (excluding tuition).

UCLA also has an Advancement to Candidacy Restricted Program. Funding from this program is awarded only to students who have advanced to doctoral candidacy. Selection of students to receive this funding, and the size and type of award, are at the discretion of each graduate program.

Non-resident tuition for doctoral students who have advanced to candidacy is automatically reduced by 75% for up to three years beginning when the student formally advances to candidacy. This benefit is only available to non-resident PhD candidates.

4.4 Summary

Foreign born scientists and engineers contribute significantly to the brain-power of the United States (US), and we have seen that they represented 29 percent of doctorates conducting R&D in 1993. More importantly, a large percentage of foreign researchers gained their education at an American institution.

The US has a long established scientific reputation and institutions of world class, and is one of the favourite host countries for researchers alongside the UK. The reputation of some of their universities attracts many research graduates and post-doctoral researchers The US also offers good career opportunities outside the university system, after the researchers have completed their degrees or research projects.

The renowned centres of excellence such as Harvard, MIT, Cambridge and UCLA can rely on word of mouth as a marketing strategy and their many international science collaboration networks give them access to the best centres and talents around the world. They can therefore choose between many candidates instead of having to find them.

Despite this position the US provides additional incentives for foreign researchers to stay in their countries. At the federal level this is mainly dome through regulatory measures (immigration procedures).

5 The Netherlands

5.1 Introduction

The Dutch economy is increasingly becoming a knowledge economy, with the demand for scientific research growing accordingly, and expected to become even higher in the future. The development of science is therefore seriously jeopardised by these imminent personnel shortages. On the one hand a large number of staff will leave the academic system as they reach retirement, and on the other hand, there is a large outflow of young talent. The Netherlands faces shortages of scientific personnel, and it is a key issue for future scientific development. Strategies have to be developed to solve these scientific staff shortages, reflected in a recent study by the Association of Dutch Universities (VSNU) which indicated that the attractiveness of universities as a future employer among students is low.[36]

The policy of the Ministry of Education, Sciences and Culture (OC&W) is aiming to increase the attractiveness of a career in science vis-à-vis a business career. In the policy paper published in September 1999 by the Ministry - Science Budget 2000: nothing ventured, nothing gained – promoting science as career is one of their focal points.

The responsibility for the policy lies largely with the universities. From the mid-80s onward the responsibility for research and education as well as finance, accommodation and personnel management has been decentralised to the research organisations. National policy merely serves to create a framework for action to be taken at the institutional level. In this context the government has allocated additional means to invest in science.

Attracting foreign researchers is not used as an instrument to solve the personnel problems per se. Nevertheless, internationalisation is a common phenomenon in Dutch universities. International student (i.e. undergraduate level) mobility is actively promoted throughout the higher education sector. There are extensive facilities, both financial and non-financial for international student exchange. Most universities offer complete curricula in English to increase access for foreign students. Moreover, universities have reached co-operation agreements with partner institutes abroad, in particular joint curricula and the mutual recognition of credit points. The latest initiative in this respect involves the (discretionary) introduction at Dutch institutes of higher education of the Master degree alongside the traditional Dutch degree of *doctorandus*.

[36] Vereniging van Nederlandse Universiteiten (VSNU), 'WO-Monitor: de arbeidsmarktpositie van afgestudeerden van Nederlandse universiteiten', Utrecht 2000.

5.2 Research System

Research training in The Netherlands is administered through the assistant in education (*assistenten in opleiding* – AiOs) system.[37] The universities allocate part of their institutional funding from OC&W to the employment of assistants in education. Each year AiO projects – the number depending on financial conditions – are selected via internal competition. Professors, or research groups, submit proposals and if the proposal is approved an AiO (internal or external) will be employed for 4 years to carry out the project. A *promoter* is appointed to supervise the AiO during these 4 years. Upon successful completion of the project, the results of which are recorded in a dissertation, the AiO receives a PhD degree.

The Dutch research system comprises a total of 23,852 lecturers/researchers in full time equivalent (fte). These include professors, senior lecturers, lecturers, doctoral candidates (AiOs) employed by universities, those employed by the Dutch Research Council (NWO)[38], researchers employed by the Royal Netherlands Academy of Arts and Sciences (KNAW), and other scientific personnel (OVWP). The last category includes post-doctorate researchers (post-docs). These post-docs are temporary positions (maximum 18 months) for young researchers who have already obtained their PhD degree. The position is intended to give the researcher an opportunity to expand on their thesis, and opportunities to publish articles based on the results. The position is intended to result in a tenured faculty position.

Of all students enrolled in university education in 1995 4 per cent was foreign, although there are wide differences between universities. The University of Maastricht, for instance, has a very active policy on international student mobility. Internationalisation is one of the key elements in the university's marketing strategy. In addition to promoting international student exchange, the University of Maastricht also actively attracts foreign students to come and complete their entire education in Maastricht. As a result, approximately 50 per cent of first-year students are foreign.

As to amount of internationalisation in research in the Netherlands, there are no 'hard' figures for the entire academic sector,[39] although the percentage of foreign PhD candidates is estimated to be about 5 per cent, while the percentage of foreign professors is 2 per cent. At some universities the internationalisation of research is significantly above the (estimated) national level. This is especially the case for young researchers, i.e. PhD candidates and post-doctorate researchers. For instance, of the 182 PhD candidates obtaining their degree at the Wageningen University of Life Sciences in 1999, 46 were foreign, which represents 25 per cent of the PhDs. Similarly, at the Delft University of Technology, over 30 per cent of the PhD candidates who obtained their degree in 1999 were foreign. And at the Technische Universiteit Eindhoven (TU/e) the level of internationalisation is represented by: 23

[37] The AiO system was launched in 1986.
[38] This will be explained in the section on the research training system.
[39] The Association of Universities in the Netherlands (VSNU) is currently undertaking a project to analyse the internationalisation and internationalisation policies of Dutch universities.

per cent of PhD candidates, 41 per cent of designers and 62 per cent of post-doctorate researchers Exhibit 11 summarises these figures.

Exhibit 11 Percentage of Foreign Researchers at Individual Universities, 1999-2000

Delft U. of Technology	Wageningen U. of Life Sciences	TU/e
30 % of PhD candidates	25 % of PhD candidates	23 % of PhD candidates 41 % of designers 62 % of post-doctorate researchers

The degree of internationalisation among young researchers has increased rapidly in the last decade. The percentage of foreign PhD candidates at Wageningen University of Life Sciences was a mere 6 per cent in 1990 (4 out of 67), and in 1993 was 13 per cent at the Delft University of Technology. Corresponding to the estimates for the Netherlands as a whole, the internationalisation among other researchers is more limited. For instance, at the TU/e the percentage of foreign researchers among scientific staff (i.e. not including PhD candidates, designers and post-doctorate researchers) is 11 per cent.

During the first two years of the assistantship the emphasis is on additional education and in the last two years the focus shifts to research. In all four years there is a teaching obligation of maximum of 25 per cent of the AiO's time. It is largely because of the contribution to teaching that AiOs are employed as university staff with corresponding wage and entitlements to social security and social benefits.
The following exhibit gives the wages for AiOs as of May 2000, as agreed upon by the employer organisation VSNU, the labour union and the government.[40]

Exhibit 12 AiO Wages as of May 2000 (gross in euro)

1st year	2nd year	3rd year	4th year
5270	5920	7325	8985

Source: VSNU

The AiO wage on the whole is lower than the wages of 'regular' university staff to compensate for the fact that there is a training element involved. For the same reason, the wage increase from year one to year two is relatively low. In a limited number of

[40] VSNU, Collective Employment Agreement (CAO) of the Dutch Universities 1 January 1999 – 31 May 2000, Utrecht 1999

cases the post-graduate training positions are funded by the Dutch Research Council (NWO), and in this case, candidates are called researchers in education (*onderzoekers in opleiding*, or OiOs). The salary is equal to the AiO wages presented above. Nevertheless, OiOs do not have a teaching obligation, they can work full-time on their thesis. In 1998, there were 3,886 AiOs and 2,486 OiOs in the Netherlands.

Exhibit 13 indicates that 6000 (fte) researchers in the category over 50 will leave the academic system between 2000 and 2008 because they have reached retirement. Among them are 1600 professors, 1500 senior lecturers and 1900 lecturers[41]. On the other hand, there is a large outflow of researchers from the youngest two groups, these are PhDs and post-doctorate researchers who could not move to a higher and permanent position at the university. Further, Exhibit 14 shows the distribution of scientific staff by function across different scientific disciplines.

Exhibit 13 Researchers by Function and Age, 1998

Age	*1998*	*% female*	*HGL*	*UHD*	*UD*	*OVWP*	*AIO*	*KNAW*	*NWO*
≤ 29 years	6535	39.1	0	2	129	1645	3129	70	1561
30-34	3474	34.7	20	41	653	1533	625	46	554
35-39	2952	27.1	100	210	1129	1103	102	56	253
40-44	2602	23.2	244	394	1134	674	21	47	88
45-49	2371	18.3	432	491	910	474	8	36	19
50-54	2737	11.9	662	693	970	387	1	16	8
55-59	2226	8.6	624	593	732	249	0	26	2
? 60	955	5.7	392	199	273	82	0	8	1
Total	23852	25.9	2474	2623	5930	6147	3886	305	2486

Source: : *Commissie Van Vucht Tijssen, Talent voor de toekomst, toekomst voor talent, Table 2*

Exhibit 14 Distribution of Scientific Staff by Function and Scientific Discipline 1998

	Agriculture	*Science*	*Engineering*	*Health*	*Economics*	*Law*	*Humanities*	*Arts*
HGL	95	399	366	539	208	204	296	334
UHD	142	421	464	616	188	175	340	247
UD	300	562	993	1344	416	488	862	842
OVWP	285	935	1465	1566	377	329	720	581
AIO/OIO	402	1565	759	1245	284	287	592	404
% temporary	56.1	64.4	55.0	52.9	44.9	41.5	46.7	40.9
Totaal:	1224	3882	4047	5310	1473	1483	2810	2408

Source: *Commissie Van Vucht Tijssen, Talent voor de toekomst, toekomst voor talent*, Table 12

[41] Commissie Van Vucht Tijssen, *Talent voor de Toekomst, Toekomst voor Talent*, Utrecht 2000.

The Netherlands Bureau for Economic Policy Analysis (CPB) has estimated that shortages will arise in 2003 and 2008 if the current economic situation remains the same and the developments (outflow) in scientific personnel continue in the next 5-10 years. These shortages will differ across scientific disciplines and across functions, outlined in Exhibit 16.

