

**NEW S&T INDICATORS FOR A KNOWLEDGE-BASED
ECONOMY**

**NOUVEAUX INDICATEURS DE S&T POUR UNE ECONOMIE
FONDEE SUR LE SAVOIR**

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**An Inventory of National Priorities and availability of data
in OECD Countries to Quantify Science and Technology
Personnel Mobility Patterns**

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1. Executive summary

1. In June 1996 an international conference on new science and technology (S&T) indicators for the knowledge based economy was held at the OECD headquarters in Paris. At this conference, several areas that deserved significantly improved statistical coverage and the development of indicators were identified. One of these areas was the circulation of knowledge embodied in human resources. The current inventory of national efforts in OECD countries to quantify mobility patterns of highly qualified personnel has been conducted as part of this endeavour.

2. During the course of the inventory, discussions have been held with all in all 38 national experts. The experts were found to be in basic agreement regarding what aspects of the mobility of highly qualified personnel that are policy relevant, i.e. they agreed that the mobility of highly qualified personnel was of concern to policy makers. However, the availability of specialist studies/data sources/statistics for analysing these issues, and hence also for the calculating relevant indicators, vary from country to country. There is an obvious need for further work, in order to be able to produce a core set of indicators that might be feasible to collect and which could provide a basis for meaningful international comparisons.

3. For the continuation of the work, and based on the rating of the issues in terms of policy importance supplied by the individual countries, the following topics and countries to be included could be proposed for the next stage, notwithstanding resources constraints:

- (i) The interaction between industry and the public research infrastructure: Austria, Belgium, Finland, Germany, Hungary, Iceland, Israel, Italy, Luxembourg, Mexico, Norway, Poland, Portugal, Sweden and the United Kingdom;
- (ii) Inter-firm flows of highly skilled human resources: Korea, Nordic countries;
- (iii) The contribution of the national educational system to industry: Australia, France, Ireland, Japan and Spain;
- (iv) The importance of brain drain/brain gain: the Federation of Russia and Greece;
- (v) Employability and the quality of employment for highly qualified personnel: Australia, Canada and the United States;
- (vi) Age related mobility: the Federation of Russia, France and New Zealand.

4. However, taking all these topics and requesting countries to do all the work would involve much more resources than are currently available and time frames well beyond the ones set for the "New S&T Indicators" exercise. It is therefore proposed, in a first stage, to narrow the exercise down by concentrating on topics which have high priority and where there are practical experience and sources on which to draw, namely topics (i), (ii) and (iii). The work would be performed by consultants working with the Secretariat in close connection with a core group of Member countries.

2. Introduction

5. Since the beginning of the 1990's, discussions have been ongoing within the OECD Group of National Experts for Science and Technology (NESTI) on how to measure human resources devoted to science and technology. These discussions led to the Canberra manual which in April 1995 was accepted by NESTI and thereafter approved by the CSTP.

6. To develop indicators of the mobility of highly qualified personnel is important for several reasons: (i) human mobility can be seen as a proxy for knowledge flows, especially when it concerns the highly educated; (ii) mobility indicators would help to evaluate effects of different policy measures in the areas of education, research, labour market, regional development, etc.; (iii) indicators involving human resources (especially those highly skilled in natural sciences and engineering) complement traditional R&D statistics - for instance, technology in the service industries, as well as in small and medium sized enterprises, is incompletely reflected by these statistics; (iv) stock data on human capital become more meaningful if inflows and outflows can be measured, e.g. the effects of educational specialisation can then be better understood.

7. At the CSTP meeting in October 1996 Sweden was asked to take on the role as leading country for this project. Sweden accepted this role primarily for two reasons: (i) the work on Ph.D. mobility that NUTEK¹ had already conducted²; and (ii) the fact that Sweden through Statistics Sweden has access to data which allows studies of mobility of S&T personnel.

8. The purpose of the above project is to trace the flows of highly qualified personnel (i.e. \geq ISCED 6 in natural science and engineering) from higher education to first employment/destination and subsequent moves between units (firms, laboratories, etc.), sectors, regions and countries. The objective is to try and produce a core set of indicators which might be feasible to collect and which could provide a basis for meaningful international comparisons. The current inventory of national efforts in OECD countries to quantify mobility patterns of highly qualified personnel, has been conducted as part of this project.

9. The aim of the inventory has been to assess which questions are considered to be policy relevant, and to identify what types of studies that have already been undertaken or would be of interest to undertake, the types and sources of data, the organisations responsible for collection, processing and analysis of the data, available documentation and contact persons and furthermore, to note the coverage of existing studies/data sources and any methodological problems which have been encountered. The findings of this inventory are reported below.

3. Human resource mobility: Background

10. There are, of course, a variety of reasons as to why people choose to be mobile. Mere curiosity and a simple desire to learn something new has always set people off in the search for new experiences and the exchange of new ideas. People choose to be mobile for both private and professional reasons. Examples of private reasons for choosing to move are family, social or cultural reasons and examples of more professional reasons for moving are to get a better chance for a career advancement, a wage increase, access to better equipment, connections with colleagues or moving because of the lack of employment opportunities in a certain sector, region or country.

¹ The Swedish National Board for Industrial and Technical Development.

² The paper *Use of Human Resource Data for Analysis of the Structure and Dynamics of the Swedish Innovation System* by Lennart Stenberg, Eva Gustafsson and Göran Marklund was presented at the June 1996 conference on new S&T indicators for the knowledge based economy held at the OECD headquarters in Paris.

11. Mobility is effected by both push and pull factors. Both of these factors have been behind the historic movement of people from rural areas to cities. In times of high unemployment mobility can often be characterised as being more or less forced, i.e. as being caused by push factors in order to have a chance at a better life or even at finding a (suitable) job. In a stable economic climate, mobility is more likely to be a matter of choice and thus to be due to pull factors leading people to move if and when they are given enough incentive to do so.

12. Mobility patterns are affected by the level of economic development and openness of a country to the outside world. For example, the transitional phase from planned to market economies that many of the eastern European countries are going through, allows not only for the creation of jobs but also leads to the loss of or destruction of jobs forcing people to be mobile. The opening up of borders offers new opportunities of going abroad to work. In addition, the attraction of higher wages in the competitive sector has lead to an outflow from other sectors and an inflow into the competitive sector³.

13. As interesting as these examples of the mechanisms behind mobility are, it is not the mobility itself that constitutes the main focus of this project. Instead we are primarily interested in the long term perspective of gaining a better understanding of the specific relationship between mobility of highly qualified personnel and knowledge flows, in order to be able to assess the effect that various types of mobility of highly qualified personnel has on economic performance⁴. Only on the basis of such an understanding, would it then be possible to proceed with a review of government policies in order to identify failures/successes and to propose new measures accordingly. The first step towards such a development must however, be an inquiry into what mobility issues that are considered as policy relevant and what data sources/statistics that are available for the study of these issues.

14. It is important however, already at this stage to note that mobility is not necessarily something beneficial. There are various problems with how to interpret mobility. Too much mobility can lead to instability and can be just as bad as no mobility at all. Certain politicians may perhaps be of the opinion that mobility is a good thing and hence in their minds mobility is something that ought to be promoted. But matters are a little more complex than that. For example, if a firm invests heavily in the training of a particular employee and that employee then choose to leave for another job, it could certainly be regarded as a lost investment for the firm that had originally paid for the training. With too much mobility a company runs the risk of losing shared values, networks, etc. However, it could also well be that the employee because of this training performs better in his/her new job than he/she would have done otherwise. Depending on if you look at the above situation from the perspective of "a zero sum game" or take a broader more comprehensive view, were in the long term the stock of knowledge increases in spite of the fact that certain organisations lose out in the short term, it can be argued that mobility is both a good and a bad thing. Hence, it is a matter of at what level you choose to view mobility. Mobility can be looked at from the perspective of the individual, the organisation/institution, the society or the national perspective. At each level the gains and losses associated with mobility might differ.

³ Perhaps "brain flight" is an appropriate term to describe this phenomenon. Brain flight incorporates not only outflow from a certain country but also flows from one sector to another.