Exhibit 15 Estimated shortages in 2003 and 2008

	2003	% relative to 1998	2008	% relative to 1998
Estimated shortages scientific personnel in fte and %	-1294 fte	-5.4	-2886 fte	-12.1

Source: CPB, *De Arbeidsmarkt voor wetenschappelijk onderzoekers.*

Exhibit 16 Estimates for 2003 & 2008 by Scientific Discipline and by Function in fte (%- Discrepancy Relative to 1998)

2003	AGR	SCIEN	ENG*	HEAL	ECON	LAW	HUM	ARTS
HGL	-11.6	-7.5	-5.2	-1.9	6.7	7.8	-3.0	0.6
UHD	-5.6	-11.2	-3.0	-6.5	-9.6	-6.3	-12.1	-15.0
UD	-19.7	-7.1	-13.9	-11.2	-20.2	-15.2	-8.1	-10.8
OVWP	-4.9	10.5	17.5	4.7	19.6	6.7	-17.8	-3.6
AIO/OIO	-1.7	-2.2	29.5	-4.0	3.5	3.5	0.5	3.7
Total:	-8.2	-1.4	7.6	-3.3	-0.3	-2.4	-8.7	-5.4
Shortage	-8.2	-3.9	-4.2	-4.7	-6.9	-5.7	-8.8	-6.2
2008	AGR	SCIEN	ENG*	HEAL	ECON	LAW	HUM	ARTS
HGL	-24.2	-19.3	-14.8	-7.8	18.8	22.5	0.3	10.2
UHD	-24.6	-32.1	-19.8	-25.0	-29.3	-23.4	-33.8	-36.8
UD	-37.7	-18.1	-29.2	-24.9	-38.5	-30.9	-20.0	-24.2
OVWP	-10.2	15.1	27.5	6.4	33.7	9.7	-27.2	-7.2
AIO/OIO	-2.0	-2.6	34.5	-5.3	4.2	4.2	0.7	4.5
Total:	-17.0	-5.5	5.7	-9.4	-2.5	-6.9	-17.0	-11.8
Shortage	-17.0	-9.1	-10.8	-11.2	-14.6	-12.9	-17.2	-14.0

Source: *Commissie Van Vucht Tijssen , Talent voor de toekomst, toekomst voor talent,* Table 3
* change in classification aio/oio (see section on research training system) and OVWP in 1998.

5.3 Mechanisms to attract research graduates

5.3.1 National level

In order to solve personnel shortages in the Dutch science system a number of measures have been introduced at the national level. With respect to improving the position of young researchers the government will invest an annual sum of 26 million EUR in the period 2001-2010 for the funding of 20 positions per year, this is to enable talented researchers to start up a career in science. For the years 2000 and 2001 an additional start-up impulse is given that enables funding of about 40 positions. Other measures to improve the position of young researchers include the appointment of young, talented scientists as professors in areas of science where there will be large outflows when current professors retire (in 1-3 years). This double function, the so-called 'roof tile construction', serves to simultaneously offer career perspectives to young talent and to avoid shortages at the time of retirement.

As previously outlined the responsibility for personnel management lies primarily with the institutes. National policy merely serves to create a framework for action at the institutional level, and therefore concrete measures are implemented at the institutional level, with the national government monitoring the process and evaluating the results.

Within national programmes to reduce the shortages of scientific staff there is no specific policy aimed at attracting foreign researchers. Again, the responsibility for personnel management, and therefore the decision to attract foreign researchers, lies largely with the institutes. National policy on internationalisation is based on a different principle. Policy makers acknowledge the advantages of internationalisation in research. Correspondingly the Ministry of Education, Culture and Science (OC&W), the Royal Dutch Academy of Sciences (KNAW) and the Research Council (NWO) have reached agreements with partner administrations in a number of countries for co-operation in the area of science and technology. A concentrated approach has been chosen in order to develop structural and long-term co-operation with selectively chosen countries.[42]

This objective appears to be a dominant one among the various agreements and indicates that bilateral R&D co-operation primarily serves as an extension of international policy to a large extent. Nevertheless there are some measures at the national level that directly or indirectly serve to attract foreign researchers.

In 1986 the Royal Netherlands Academy of Arts and Sciences (KNAW) introduced the 'Academy Researchers Programme'. The aim of the programme is to retain young research talent in the Dutch academic system and to reinforce the research potential of the universities. Within the programme talented young researchers – who have already obtained their PhD degree and who have at least two years of experience as a post-doctorate researchers – can be appointed for three years with the option of extension to 5 years as Academy researchers. Foreigners can apply for a position as Academy researcher too, but they have to have worked for 2 consecutive years in the 5 years preceding their application.[43] In 2001 universities can submit 107 proposals with 37 candidates being selected for a 3-year position.

Foreign knowledge workers with expertise that is not, or scarcely, available in the Netherlands are compensated for their 'extra-territorial costs', i.e. the costs they incur through working in the Netherlands. The compensation is 30 per cent of the sum of the salaries earned during employment in the Netherlands.

Quite at odds with the apparent positive attitude toward internationalisation of research and education is the inflexible, and even restrictive, immigration policy. No special arrangements have been made for foreign researchers or students. Foreign

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[42] OC&W, Science Budget 2000, 1999.

[43] This measure is very useful with respect to the current situation concerning the personnel shortages. Nevertheless, the 'Programme Academy Researchers' is not part of measures presented at the beginning of this section.

researchers and students have to take many steps to get the required visa and working permits. According to J. Halbertsma of the Netherlands Organisation for International Co-operation in Higher Education (NUFFIC) an additional problem is that not all parties involved in this process – embassies and university departments – are fully aware of the rules and regulations. Therefore it sometimes takes months – seven months is by no means an exception – to get a visa to even get into the country, and once inside the country contradictory regulations may further delay getting a working permit.

5.3.2 University response

At the institutional level measures to address the issue of staff shortages include raising the effectiveness of personnel management and the revision of the AiO system. With the AIO considerations the universities are moving away from collectively agreed and uniform wage levels, and through salary bonuses, 'linking premia', and improved secondary labour conditions, universities are trying to improve the attractiveness of the AiO system. Further there has been increased diversity in the system, with the payment of young researchers more in line with their labour market position. Previously AiO wages and social benefits and services were uniform across all universities. This allows the universities to compete not only among each other, but more importantly with the enterprise sector. In some cases, e.g. the Delft University of Technology, research assistants are classified and paid as formal scientific staff. Overall, the extent of the pay rise ranges between 10 and 80 per cent of the relevant AiO wage.

Technical University of Eindhoven (TU/e)
Attracting researchers from abroad is mainly restricted to AiOs. At the TU/e, AiO projects in which foreign candidates are appointed are partially sponsored from central university funds. In other words the AiO position is co-financed by the respective department and the university.

Universities take care of the reception and integration of the foreign AiOs. The TU/e also guarantees accommodation. Moreover, the Bureau for International Activities assists departments or research teams in matters relating to visa and residence/working permits.

The policy of the TU/e of attracting young researchers from abroad has been very successful. In fact, the policy may have become too successful: the increase in the number of foreign AiOs and designers – at present 23 per cent and 41 per cent respectively – has seen the university considering setting a maximum to the percentage of foreign AiOs and designers. In other words, the policy emphasis is shifting back to attracting more Dutch candidates.

Delft University of Technology
Measures to attract foreign AiOs merely involve the marketing of research abroad and the launching of an English data-base for vacancies and financial facilities. In 1999, 30

per cent of the AiOs receiving their PhD degree were foreign. Attracting other scientific staff from abroad is mostly limited to short periods of time. The Delft University of Technology has instituted the Research Fellowship Fund, which enables an annual number of 35 visits of 3-12 months by foreign researchers. The budget for the fund will be raised to attract leading researchers from universities with which agreements have been reached about strategic co-operation and the exchange of researchers.

5.4 Summary

The Netherlands is facing problems with regard to scientific personnel, which have become key issues for the future scientific development. In the Netherlands the policy to address imminent personnel shortages in the science system is largely aimed at increasing the attractiveness of science as career. The emphasis of policy is on retaining young talent, with the role of the government being to create a general framework for action, while the responsibility for concrete measures lies with the universities.

Although internationalisation of education and science are common phenomena in Dutch universities, there is no explicit national policy in which attracting foreign researchers is used as an instrument to solve the personnel shortages. The decision whether or not to attract foreign researchers is left to the universities.

6 Finland

6.1 Introduction

With the exception of the remarkable increase in government R&D funding, Finland has recently been moving closer to the science and technology policy lines adopted in the major R&D-intensive OECD countries. A key factor in this regard is that Finnish research has become closely integrated with the international science system during the past 15 years. Finland is currently involved in several international research organisations (e.g. ESA, EMBL, CERN) and EU research programmes. In addition, Finnish researchers have visited foreign countries to an increasing extent, and new agreements on researcher exchange programmes have been signed. [44]

During the past decade there has been a marked increase in the general preparedness and willingness for collaboration. The mobility of researchers, the number of informal contact networks and interaction are all at a much higher level than previously. Together with the development of creative research environments, collaboration has been promoted by an up-to-date science policy and by developing funding instruments and other forms of support for research. In the late 1990s a number of reforms were carried out that had a major impact on the science system and that gave rise to heated debate: examples include the centre of excellence policy and research programmes.

Reform relating to human resource aspects of research, and researcher training, have been some of the main priorities in science policy over the past decade. One of the main aims has been to increase the supply of researchers, especially in the fast growing sectors of the knowledge intensive economy. With this in mind, postgraduate training has also become closely linked with major research projects and centres of excellence.

6.2 Research System

The Finnish higher education system consists of 20 universities, which carry out basic research and 32 polytechnics. This decentralised university system has proved its merits and it has an increasingly important role in the regional development of the country. The annual number of new PhDs is presently ca. 1000, which is twice as many as in 1990. Most PhD students are supported under the graduate school system, graduate schools are in fact networks of several universities. Increased research funding by the private and public sector has created many vacancies and the labour market has been able to absorb the increasing number of PhD's.

[44] Husso,K., Karjalainen, S. and Parkkari, T. *The State and Quality of Scientific Research in Finland – A Review of Scientific Research and Its Environments in the 1990s*, Academy of Finland, 7/00, Helsinki, 2000.

Finland has extended the higher education system by up grading and promoting polytechnics to the higher education sector. These are more or less comparable to the new universities in the UK at their initial stage. This development has rapidly extended the capacity of higher education, particularly in terms of the number of PhD places available.

The most important reforms in scientific policy in the 1990s have included the reform of post doctorate training, which started halfway through the decade with the aid of the 'graduate school' system. This post-doctoral researcher training system has been launched to further develop a researcher's career, and promote the further training of talented people who have just received their doctorates as professional researchers. Postgraduate students can concentrate full-time on their studies in fixed-term posts at graduate schools, with funding provided through the Ministry of Education. The funding channeled to graduate schools has increased international exchange in education, with the schools being open to foreign students. Funding for places in graduate schools is provided for four years at a time, and earmarked for a specific purpose in connection with other funding allocated to universities.[45] Today there are 100 graduate schools and the total number of doctoral students in these graduate schools is nearly 4000.

The total university enrolment is currently 152,000 students, of which almost 3,500 are students from abroad studying for a degree, this amount also represents the average number of international students per year. International students come from over 100 different countries.

The basic funding for the universities comes from the state and the salaries for university researchers are based on the national agreement on salaries for the public sector. PhD students who are within the graduate school system have a monthly gross salary of around 2000 EUR.[46] All salaries depend on the number of years worked in the public sector.

About half of the university post-docs have a monthly salary of less than 1700 EUR. The average salary of a post-doc is 2085 EUR. Among professors the average monthly salary is 4064 EUR, the lowest 10% earn on average EUR 3,195 and the highest 10% around EUR 5,045. Besides increments professors can receive research and administrative task related top-ups which are decided by the university.

National scholarship programmes managed by the Centre of International Mobility (CIMO) aim to internationalise teaching and research by forging links between institutions of higher education in Finland and abroad. The aim is to encourage academic mobility between Finland and other countries and establish Finland's reputation as a country with numerous opportunities for post-graduate study. Scholarships are available for post-graduate study and research and for international

[45] The State of Scientific Research in Finland, 2000

[46] Sundbäck, K., 'Public sector wage table A-category - 1.1.2001', *Acatiimi,* Vol. 4, No. 8/2000.

visitors to Finland. In 1998, almost 600 scholarships were awarded. There are 4 different scholarship programmes, each programme having different requirements.[47] There are no tuition fees unless otherwise stated in the course description. However, the student unions at the universities may charge a membership fee (42–84 EUR/year) to cover services such as counselling and health services. Students in both universities and polytechnics also have to pay for their books and other materials, plus accommodation and living expenses.

6.3 Mechanisms to attract research graduates

6.3.1 National level

The basic principle in Finland is that education – including research - is free and funded from tax revenues. Foreign researchers have the same benefits and access to funding as the Finnish students/researchers.

The key elements of Finnish R&D policy include a number of initiatives and agencies. The Ministry of Trade and Industry and the Ministry of Education are the main sources of funding for the various bodies in charge of R&D policy activities. The National Technology Agency (Tekes) is the prime R&D and technology promotion/funding organisation in Finland. The Academy of Finland provides funding for basic research and work in co-operation with TEKES, and on national level provides grants for foreign researchers.

Academy of Finland

The Academy of Finland is an expert organisation seeking to enhance the quality and reputation of Finnish basic research by providing funding allocated on a competitive basis through a systematic evaluation. It granted over 150 million EUR for the funding of research in 2000. More than 3 000 professional researchers at universities and research institutes are working on Academy-funded research projects. The Academy operates within the administrative sector of the Ministry of Education and has a wide range of national initiatives aimed at promoting research. These schemes are open for foreigners as well as for Finnish nationals, some of them are specifically targeted for foreigners or Finnish citizens who are doing research abroad. These initiatives include:

Research Posts - The Academy of Finland research posts are those for Academy professor and senior fellow. Appointments to the posts are for fixed periods and researchers hold posts with the Academy of Finland but work in external organisations/universities. Researchers who are Academy post holders may use five per cent of their working time for teaching and supervision associated with their research.

[47] CIMO, Studying in Finland, http://finland.cimo.fi/

Research projects – projects which are granted funding for the hiring of scientific staff and other personnel, for the acquisition of equipment and supplies, and for other expenses. The aim of this funding is to attain an international forefront of research, and therefore provide for international researchers/post-docs to work in Finland. Foreign researchers are recruited and hired jointly by the leader of a research project and the institution concerned, following the procedures of the relevant university. A university or a research institute may apply for a separate appropriation for the work of a foreign researcher in Finland. This is possible if the visiting researcher will take an active part in the work of a research team, give scientific instruction, or transfer other specialised know-how to Finland.

These funds are, in general, awarded as a grant for a minimum of three months work. In exceptional cases shorter visits are possible, e.g. giving instruction in a training course. In addition to the grant a visiting researcher may be reimbursed for his/her travel costs, as well as the travel costs of the accompanying family if the duration of the visit is at least six months. An additional appropriation to cover the research expenses directly incurred from the visitor's work may be allocated to the institution concerned. Exhibit 17 shows the breakdown of monthly grants for researchers.

Exhibit 17 Grants for Foreign Researchers Working in Finland

1–21 days	27 EUR/day
Compensation for accommodation	336–840 EUR/month
Monthly grants, including compensation for accommodation, for visits lasting longer than 21 days:	
Master's degree	EUR 840–1345/month
PhD	EUR 1177–2018/month
Professor	EUR 1597–3363/month

Researcher Training - The Academy of Finland supports the graduate schools nominated by the Ministry of Education by funding researcher training positions and courses, as well as domestic and foreign travel by doctoral students. These steps by the Academy are aimed to raise the quality of education and to speed up doctoral studies, and particularly to promote internationalisation of postdoctoral research.

International Co-operation - The Academy of Finland serves as the Finnish contact for a number of international scientific organisations. The Academy subsidises the participation of Finnish researchers in international research and funding may be obtained for the following purposes for the promotion of international co-operation:

- Researcher training and researchers working abroad
- Grants for researcher training at the European University Institute (EUI)
- Foreign researchers working in Finland
- Bilateral exchange of researchers
- Organising international conferences
- Travels for preparing international co-operation projects
- Co-operation with Deutscher Akademischer Austauschdienst (DAAD).
- Co-operation with the Alexander von Humboldt Foundation
- Polish Science Days in Finland from October 16 until 20, 2000
- Co-operation with Netherlands Organisation for Scientific Research (NWO)

Centre for International Mobility (CIMO)
CIMO is a governmental organisation and is part of the Ministry of Education. CIMO's expertise is geared to the promotion of cross-cultural communication and international mobility, with a focus on education and training, work, and young people. CIMO's client base in Finland covers a range of educational institutions, universities, polytechnics, and vocational colleges. In 1999 CIMO had a budget of 13.5 million EUR, at the same time CIMO awarded 7.7 million EUR as grants.

CIMO supports internationalisation through the provision of training, information and advisory services, and publications, and markets Finland's education and training programmes abroad. Scholarships are available to post-graduates and young researchers travelling to and from Finland. CIMO runs scholarship programmes based on bilateral cultural agreements with over 30 countries. For programmes available to visitors from abroad, the grant applications are to be submitted by Finnish universities. An average of 900 people participate in the programmes every year, around 650 are from outside Finland.

CIMO's scholarship programmes aim to internationalise teaching. The objective is to encourage academic mobility between Finland and other countries and establish Finland's reputation as a country with a wide range of opportunities for post-graduate study. The countries targeted reflect the geographical areas of importance to Finland, with the emphasis on co-operation with its near neighbours, the Baltic States and countries in Central and Eastern Europe.

CIMO's scholarship unit works in close co-operation with universities and their international relations offices, as well as Finland's embassies abroad and foreign embassies in Finland. CIMO has a number of possibilities to support international researchers, these come in the form of:

Fellowships **–** for young researchers (PhD and post-docs) to Finnish Universities. The programme is open to researchers under 35 years of age from all countries. The monthly allowance is 673 – 1100 EUR for 2000-2001, and is for a period of 3-12 months. The scholarship is intended to cover living expenses only, and may vary according to academic qualifications.

Bilateral scholarships - are based mainly on cultural agreements or similar arrangements between Finland and the following countries:
Australia, Austria, Belgium, Bulgaria, Canada, China, Cuba, Czech Republic, Denmark, Egypt, France, Germany, Great Britain, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, Mongolia, the Netherlands, Norway, Poland, Portugal, Republic of Korea, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey and the USA.

These scholarships are meant for post-graduate academic studies and research for 3-9 months at a Finnish university for a researcher not older than 35. The bilateral scholarships consist of a monthly allowance of 690 EUR in 2000-2001.

With several countries there is also the possibility of study visits of 1-2 weeks for university teaching or research staff members and cultural experts in order to create contacts or to strengthen co-operation between the institutions of the two countries. For short-term visitors there is a daily allowance, the amount of which is determined annually (26.5 EUR in 2000). Accommodation is also provided for short-term visitors.

The Nordic Grant Scheme – grants are available once a year for collaboration projects between academic departments or voluntary organisations in the Nordic countries and the neighbouring areas: Estonia, Latvia, Lithuania, the St. Petersburg and Kaliningrad areas, and the Barents Region. A network must involve the participation of at least two Nordic departments or voluntary organisations representing different countries, with at least one from the neighbouring areas. Grants are paid to the department or organisation co-ordinating the network. Maximum period of support is two years.

6.3.2 University response

The number of foreign researchers/teachers participating at Finnish Universities has been increasing rapidly, although did suffer some set-backs in the mid nineties. Foreign student numbers at Finnish Universities are also increasing. In the years from 1981 to 1997 they have increased their representation in the overall student population by 1.5%, with a current figure of 2.2%. (see

Exhibit 19) In terms of promoting foreign stay, Universities are providing support and help with housing arrangements for foreign students.

Exhibit 18 University personnel working abroad and visits of foreign researchers and teachers to universities in Finland 1991-1999 (working over one month)

	Researchers/ teachers abroad, No of persons	Length of stay (mean) Months/person	Foreign researchers/ teachers, No of persons	Length of stay (mean) Months/person
1991	783	5.1	986	4.2
1992	875	5.0	1,057	4.3
1993	963	4.9	1,152	4.5
1994	958	5.1	1,309	4.7
1995	986	5.0	1,357	5.0
1996	992	4.6	1,065	4.4
1997	939	4.1	1,201	4.2
1998	912	4.1	1,107	4.6
1999	825	4.3	1,170	4.6

Source: KOTA Database

Exhibit 19 International degree students at universities in 1981–1997

	1981	1991	1995	1997
Total	658	1,899	2,759	3,131
% of students	0.78	1.64	2	2.19
Europe	360	807	1,348	1,653
Asia	117	575	817	814
Africa	77	301	316	338
North America	70	143	147	188
Latin America	26	47	68	80
Oceania	3	9	15	13
Unknown	5	17	48	45

Source: KOTA Data Base

The Helsinki University

All foreign students must be self-financing because the university is not funding studies. However, most university studies are free of tuition fees so the need for financing is limited to the living costs in Finland.

International relations are based on personal contacts between researchers and on agreements between departments, faculties, universities and governments. The University of Helsinki has co-operation agreements for scientific and student exchanges with more than 75 universities around the world, and it is active in the European Community action programmes in the field of education, research and development.