⁴ For example on the performance of firms, the career profiles of workers, knowledge spillovers, etc. Ideally such work should also determine the types of mobility which are socially beneficial and those which are not.

15. Because of the existence of knowledge flows without human mobility through different forms of networks⁵, co-operation between different parties, etc. one should furthermore be careful with using mobility as THE proxy for knowledge flows. Rather mobility should be seen as just one of many such proxies. Moreover, indicators are always a bit rough and therefore need to be complemented with qualitative research and in depth case studies.

4. The inventory method

16. At the beginning of December 1997, an e-mail was sent out to each of the principal delegates to the OECD group of National Experts on Science and Technology Indicators (NESTI), asking them to suggest the name of an expert in their country knowledgeable about which questions that were of high policy relevance to their particular country as well as about the existence of national data sources on the mobility of highly qualified personnel and types of mobility studies that had been undertaken or would be of interest to undertake. All in all 38 different names were proposed, 20 of these being the names of the principal NESTI delegates themselves⁶.

17. In early January 1998, a letter with information on the background and aim of the inventory, including a discussion note with various questions, was sent out to the nominated experts⁷. Using the discussion note as a basis, telephone interviews with the experts were then carried out between late January and the middle of April 1998⁸. It is the information gathered during the course of these discussions that constitute the core of this report.

18. It is important to note, that an obvious limitation of this inventory is that it is based solely on replies from one, or at most two, experts in each country. Surely, their responses cannot always be taken as indicative of national standpoints and it must be realised that they also reflect personnel opinions. Furthermore, because of the very broad scope of the inventory an unfortunate consequence of limiting discussions to only one or two experts per country, is that not all aspects may have been considered.

19. Before proceeding with presenting the actual results, I would however like to take the opportunity to extend my deepest gratitude to the national experts, those at the OECD and all others who I have been in contact with during the course of this inventory. Thank you for taking time out from your busy schedules to contribute to this report.

⁵ For example, community computer communication networks play an important role in knowledge distribution. But computer networks also play a role in knowledge creation. It is emerging from academic studies in New Zealand that communication is not just an information transfer activity but also a knowledge creation activity. This might be particularly true in organisations which have implemented internal knowledge management systems that integrate systems for rapidly accessing institutional knowledge with communication systems.

⁶ See also appendix A for a list of the names and addresses of the national experts.

⁷ See appendix B for a copy of the letter sent to Sweden. Similar letters were also sent out to the other member countries.

⁸ In a few cases, experts choose to respond entirely or partially by e-mail/fax.

5. Policy issues

20. Listed in the discussion note sent out to national experts were six mobility issues. As well as asking the experts to offer comments on each of these issues and to suggest alternative policy issues that might be of greater concern to policy makers in their countries, the experts were also asked to rate/rank the issues in terms of policy relevance. Given in appendix C is a summary table of the order of importance given to the policy issues in the respective countries.

21. It is important to note that several of the experts found it difficult to rate the issues and commented that the specified order could be influenced by personal preferences. The importance attached to each of the issues was furthermore likely to change over time and hence, the ranking could very well be different a year or even one month from now. Nevertheless, the strong conclusion that emerges from this exercise is that the experts generally agree that the list of policy issues was well chosen and comprehensive and that these issues were of relevance to policy makers in their respective countries⁹.

22. What follows are some of the more important remarks offered by national experts on the specific policy issues. In order to fully comprehend these topics and to be able to develop indicators that could illuminate them, it is important to be aware of and consider the various difficulties here highlighted. For each issue, a list of countries for which the concerned question was rated as being the top mobility issue, is also given.

The interaction between industry and the public research infrastructure

23. Concerning the interaction between industry and the public research infrastructure the point was raised that there need not necessarily be any correlation between the importance of public research efforts to different industries, and the mobility of researchers between the two sectors. Co-operation between the sectors certainly lead to knowledge flows, but this does not necessarily have to imply mobility of human resources. Mobility may thus not be a very good indicator of the interaction between industry and the public research infrastructure.