In 1999 the University of Helsinki hosted 35739 students of which 1537 were foreign (4.3%). Further there was 280 foreign researchers and scholars, and 156 foreign doctoral dissertations out of a total of 369 (42%). Language is an issue for foreign students because the courses at Finnish Universities are traditionally in Finnish and Swedish only. However, several departments of the Faculty of Science currently organise courses in English. Most examinations, at all levels, can be taken in English if so requested.

The Helsinki University of Technology (HUT)

As is the case for the University of Helsinki, the University does not fund international students living expenses. In 1998-99 579 foreign students were studying at the Helsinki University of Technology (HUT). Of these students 174 were exchange students, 159 were studying a degree course, and the number of foreign post graduate students was 218.

Helsinki University of Technology is seeking applications for visiting professor positions for 1-12 months from highly qualified professors in varying fields of engineering and architecture. The university provides the recipient with a salary that is parallel with a Finnish professor in the same position, plus free accommodation near the campus (1-3 bedrooms) and one economy class air ticket. The visiting professor is expected to participate in the research carried out at HUT departments,

institutes and research centres. Furthermore, the visiting professor is expected to participate in the postgraduate education through lectures or seminars.

6.4 Summary

Finnish research has become closely integrated with the international science system during the past 15 years. Finland is currently involved in several international research organisations (e.g. ESA, EMBL, CERN) and EU research programmes. In addition, Finnish researchers have visited foreign countries to an increasing extent, and new agreements on researcher exchange programmes have been signed.

Although Finnish students are keen to enroll into exchange programmes the share of foreign university students in Finland is not very high at the moment. Out of 152,000 university students some 7000 are foreigners, which makes about 4.6 %. The government task is to meet the needs of rapidly developing knowledge-intensive industries. This challenge is met by: strengthening the education and research continuously, improving the match between education and working life, investing into life-long learning, strengthening research environments and developing their material resources.[48] Despite these measures, salaries of the university researchers are not competitive with the private sector remuneration packages. To cope with this problem universities have started to negotiate pay packages based on researchers individual merits.

Universities welcome foreign students and organise courses in English language to overseas students. Exchange programmes are the main routes for the foreign graduate students who wish to study in Finland. Post graduate students and postdoctoral researchers are in most cases recruited as a result of their personal contacts with Finnish researchers. All foreign students must be self-financing because the universities do not fund their living expenses. However, most university studies are free of tuition fees so the need for financing is limited to the living costs in Finland. CIMO and the Academy of Finland can provide funding for the foreign researchers.

[48] Science and Technology Policy Council of Finland, *Review 2000: The Challenge of Knowledge and Know-How*, Helsinki 2000.

7 Denmark

7.1 Introduction

The formulation of strategies for internationalising Danish tertiary (further and higher) education is a comparatively recent phenomenon, one that took off at the beginning of the nineties. There have always been international educational activities, including programme-based student mobility (the national cultural agreements, the Fullbright programme and suchlike). However, international student mobility was not highly visible in Denmark on any major scale until 10 years ago. (www.rks.dk)

Danish policy makers have put internationalisation at the forefront of research policy. And the need for visitors from abroad, including both PhD students and post-docs, has been highlighted as a measure to internationalise Danish R&D. The onus has been put onto universities to attract foreign PhD students, although improvement is needed in the provision of financial support for PhD training of foreign students if there is to be any great improvement.[49]

In 1996 the Ministry of Research and Administration adopted a national strategy for research. Policy for mobility of researchers was promoted through better conditions for creativity. A number of initiatives/statements with which this priority was to be realised were:

- Promote high quality in domestic research to increase attractiveness for the best foreign researchers to come to Denmark.
- Offer foreign research students adequate academic and material conditions
- Promote an international research environment for Danish researchers by increasing the international element in the domestic research environment, particularly through incoming guest researchers.
- Streamline the employment market of researchers through legislation on government research and reform of the appointment structure at government research institutions. Appointments should become so interesting that they attract considerably more potential researchers, in turn creating competition for new posts, ultimately increasing mobility in Denmark, with a consequent improvement in quality.

In May 2000, a Political agreement on "Principles for Research in Denmark", was entered into by 9 parties in the Folketing (the Danish Parliament). It is presumed that initiatives mentioned in the agreement will be implemented during the next four years. (www.fsk.dk) The basis of this agreement is the understanding that a strong, national research base with modern, dynamic institutions for research and education is crucial for the transition of Danish society into the knowledge-based economy. This is to be achieved through special initiatives in a number of areas. With a focus on the mobility issue, the initiative of recruitment is highlighted. Basically public & private research is to be secured via PhD programmes, with new positions being created for young

[49] Danish Council for Research Policy – A Good Start – Evaluation of Research Training in Denmark, January 2000

researchers, and additional funds created for new doctoral programmes, research schools, and positions for young researchers.

7.2 Research System

In Denmark, policy and funding of research training is undertaken at various levels. Nationally, the Ministry of Research and Information, with advice from the Danish Council for Research Policy, draw up policy and outline initiatives to be undertaken. Their funding of PhDs and researchers extends to provision of a fund (designed under a progressive scheme) that pays the university expenses, and also a scholarship to fund student expenses. Both of these funds are delegated to the Universities, who then have the choice of how to fill quotas and pay researchers.

Currently there are no specific Danish programmes for post-docs. However, each university has its own possibility to support their post-docs. Concerning international positions, there has been a programme where the most outstanding research training environments might get grants for outstanding international post-docs to come and spend 1-2 years there.

Current figures show that as many students come to Denmark, as there are Danish students studying abroad.[50] With the number of foreign PhDs making up approximately 9% of the total.[51] Prospective PhD students from all countries are welcome to join a PhD course in Denmark. In most cases the living expenses of students will need to be funded from their own universities, although the Universities can grant special fellowships to foreign students if they believe it is important in improving the quality of Danish research.

In principle the grants for tuition fees are available to Danish students are open to foreigners, as long as they have an education at the same level as the Danish PhD students. In most cases this opportunity to study in Denmark is used by PhD students who have prior knowledge of the Danish research institution, although in some of the research schools they advertise internationally (usually on the internet).

Very few state-financed scholarships (used for living expenses) are available to non-Danish PhD students, and it is difficult to find private funds. Non-Danish students therefore usually need sufficient external money to cover their living expenses. They also have to negotiate individually the financial conditions for being accepted as a PhD student, as each university has different financing and regulations. (rectors web pages)

Financial support may be available for doctoral training and scientific co-operation, but only for limited stays. Scientists interested in coming to Denmark for research training are advised to contact Danish colleagues. At the postdoctoral level, funding is

[50] Danish Council for Research Policy – A Good Start – Evaluation of Research Training in Denmark, January 2000

[51] Telephone conversation with the Academy of Research

available through European Union programmes such as the Training and Mobility for Researchers (TMR).

In 1998, the Danish Research Academy published PhD graduates - Supply & Demand 1998-2000. The overall finding is that demand will supersede supply in almost all studies. The report recommends that the numbers of PhD students need to be increased, while at the same time structure and standards need to be reviewed.[52]

The Council for Research Policy in its evaluation of research training realises that "there will be stiff competition for the best young people. They say that the possibilities of increasing the numbers of PhD students and of recruiting the best students depends on the availability of sufficiently good study programmes, which will have considerable value for the future lives of students"

To meet the costs of the PhD programmes, each university receives an annual grant per fellowship granted from the Ministry of Research. This grant scheme uses a 'taxameter' (scaling system to different levels of education) and designates 13 291 to 18,607 EUR per year per fellow. Externally funded PhD students – e.g. Research Councils or Danish Research Academy – have to meet the same requirements by paying a corresponding 'taxameter' to the institution. The enrolment of PhD fellows who do not have taxameter support can take place as the institutions may decide not to charge one, but then enrolment is dependent on the availability of resources at the institute to carry out the programme.[53]

There are however recruiting problems in a number of areas, for example technical studies and computer science. This is being overcome through maintaining/increasing quality of programmes, but also by financial incentives. To this extent supplements have been used to compete with industry/civil salary levels.

The living expenses of Danish PhD students will usually be covered by The Ministry of Research, which allocates a number of PhD scholarships annually to each university in order to finance their PhDs living costs. In 1996 alone 1125 scholarship fellows were included. These amount to 21930 EUR per year over the three years provided for (IHP Report). PhDs are seen to earn a salary and therefore are required to pay personal income tax on these funds. As a part of the salary agreement the PhD student is obliged to accept 840 hours of work during the three-year period. In addition to being nationally funded these expenses can be supported through a research fellowship, paid salary from a private company, or through a public institution external to the university, such as the Danish Research Academy.

Universities are allowed to give top ups if the student works more than the 840 hours during the 3 years, in fact, they are obliged to do this. Also, in some fields (such as

[52] Danish Council for Research Policy – A Good Start – Evaluation of Research Training in Denmark, January 2000

[53] IHP-Strategies & policies on Research Training in Europe – Danish Report

law) top ups are paid due to problems with attracting students. Students working at Government research institutions are also often paid extra for the same reason.

7.3 Mechanisms to attract research graduates

7.3.1 National level

National Policy for Internationalisation, and in particular education, was until 1998 the primary responsibility of The Danish Ministry of Education. Mr. Ole Vig Jensen[54] identified study and internship visits abroad for Danish pupils and students and visits of foreign students to Denmark as one of four main priority areas. Under this heading the minister mentioned a number of initiatives.

- A special appropriation of 5.000 DKK to higher education institutions for each outgoing and incoming student. Which cost on a national basis about 28 million DKK in 1996
- A bill on housing, which permited the local authorities to allot up to 10 % of housing designated for youth to foreign exchange students.
- A Strengthening of teaching in foreign languages.

In 1997 some were already in effect although were not pursued by the Ministry of Research when it took over the responsibility of internationalisation and education funding in 1998. Since this time a number of other initiatives have been put in place these are:

- Reductions in the amount of tax paid by international researchers. Outstanding international researchers are given the lower tax rate of 25% for the first three years of their study. To be eligible, the researcher should at least hold a PhD degree. The university, state research institution, or the relevant research agency decide whether the researcher is qualified, based on publications, c.v. etc. (generally speaking a post-doc earning around 39.000 Euro per year would pay around 40% in tax, so the 25% tax rule is quite an incentive – Research Academy)
- Danish Immigration Service has , through the insistence of the Rectors conference, arranged for reductions in the duration of processing of residence permit applications for foreign students and visiting researchers
- The Growing Universities programme, which gives increased funding for student in-take, increasing possibilities for international students
- The Danish Finance Act which has introduced a scheme which provides 'research packages', these include funds for increased participation, research programmes (administered through the research councils), and general research funds for development. These are not focused at international students, but do provide the Universities with increased opportunities to increase PhD and post-doc positions.

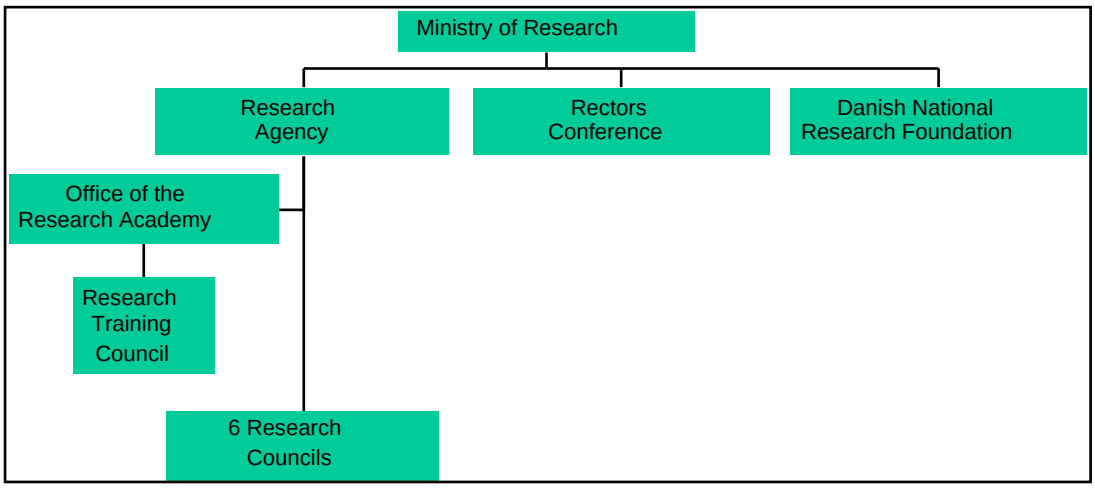
7.3.2 Intermediate Level

In Denmark there is one main intermediate body, the Research Agency, which houses both the 6 national research councils and the research academy, which until a year ago was under the Ministry of Education. Attached to the Office of the Research Academy (which is a department of the Research Agency) is the research training council, a kind of 7th research council. For the year 2001 this division has the main responsibility for independent PhD grants.

[54] Jensen, Ole Vig, Strategies for the development of the international dimension in the Danish education system ,1997

PhD grants do still occur as part of special programs and networks under the other research councils, but the training council will be the main source of PhD grants today. The Rectors Conference Secretariat and the Danish National Research Foundation also play a role in awarding grants to researchers, and are independent from the Agency. Exhibit 21 shows the structure of these institutions.

Exhibit 20 Danish research funding structure



Danish Councils

The Danish Councils provide funds for projects staffed by a number of researchers. When internationalisation within project teams is promoted, these funds directly effect the number of research positions that are available to foreign researchers. Although, overall there are few direct internationally focused initiatives.

However, in order to attract young Danish researchers at the international level back to the Danish research environment and give them the opportunity to establish an active research group in Denmark, the Natural Science Council has created the so-called Ole Rømer scholarships. The council further promotes internationalisation by supporting international networks and projects that increase the mobility of researchers, as well as by supporting foreign visiting researchers' stays in Denmark. The methods of the Council are still being developed and the emphasis has shifted in recent years from more limited projects to long-term funding of selected research groups. The council gives block grants as a way to ensure the need for funding in the case of longevity of research problems. Although not direct these type of actions provide international researchers stability in employment, in turn increasing mobility.

The Council of Social Sciences, in order to promote the internationalisation of Danish social science research, grants support to foreign visiting professors' stays at Danish institutions, finances Danish researchers Ph.D. studies at foreign universities, and supports senior researchers' studies abroad.

Research Training Office

At present the Training office supports special areas by making Grants available for single environments/projects, these are chosen on a general assessment of quality. Ten "graduate schools" (forskerskoler), have received special funding, and it is likely that future funding of PhDs are going to be concentrated around such schools.

National Research Foundation

The Foundation is committed to funding unique Danish research at the international level. The Foundation gives large, concentrated grants (e.g. to Centres of Excellence) in order to permit top scientists and research groups to rank among the best in the world. They have founded some 31 research centres within Denmark for this purpose. The Foundation has set up criteria for consideration of grants, those criteria which impact internationalisation are:

- There has to be a group of highly qualified scientists from Denmark and other countries who can make up the core of the research activity.
- That the research should have an international impact
- That the research group has to be able to co-operate with leading groups of scientists in other countries and enter into major international research programmes such as the programmes of the EU.

However, the specific way of enhancing this international mobility is very much an issue for each of the centres the Foundation supports. But indeed, the centres for most parts are very internationalised and comprise quite a few foreign researchers staying in Denmark for a shorter or longer time, or even more permanently.[55]

There are also grants available for temporary visiting senior scientists and professors as well as post-docs. The Foundation allocates funds for this type of grant only in connection with major research initiatives.

Danish Rectors Conference

The Danish Rectors' Conference Secretariat is an independent organisation under the Ministry. It is, among other things, designed to function as the service and information body for institutions of higher education, particularly in connection with the promotion of international aspects of education. The Danish Rectors' Conference Secretariat is in charge of the national administration of the education and co-operation programmes: SOCRATES, TEMPUS, and LEONARDO DA VINCI, all of which are European Commission initiatives.

The Danish Rectors' Conference Secretariat administers grant programmes, the exchange of experts and guest lecturers in accordance with cultural or bilateral agreements reached with 28 countries. The grants are offered to students and researchers in institutions of higher education. Although no independent grants are given by the Rectors' Conference.

[55] Interview with Danish Research Foundation

In accordance with the Cultural Agreement Programmes and other scholarship exchange programmes, Denmark offers scholarships to nationals from the following countries:
Austria, Belgium (the Flemish Community), Bulgaria, China, the Czech Republic, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Israel, Italy, Japan, Latvia, Lithuania, the Netherlands, Poland, Portugal, Romania, Russia, the Slovak Republic, Spain, Switzerland, Turkey and the United Kingdom.

The scholarships are available for advanced students, graduates and specialists to enable them to study or carry out research at a Danish university or a similar institution of higher education (usually for periods of 2-9 months). Scholarships are granted for a full academic year or shorter periods, and are not available for a full course of study, and in most cases an academic degree or a diploma cannot be obtained during the tenure of the scholarship.

Overall, these grants positively effect the level of internationalisation in Danish education, but the small time frames do not allow the full exploitation of international researchers. However, as witnessed in the DTU (Danish University of Technology) most foreign PhD students have had former study experience at the Masters level, through these bi-lateral grants, or the EU programmes. In this respect, programmes such as these are providing knowledge of Danish PhD opportunities to foreigners, a form of indirect marketing.

The Rectors' Conference has a Committee for International Relations (RIU). The establishment of the RIU created scope for greater leverage in dealings with the Ministry and other external players. The Committee has already accomplished results like an agreement with the Danish Immigration Service on faster processing of residence permit applications for foreign students and visiting researchers, as well as the agreement on international mobility taximeters.

As far as marketing is concerned the Rectors conference actively pursues Agreements with other countries. Currently, they have contacts with South Africa, Portugal, Japan and Slovenia, all of which are conducted with the Research Agencies. In China they have currently signed an agreement with The Chinese Academy of Sciences. These agreements provide the contact between the respective countries and Denmark, and provide access to information and linkages with universities. The study costs, however, are paid by the country of origin, i.e. the country sending the researchers pay for the study and living costs of that person. Applicants must be proposed for by their own party, but must have an invitation from an eligible Danish institution.

7.3.3 University response

The Technical University of Denmark (DTU)

As the largest educational establishment for the engineering sciences in Northern Europe, DTU has an extensive research potential distributed across all-important areas of engineering science. Approximately 1500 of DTU's total staff (including

PhD students) are qualified scientists. DTU has many well-equipped laboratories and experimental facilities, and in a number of cases the equipment is of unique quality even by international standards. It is DTU's goal to maintain and further develop its experimental facilities so that they always represent the very best, both technically and from the point of view of the working environment. (www.adm.dtu.dk)

An important element in quality development at DTU is the internationalisation of research. DTU fosters this through a variety of means, including:

- attracting visiting researchers and teachers of high international standard
- stimulating the setting up of international research projects and research networks, and participating in the European Commissions Fifth Framework Programme for Research and Technological Development
- attracting foreign PhD students
- establishing sabbatical schemes, to encourage DTU's scientific staff to spend substantial periods at foreign research establishments and universities
- participating in organisations for international co-operation and working actively through them to foster opportunities for DTU scientific staff to take part in research collaboration at a high international level.

PhD students who receive a grant or scholarship from DTU will receive a salary, with a pension contribution.

The University of Copenhagen

The University of Copenhagen has a long tradition of welcoming international students. An academic centre of excellence in both research and teaching, the University of Copenhagen is host to some 700 visiting international students every year. The students come from approximately 65 different countries. (web pages of the university) Data on nationality of students is restricted at the university, however, the university has most of its international students coming from Western Europe, China, Japan and the USA.

The University of Copenhagen has exchange agreements with 66 institutions world-wide, and Socrates-Erasmus agreements with 215 European universities. In addition, exchange programmes provide links between the University of Copenhagen and its partner universities in a world-wide network of researchers. (web pages)

There are few financial arrangements for students overall in Denmark as all costs are financed by the state. The University does however communicate the tax rule, which is directed to promote foreign researchers. There is no top up policy for particular students/study directions at the University. The University has rules and policy on recruiting, but it is aimed at quality, and not nationality, although, if there are stipulations of nationality attached to EU funding, they do follow them.

7.4 Summary

The Danish system for PhD funding is a national concern and foreign students are able to access these funds in the same way a Danish researcher would. Therefore, few Danish institutions currently have any experience in conducting all-out international

marketing for their study programmes. The importance of international marketing has been stressed, particularly in the interest of internationalising domestic environments by means of more international students and researchers at Bachelor's, graduate and PhD levels. Selling study programmes, individually or collectively, is seen as a novel approach for the institutions. Marketing is presumably seen as a field in which consultancy services will largely be needed in order to draw up a strategy.[56]

[56] From debate online - International marketing (www.rsk.dk)

8 Good Practices From Other Countries

In this chapter we describe two good practices found in other countries that could be of interest for the Irish situation;

- The French package of initiatives taken to make France more attractive for foreign researchers
- The Associations of Korean Scientists in Foreign Countries addresses the problem of attracting back expatriates to their home country by providing them opportunities to keep informed about career opportunities at home

8.1 Improving the International Attractiveness of the French Science System

France has recently developed a package of measures to make the research system more open and attractive for foreign researchers. Two issues are behind these measures: a need for a more open scientific landscape and the fear of brain drain.

The first issue is a new policy orientation which is fundamentally changing the French R&D landscape. The poor linkages between academic and industrial research are perceived as a first order problem in France. One reason for this situation lies in the institutional separation between public and industrial research institutes with different funding and employment structures and therefore different incentive systems. One way to match the difficulties in integration of industrial priorities to fundamental research lies in an increase in the mobility of research personnel. A major policy objective in France is therefore to increase the mobility of researchers at a number of different levels:

- The most important level is research-industry mobility, accompanied by facilitating measures for SMEs. The law for innovation and research[57] of July 12th 1999 introduced several measures in this direction, in particular the introduction of incentive schemes for individual researchers in the public sector to engage with industry.
- The second level concerns researcher mobility in higher education, which is primarily a question of the integration of young researchers, who finished their PhD, into public and industrial research.
- Thirdly, it is expected that an increase in mobility (and therefore in communication) between disciplines would facilitate the first level, namely communication between research and industry.

[57] Loi no 99-587 du 12 juillet 1999 sur l'innovation et la recherche. This law already takes into account the analysis and some of the recommandations of the report of Henri Guillaume. It mainly refers to the Law n° 82-610 of July 15th 1982, "Loi d'orientation et de programmation pour la recherche et le développement technologique de la France", which represented an important reform of the research system, and for the first time introduced the possibility for public research organisations (epic and epst) to create industrial affiliates.

- Finally, international mobility is needed in a context of globalisation. In France, however, the attractiveness and efficiency of its research system are of higher priority. Nevertheless, measures have been undertaken recently in order to facilitate the integration of international researchers in France (see below). Different sources of scholarships allow international researchers to install themselves in France for a fixed period, or even indefinitely.

The second issue in France is brain drain, which is seen as a three-way problem in France:

- Brain drain to, in particular, the United States, of talented researchers in computer science. Due to the rapid increase in demand for ICT, there is a large lack of researchers in this field on the global level. For several years, the United States has successfully attracted high numbers of researchers in this field.[58] French researchers have been attracted to the US by the flexible structure of career paths and salaries, as opposed to the more regulated environment in their home-country. Another pull factor has been the high level of development of research fields in the US than in France, e.g. medical robots. Additionally the fact that start-up companies are more easily created (and undone…) in the US than in France.

- Brain drain in ICT R&D as well as in fields like chemistry and biology seems to happen mostly with researchers having 4 to 5 years of experience in France, or at the post-doc level. Partly due to the difficulty of finding an appropriate job after attaining a PhD, in some disciplines, around 30% of post-doctoral studies are realised abroad. And young researchers who have not been integrated into a research laboratory in France before leaving have great difficulties in coming back.[59]

  Two recommendations have been proposed by a high-level working group,[60] On the one hand, incentive-schemes offering researchers interesting contracts in France to reduce brain drain in the high-tech field. And on the other hand, measures promoting the reintegration of French researchers at home, In particular French post-docs abroad, who merit special attention in facilitating them to return home, for instance through subsidised employment contracts, limited to one year.

- Finally, there exists a fear that France is becoming less attractive as a country (again in favour of the US) for talented researchers, especially PhDs. As a result, the fraction of foreigners doing their doctoral theses in France decreased from a third in 1992 to less than a quarter of theses in 1997.[61] The decrease in the number of foreign PhD students in France mainly occurs in mechanical science and chemistry.

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[58] The problem of brain drain is discussed in the Report of the Commissariat Général du Plan in several respects, mainly in the context of ICT (p. 238), and the internalisation of industrial R&D (p. 157).

[59] See Cohen, Le Déaut 1999, p. 54

[60] See Commissariat General de Plan, p157ff

[61] See Commissariat général du plan, p 49.

To respond to these two issues the following measures have been put in place.

· **Researchers-exchange schemes**

For young researchers special schemes can be found that promote international exchange, these fall under the responsibility of the education and higher education department of the MENRT (Ministry for Education, Research and Technology) and are:

1 The programme 'cotutelle de thèse' (double supervision) which allows French and foreign students to have one PhD-supervisor in a foreign country, in turn increasing their mobility.
2 In the framework of education-research networks (réseaux formation-recherche) exchanges between researchers coming from high quality laboratories and associated doctoral education are financed in order to promote a common space for research between two or more countries.

· **The agency Edufrance**

In November 1998, the French Ministry for Education, Research and Technology together with the Ministry for Foreign Affairs created the Agence Edufrance, to work towards pursuing a triple goal:

1 To reinforce France's position in the world market of training and scientific exchanges
2 To stimulate and co-ordinate the French offer;
3 To propose services and solutions that coincide perfectly with the demands of institutions and establishments of higher learning.

Edufrance is a public interest group that associates the two ministries together with universities, Grandes Ecoles, and institutes and foundations. Its main task is the communication of information about the French research and higher education system on the international level.

One example of actual activities was the organisation and sponsoring of a one-week seminar in February 2000 on the development of Exchange Agreements with French Universities. The aim was to introduce US study-abroad professionals to the unexplored resources of the French system of higher education, and to expand their network of contacts for future program development, particularly in the areas of science.

· **Integration of foreign public/industrial researchers in national schemes**

France has a tradition of integrating international researchers. A number of budget lines are reserved for these cases:

- *Les chercheurs de haut niveau*: around 80 high level researchers are financed for a 1-5 months stay in France (0.76 Million EUR total budget)
- *Postes PAST: Les professeurs associés pour un séjour temporaire*: this programme funds the invitation of researcher-professors in universities for 1 to 3 years, selecting 60 professors per year, they are employed under the same conditions as French professors.
- A new post-doctoral programme (which started in 1999) allows young researchers to get a place in a French laboratory, 7.5 MF (1.1 MEUR) were reserved for this line in 1999, the budget shall be raised up to 35 MF (5.4 MEUR) in year 2000, inviting 250 post-docs.

· **Regulatory conditions**

Working permits

The administrative procedures required in order to get a working permit as a researcher in France were changed in 1998[62], considerably improving the process. In general, European Union nationals and those from the countries who benefit from the special European Economic Area agreement come under the Community Directives and the regime for free circulation within the European Union. They need a European Community Resident's Permit, the reason for the stay, as well as a justification for the resources and social security cover.[63]

The reforms therefore mainly concern non EU-members. The new law of May 11th, 1998 is based on a form called the Welcome Protocol. The Researcher must clearly state the reason and the dates of his stay as well as the existence of the necessary resources. Every researcher, no matter how he is financed must apply for a visa at the French Consulate in the home country. Thus he is exempt from the OMI (Office of International Migrations) procedure, however a medical examination is still required for the application of a Resident's permit. A work authorisation is therefore not needed, and the visa application is no longer conveyed by centralised French authorities, the process is therefore quicker and the application is usually granted.

When a 'Welcome Protocol' has been validated with a consular stamp, it justifies the application for a "Scientific" Resident's permit at the *Préfecture*.[64] Since 1994, in each *Préfecture*, a Foreign Researcher's Agent has been appointed. This agent acts as the moderator for the foreign researcher or his representative, and acts on his behalf during the administrative procedures necessary for the acquisition of the Resident's Permit in the host institution or organisation. Researchers who are not yet at the post-doctoral level are not concerned by these rules, they benefit from a specific student status.

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62 Loi 98-349 relative à l'entrée et au séjour des étrangers en France, et au droit d'asile. J. O. Numéro 109 du 12 Mai 1998 page 7087

63 Added to this, the employer must fill in the form entitled "Declaration of employment of a national from a European Union Member State" (Cerfa no. 65-0056) if the researcher is to receive a salary.

64 In brief, the 'Préfecture' represents the Republic in each region, but is also the police's main quarters.where work permits and the like should be obtained.

To sum up, the main benefits from this new regulation are

1 the reduction of waiting time for a visa from 2 to 3 months before 1998 to only 1 to 2 weeks today
2 The definition of a contact person for the foreign researcher both in the prefecture and the research institute from the first day of the procedure onwards
3 A single form for the whole procedure.

Increasing transparency of the French system

It is a tough task to try to understand the French system of research and higher education. In its nature, the increase of transparency is a vertical activity, which concerns the reform of the structure on the one hand, and the distribution of information on the other. This last aspect has received some attention recently, and has been treated in several ways:

- All the ministries concerned have a well-established homepage with relevant and recent brochures on line, what is perhaps most important is that they are well interconnected with their links to all public research institutes and the other ministries.
- With the creation of Edufrance all institutions, from higher education to high level professional research, are covered by one body whose main task is distributing information in France and abroad. On the level of doctoral students and post-doctoral researchers, the Foundation Bernard Gregory[65] fulfils this aim, while the Alfred Kastler foundation is in charge of professional researchers.

8.2 Associations of Korean Scientists in Foreign Countries

South-Korea has suffered from brain drain for many decades. The brain drain issue was particularly severe during the 1960s, when many overseas graduates refused to return home. In 1967, for instance, 96.7% of South Korean scientists educated abroad remained there, compared with 35% for all countries (Kim 1997a:66). At that time, South Korea belonged to the poorest countries of the world, so that returning home was not an attractive alternative for South Korean students living abroad.

A traditional Korean policy instrument to achieve a 'brain gain' has been the use of the Associations of Korean Scientists in Foreign Countries. The first was set up in the US in the 1960s. Nowadays there are similar associations in all countries, with a number of Korean post-graduate researchers and engineers, such as France, Canada, the UK and Germany. These state-sponsored associations have been playing an important role in informing Korean scientists and researchers abroad about job opportunities in their home country. Annual conferences are organised in Korea dealing with specific topics in S&E, and every three years a large conference dealing with all main topics in the field. These conferences include Korean researchers living abroad, Korean companies, universities, and PREs.

[65] http ;//www.abg.asso.fr

One example of these type of associations is VeKNI (Korean Scientists and Engineers Association in the Federal Republic of Germany) which was established in 1973 by Koreans students and scientists living in Germany.[66] The association currently has about 1,000 members, with a fee of 40 DM (20 EUR) for students and 100 DM (51 EUR) for others. 20-30% of the associations budget is financed by the Korea Science and Engineering Foundation, and a small part of the budget comes from firms that pay for projects carried out by VeKNI. Every two to three years the association organises scientific conferences in Germany which are attended by both Korean and German scientists. One of the most important activities of VeKNI is to help Korean engineers and scientists living in Germany to find employment in Korea. In order to do so, the association has contacts with big companies and research institutes in Korea on a continuous basis.

[66] Byung Ro Kim in personal conversation.

9 Lessons learnt from the benchmark study

The benchmark study has looked at five countries in great detail and a further number of good-practice policy initiatives, with a view on the attractiveness of these countries to foreign research graduates and post-doctoral researchers. We have seen in previous chapters that the response to the international mobility of researchers and the urgency of the problems is very different from country to country. There is no clear overall pattern since each national innovation system has a different position in this global battle for the best brains.

The benchmark countries can be roughly divided in two groups. Firstly the two large countries with a long established scientific reputation and institutions of world class, i.e. the USA and the UK. The numbers and share of foreign researchers in the US and the UK support the literature that these two countries are globally the favourite host countries for researchers. The reputation of some of their universities attracts many research graduates and post-doctoral researchers. Neither of these two countries consider brain drain as a particular pressing science policy issue. Nevertheless they have programmes and initiatives to stimulate foreign researchers to reside in their countries. In the case of the UK there is a clear divide between the national system of funding for research graduates and a large 'add-on' system dedicated to foreign students. The weight of the expenditures in that country is also considerable, where nearly 20% of stipends are earmarked for foreigners. In the US foreign students use a myriad of funding opportunities mainly from the universities themselves.

Secondly we have the smaller European countries, Denmark, Finland and the Netherlands, which have some pockets of strength in certain science areas but whose academic system does not have an overall world class reputation. These countries have much more in common with the Irish position in the global competition for researchers. With the exception of a few universities the internationalisation in terms of visiting foreign researchers is much lower. In general these countries have tackled the skills shortage problem by improving their academic research systems, which is also accessible for foreigners. Therefore the 'add-on' measures to attract foreign research graduates are small and concentrate on framework conditions (tax, immigration) and improved marketing efforts.

There are several lessons to be learnt from both the benchmarking element of this study (what are the general conditions for a foreign research graduate in a country) as from the good-practice overview of responses to the mobility challenges. The overall results from this study will be presented by answering a number of key questions that have led our study.

Exhibit 21 Overview of mechanisms to attract foreign research graduates

MECHANISM	DESCRIPTION	COUNTRY/INSTITUTION
TAX	Tax exemptions for students	US
	Outstanding researcher tax reductions for up to 3 years from 40% to 25%	Denmark
	Specialty workers compensated with a rebate of 30% of total earned during stay	Netherlands
IMMIGRATION	Increase the speed of processing visa applications for students and researchers	UK, Denmark
	Provision of a continuos visa in place of having to renew permits every year	UK
	Assistance with immigration procedures	All countries
	Specialty workers visas - allowing researchers with special skills to remain for up to 6 years in US	US - H-1B status
	Allowing applications for researchers to be made in the French Embassy in their home country - eliminating the need to go through the International Immigration office - reduces time for applications and the possibility of rejection	France
	Providing the researcher with an agent - who will moderate administrative procedures once the Embassy has permitted the researcher to obtain the visa	France
GRANTS	For short term study visits for research students	Finland/CIMO
		NL/Delft University
		UK/Royal Society
	Research Grants/fellowships	UK/Royal Society
		France (post-docs)
	Joint grants for exchange visits of researchers and bilateral research	Finland/CIMO
		UK/British Academy
		Denmark/Council of Social Sciences
		France/up to 3 years
Specialty grants	Japanses Students	UK/Oxford
	Indian Students	UK/Oxford
	Nordic Countries	Finland
	Commonwealth Country students	UK/Cambridge

MECHANISM	DESCRIPTION	COUNTRY/INSTITUTION
	University grants especially for international students	UK/Oxford and Cambridge
SCHOLARSHIPS	Overseas student scholarships	UK Finland/CIMO
	Commonwealth Country scholarships	UK
	For students from countries that have special economic relations with home country	UK - Chevening Scholarships Finland - Baltic States and Central Europe
	For US students	UK -Marshal & Fullbright scholarships
MARKETING	International data base for vacancies	The Netherlands - Delft University
	Marketing plans to increase share of international market	UK/DTI & British Council
	Raise the profile of education in home country overseas (The Education Brand programme)	UK/Dept. education and employment
	Unified body for international marketing	France/Edufrance Finland/CIMO
	Funding Joint research programmes - providing for international researchers to take part	Europe wide initiative
	Associations in other countries promoting research jobs in home country - usually for nationals	Korean Assoc. in a number of countries - Germany -VeKNI
	Pursing agreements with international assoc.	Denmark/Rectors Committee for Intl. Relations
OTHER	Organising accommodation	Netherlands/TUE
	Free accommodation for visiting professors for up to 1 year	Finland/HUT
	Travel payment for visiting professors for up to 1 year	Finland/HUT
	Bill on housing to provide 10% of all student housing is put aside for foreign students (former initiative)	Denmark
	Double supervision scheme that allows supervision from two different countries	France/Dept. Education, Technology and Research
	Funding of International education-research networks	France

9.1 Do the benchmark countries have the same research skills problems as Ireland?

The benchmark countries' national innovation systems have had a much longer period with far greater resources to build up their research institutions, to train researchers and to employ vast numbers of scientists. Ireland is in the process of catching up on these relative expenditures and therefore the relative size of the academic community is growing accordingly.

So in broad lines none of the benchmark countries face a similar problem having to adjust to a sudden expansion of their academic research systems, requiring many new research graduates and young researchers.

But there are definitely skill shortage issues in some of the benchmark countries:

- There is an overall concern for shortage of skilled workers in the IT industry, particularly in the US, NL and FI. In the policy debates and actions this is not connected with research training or academic research capabilities but with providing enough non-research graduates in IT related areas.
- In the US there is a worry connected to the change of demographics, with an increasing share of people in the younger age categories from minority groups. There is a lower tendency to pursue a career in research among these minority groups, therefore the supply of young researchers is expected to diminish in the long term. Targeted actions to stimulate people from minority groups to go to university and research are undertaken in the US.
- The concern for research skills shortages that were in the public debate in the benchmark countries were connected to very specific science areas. In the US the sudden upsurge of private and public research expenditures in the bio-medicine area has been accompanied by a lack of human resources trained for this particular area. In the Netherlands the erosion of the work conditions and the public image of university research positions in the fields of science and engineering, have created a problem in filling these positions. In Finland the attraction of the private sector in the booming telecommunications and software development have left a huge gap in the remuneration of (potential) researchers in these areas.
- The Netherlands has made a clear analysis of skills shortages caused by the current age structure of the academic research population. A sudden expansion of the system in the 1960s and 1970s has resulted in a large group of research staff in the ages between 50 and 65. Their retirement in the coming 10 years will cause a huge gap in the numbers of staff, unless recruitment from outside the system is stepped up drastically. The UK has a similar problem with its age distribution, although this seems to have low policy priority.
- Denmark with its quite restricted number of PhD students, and a gradually grown and small system, is not expecting any major skill shortage issues according to their main science policy documents.

9.2 Are the benchmark countries equally successful and active in attracting foreign researchers?

From tradition both the USA and the UK, and in particular their world class universities have a longstanding international reputation, which attracts many foreign students and researchers. With Ireland they share another important advantage of having English as the first language which means that courses do not have to be adapted to the foreign students but the other way around.

The US has the additional advantage for offering good career opportunities outside the university system, after the researchers have completed their degrees or research projects. The renowned centres of excellence such as Harvard, MIT, Cambridge and Oxford can rely on word of mouth as a marketing strategy. Nevertheless and probably because of their many international post-graduates and post doctorates, these universities have active international offices acting as liaison between potential researchers and the institution. Their many international science collaboration networks give them access to the best centres and talents around the world. They can therefore choose between many candidates instead of having to find them.

Despite this comfortable position both countries provide additional incentives for foreign researchers to stay in their countries. At USA federal level this is mainly dome through regulatory measures (immigration procedures). The UK has a vast array of grants and collaboration agreements to finance a post-graduate position in one of the universities. In addition immigration and tax rules are favourable for foreign researchers.

Countries more similar to Ireland, i.e. the Netherlands, Denmark and Finland are not as successful in attracting foreign researchers and at the same time they are less active in pursuing activities to improve this. Denmark and Finland both address the need for increased internationalisation of research in their key policy documents. In Finland and the Netherlands the emphasis is on improving the international linkages of Finnish researchers and universities through active participation in trans-national science programmes and projects, bilateral co-operation agreements. The burden of action is with the universities themselves to set up international liaison offices, recruit foreigners and provide them with the necessary income.

9.3 How easy is it for a foreign researcher to settle in another country and what is done to support this?

The literature and benchmark study revealed that regulatory barriers are a key obstacle for foreign researchers to move to another country.
The issues here are:

- **Insufficient information:** for those researchers not familiar with the science system, the grant possibilities, the immigration rules, the taxation situation, the housing possibilities and so on, finding all this information is a huge effort, which requires dealing with a number of authorities, who usually do not operate in

parallel with each other. We have described two examples where a **Clearing House** was created to co-ordinate this the information for foreigners: the French organisations EduFrance (graduates) and the Alfred Kastler Foundation (post-doctorates and other researchers) and the Finnish CIMO organisation.

- **Immigration procedures**: can form a negative element if these are particularly strict and slow as is the case in the Netherlands. The US and France have special immigration arrangements for researchers, whereas in Finland despite lack of transparency, with the backing of a research institution, immigration can be arranged relatively easily. The UK's immigration rules are also favourable for not only studying in the country but to work on the side as well. In Ireland it was reported that although procedures for non-EEA citizens are not extremely strict, procedures can take up to a couple of months and research graduates can not work to increase their incomes. With the very low grants in the past, this means that foreigners would need to bring money from their home country.

- **Housing** for PhD graduates and even post-doctorate fellows can be arranged with the support of some of the universities that we studied, particularly since many of them have university housing facilities available at low rents. International offices in some cases help find accommodation for the foreign visitors. The Technical University of Eindhoven guarantees an accommodation for foreign research graduates. In France the Alfed Kastler Foundation helps in the search for accommodation. Our interviews in Ireland revealed that this could form a major bottleneck for attracting foreign research graduates, particularly in the expensive area of Dublin. The UCD for instance does not have accommodation available for foreign researchers, who would need to go on the private market.

9.4 What are the financial conditions for foreign research graduates?

In the United States and the UK the common pattern is that national research graduates (PhDs or MPhils) apply for grants from one of the many funding agencies as well as to the universities. US citizens and residents have access to NSF fellowships, which are not available for foreigners. PhD candidates have to find their own funding from their home country or from the various Grant and Scholarship organisations.

In the UK foreign research graduates can apply for dedicated funding schemes such as the Overseas Research Students Awards Scheme as described in the UK country report. Very often they will be paid by grant schemes in their home countries, or on the basis of bilateral exchange schemes.

In the three mainland Europe countries post-graduate researchers are considered as university employees with a fixed salary. The posts for these PhD-places are allocated through the departments of the university. Foreign researchers can obtain these positions as well but they have to compete with national candidates. So it is up to the university departments whether they give these positions to their own internal

candidates (graduates students), advertise it externally and/or bring in foreign researchers. Each of these countries face the same international competition for the best talents and are stepping up their activities to find these outside their own country, particular in those science areas where there are shortages. Ireland will be among these countries and will therefore have to at least match the conditions for the graduate students.

The literature on research mobility stresses that reputation, of a particular institution, research group or professor, is the most important motive for research talents to migrate to another country. This is almost to the effect that the unattractive financial aspects are taken for granted. In the UK non-European PhD students pay high fees and have relatively low levels of income. Despite the large numbers of foreign graduates in the US national fellowship programmes from the NSF exclude non-citizens. So grants and bursaries need to be acquired in the home country or from the many smaller private and public sponsoring organisations within the US . So the financial aspects are not a major setback to go and study in these two countries. The countries which lack this international science reputation can not afford to follow this pattern. In Denmark, Finland and the Netherlands, PhD graduates are paid fixed salaries and pressure from the private market have pushed these levels up in recent years. If Ireland want to match these income levels it would need to increase their present grant level of £2000 p.a. considerably. This is foreseen in both the PRTLI and SFI programmes.

Exhibit 22 Indication of approximate monthly incomes/ subsistence grants in EURO for research graduates (PhDs)

	IRL	DK	FI	NL	UK	US
Main source of income for foreigners	PRTLI	University held PhD positions	University held PhD positions	AiO and OiO positions at univer-sities	Dedicated UK schemes, funding from home countries	Various compe-titive grant and funding schemes
Level of monthly Income before tax	1048	1833	2000	1400	795	1900 (tax free)

9.5 What are the financial conditions for post-doctoral fellows and young researchers without a tenure?

The income position of post-doctorates is more difficult to compare since hey have different status in the benchmark countries. The following Exhibit 23 shows an indication of this income.

Exhibit 23 Indication of financial conditions for post-doctorate researchers* in Ireland and benchmark countries, nationally and from Marie Curie Fellowship programme.

	IRL	DK	FI	NL	UK	US
Level of monthly Income before tax	2899*	n.a.	2100	2400	3057	2600-4200
Marie Curie Fellowship Category 30 (gross)	3062	4373	3807	4225	3128	-

* average support for PRTLI

Both Denmark and the Netherlands have special tax exemptions for their foreign researchers where Danish excellent researchers pay 25% income tax instead of 40% and the Dutch foreign knowledge workers pay 30% instead of 50%.

9.6 What are the main policy responses from national governments and research associations to the research skills issues?

The three smaller countries all state in their key policy documents that internationalisation of research and improving mobility of researchers is important. The level of actual implementation of policy instruments varies considerably among the three. But the attraction of foreign researchers is not an explicit strategy to tackle the skills shortages problem. The expansion of the research system, the filling of vacancies in some science areas and the improvement of the career structure in all three countries are **predominantly tackled through an internal improvement of the research system, and only marginally by opening up the country for more foreign researchers**.

Key actions are:

- Making the system more open and flexible (NL, France, Finland, DK)
- Improving the regulatory conditions particularly on immigration(France, US)
- Better sign-posting and information at national level (Finland, France)
- Dedicated grants for foreign researchers (UK, Finland, NL, S-Korea)

- Adapting income situations to market forces (NL, Finland)
- Providing tax reductions specifically for researchers and knowledge workers (NL, Denmark, France)
- At university level: more active international marketing and support for international researchers (Finland, NL , UK)

Apart from these more short-term direct actions, more important is that most countries in Europe have realised that in order to compete with the two global forerunners, the international reputation and performance of their best research groups and centres needs to be improved. The centres of excellence approach, where a selection of research institutes, either free standing or as a network, receives additional government funding and support has now been adopted in most of Europe's countries. In Finland the Centres of Expertise initiative, in Germany the 'Kompetenzzentren' approach, in the Netherlands the Technological Top Institutes, in Sweden the Centres of Excellence institutes, in Austria the K+ programme, are all aimed at giving already existing excellence a boost to become internationally even better known. In Germany this is combined with explicit science marketing strategies to promote these 'pearls' to outside investors as well as outside researchers. This centres of excellence is now also at the heart of the ERA initiatives taken by the European Commission. Ireland's intended boost in the science system with the intention of supporting principal investigators and a focus on IT and Life Sciences goes along this line as well.

9.7 Do the universities themselves play a key role?

In The Netherlands, Finland and to a lesser degree Denmark, the responsibility for attracting foreign researchers has been taken up by a number of universities. Although we have not done a university wide comparison in these countries it seems clear that universities which already had vast international networks, which were already operating in European networks and transatlantic alliances are also the most pro-active in their internationalisation strategies. In the Netherlands the Technical Universities, those with the largest recruitment problems as well as the Wageningen Agricultural University which has traditional strong links with developing countries pro-actively recruit abroad. The internationally active universities in the Netherlands and Finland have introduced English spoken courses throughout the curriculum for the foreign graduates.

We found good examples of international offices which help as a broker between the foreign researcher and the various authorities and provide the information on the many practical issues that need to be dealt with.

Particularly regarding the more experienced post-doctorate researchers, recruitment happens through international scientific networks, European projects and personal contacts with scientists around the world. That means that Irish universities and professors have to be present in those international networks to find these talents.

Some of our interviewees from universities considered it important to have plenty of foreign undergraduates since very often the foreign post graduates and PhDs had been introduced to the university through these exchange programmes. So the networking with foreign talents should start early on in their career.

9.8 Recommendations for Ireland

9.8.1 Build up centres of excellence

The human mobility literature is very clear on the fact that for the best talents to move to another country, the main attraction is to work with internationally renowned professors, research groups and universities. Therefore the key long term strategy is to strengthen Ireland's science system as a whole and its centres of excellence in particular. It needs to be noted that in the two areas of science that have been chosen as focal point: IT and Life Sciences, are exactly the two areas where global competition for the best brains will be hardest. The combination of a lack of world-class science, limited career opportunities alongside the research system (private company labs) in some technology areas and unfavourable working conditions for research talents will make it very difficult to play a role in this global battle. Building up the science reputation is the long-term strategy on which Ireland is now taking up the challenge with a boost in public expenditure in basic science. As we have seen in the first chapter Ireland's expenditure on Higher Education is coming from far behind and it will take some time before the new system settles. Any strategy to attract young researchers as PhDs and post-docs will have no long term impact if this is not accompanied by actions to also attract internationally established and renowned scientists to lead research groups, faculties and institutes. An expanding system needs new blood in all its ranks.

Ireland should aim to be heavily involved in the present European debates on centres of excellence issue, because if the European label of centre of excellence will be allocated to the traditional strongholds, Ireland might well be left out. Although the exact policy implications of these European debates are still unclear, it can be expected that centres of excellence will get a favourable treatment in the future allocation of European support.

9.8.2 Improve international networks and visibility of Irish universities

International networks were key in establishing contacts with research talents and PhD graduates. Many of the benchmark countries have ample exchange programmes and grant schemes and bilateral co-operation programmes with targeted countries. Ireland should set up some dedicated foreign research grant programmes covering fees and living costs, which are marketed proactively in a few target countries. It could for a start exploit the traditional strong relationship with the US and the intentions of the NSF to stimulate Americans to spend part of their research career abroad. Following the Korean example of setting up clubs of Irish researchers abroad, could be another way of informing expatriates of opportunities and posts in the Irish system.

The Irish universities have only started dedicated internationalisation actions and international offices recently. This should be promoted and sponsored by the government. The pattern in many countries is that the marketing is done at several levels simultaneously: universities, organisations such as the British Council and national offices such as CIMO in Finland. Similar to the Finnish and French examples, one national Clearing House with a function to provide information and support to those considering going to Ireland, as well as playing a role in marketing Irish science in general could be very useful to boost visibility abroad. This organisation could also manage the grant schemes. The International Education Board is now responsible for marketing Irish undergraduate education. A similar outfit could do this but dedicated to science, research and technology.

Before launching an international marketing campaign the Irish system must be sure to be 'ready' to host these research graduates, with facilities, mentorships, research and training programmes put in place. It could be that some time is needed before the system has managed to deal with the new round of expenditures, before it can think of hosting large numbers of foreign research graduates.

9.8.3 Improve the status and remuneration of research graduates and post-doctorates.

The three benchmark countries Denmark, Finland and the Netherlands have one thing in common: research graduates (i.e. PhD candidates) are taken seriously in the sense that they are considered as part of the research staff, working alongside the other academic staff on research projects. They have teaching obligations, which prepares them for an academic position. They are paid a salary or have a grant which is sufficient to live on. In recent years universities in Finland and Netherlands have found ways to top-up the minimum salaries which have been agreed on collectively, in order to compete with the private market. In Finland this is done through private research centres linked to the university but independent enough to define their own salary policy. In the Netherlands universities have been allowed more freedom to deviate from the national wage classifications. Decisions are taken at faculty level. There is also a selection procedure for these limited amount of PhD posts, which require application procedures. Since there is no tuition fee involved, there is less tendency to take on board large numbers of PhD graduates as a source of income for the university.

So if Ireland wants to compete with other smaller countries on mainland Europe it will need to improve both the status and remuneration levels of its research graduates. One of the differences with the smaller benchmark countries is that research graduates usually already have a Masters degree, before starting their research degree. Therefore they have a longer time to prove their capabilities and are generally older when they start their research degrees. In Ireland which follows more the Anglo-Saxon model, graduates can start their research degrees after completing a BSc or BA degree, which does not occur in the other three countries.

A better awarding system for PhD candidates should have some entry barriers, to avoid the system to be flooded by all post graduate student who carries on their study after their Bachelors degree. Ireland needs to choose whether to follow

- The Anglo-Saxon model of treating PhDs as students, with a relatively low level of remuneration, and paying tuition fees, which are particularly high for non-EEA citizens.
- The mainland Europe model which have a limited number of research graduate places, higher remuneration, where the graduate is seen as part of the academic team and therefore has to undergo a selection procedure within the university.

The plans with PRTLI and SFI grants will at least make the remuneration more comparable to mainland Europe. It would be problematic to give foreign graduates a stipend that deviates from the domestic stipends. Given that it is up to the universities to recruit the research graduates, the easiest option would be allow them to recruit non-resident researchers with the current funding mechanisms.

Given the high living costs in for instance Dublin, the city to attract the most foreign researchers, the lack of affordable accommodation will form a major bottleneck and discouraging for researchers coming from abroad, particularly when they have a family. The university cases that we have looked at often offer accommodation for research graduates and/or help in the search. It could be considered to provide additional housing grants for those coming from abroad.

9.8.4 Make the move to Ireland as smooth as possible

The US, France and the UK have made efforts to make it more and more easy for researchers to deal with all the administrative procedures (visa, working permits) in a short time. Other European countries are in debate about this. Long waiting procedures could make a researcher decide for other options. This is not an issue for Irish expatriates coming back, but even EU-nationals have to deal with non transparent procedures to obtain working permits. The French case of one agency dealing with all these matters for researchers could be taken as example to organise ways in Ireland. This goes beyond science policy and requires good co-operation of various government organisations.

Apart from any regulatory barriers, Ireland can certainly benefit from two features that are important concerning the mobility of researchers:

- The English language spoken everywhere
- The image of Ireland offering a good quality of life