24. In order to understand the interaction between the two sectors, it is furthermore important not only to look at the one way mobility from public research to industry, but also to look at the flow in the opposite direction. One important factor to consider when studying flow from public research to industry is the wage differential between the two sectors.

25. The interaction between industry and the public research infrastructure was deemed to be the top mobility issue in Austria, Belgium, Finland, Germany, Hungary, Iceland, Israel, Italy, Luxembourg, Mexico, Norway, Poland, Portugal, Sweden and the United Kingdom.

⁹ This conclusion can of course be given two alternative interpretations. Either we have indeed identified the issues as regards the mobility of highly qualified personnel that are presently the most policy relevant, or we have posed the questions to the wrong people. As pointed out in paragraph 14 above, the majority of the experts that contributed to this report are members of the NESTI group which deals mostly with the statistical aspects of science and technology.

Inter-firm flows of highly skilled human resources

26. Measuring the movement of highly qualified personnel between firms/industries could meet with difficulties as it would call for record linkages of (census) files for different years. Such analysis would be expensive to perform and would probably require the approval of an oversight committee.

27. Nevertheless, four additional aspects that are linked to this issue were suggested: (i) the study of spin-off firms; (ii) the devaluation of the knowledge amongst researchers relocating from declining industries and not being able to make full use of their knowledge in their new jobs; (iii) the mobility from small and medium sized enterprises (SME's) to large firms and vice versa; and (iv) an in depth evaluation of the critical mass of highly skilled personnel needed by a firm to survive, in relation to its field of activity.

28. Because of the conditions attached under the International Monetary Funds bailout program in Korea and consequent mass layoffs due to the expected rapid restructuring of industries, the reallocation of highly qualified personnel among industries was considered to be the most important mobility issue in Korea.

The contribution of the national educational system to industry

29. As regards the contribution of the national educational system to industry, it was pointed out that the issue did not fully cover the interaction between these two sectors. Discussion of how well the educational system actually prepared students for industry, e.g. if Ph.D. students receive proper training in order for them to be productive in industry, and on the demand and supply of the highly skilled personnel was therefore called for. It was also important that mobility covered flows in all possible directions. The interactions between the education system and employment should accordingly refer to all sectors and not only to industry¹⁰.

30. Several further items that needed to be considered under this issue were suggested: (i) It was considered important to distinguish between mobility of researchers at the universities and mobility of the first time labour market entrants after completing their university education and to differentiate between a first university degree and further training to keep these qualifications updated, i.e. life long learning; (ii) regarding life long learning, one could perhaps proceed from the assumption that people these days will have several different professions during their working careers and hence, the knowledge acquired during the process of achieving a first university degree might be of real relevance only during the first few years upon graduating; (iii) the fact that it is not uncommon for recent graduates to take on various stray jobs, in order to get by, before landing their first real job needs to be considered; (iv) furthermore, as unemployment rates are increasing even for young highly qualified persons, it was important to examine the numbers of young researchers in industry; and finally (v) the contribution of the national educational system to industry linked with consequences of the ageing of the highly qualified work force, i.e. the age pyramid¹¹, was another important topic to consider.

¹⁰ The flow between university to industry or to other sectors, the flow from between firms and the flow from one country to another can all take place soon after graduation or later in a career. Combinations of types of mobility are furthermore possible (e.g. from a university in one country to an industry in another country).

¹¹ For example, if there is a sufficient inflow of young researchers into the work force of the highly qualified?

31. The contribution of the national educational system to industry was considered to be the top mobility issue in Australia, France (taken together with the consequences of the ageing highly qualified work force), Ireland, Japan and Spain.

The importance of brain drain/brain gain

32. To study the issue of brain drain from one country and brain gain in another, an overall unified approach needs to be established. In order to be able to compare national and international data concerning highly qualified personnel, every country needs to keep track of the original nationality of scientists including the field of scientific specialisation. It was considered essential to create such a common statistical basis for integrating information across countries so that information on highly qualified personnel in one location can be fed back to studies being conducted in those locations from where they originate. This is perhaps slightly different from the brain drain/gain issue in that the highly qualified personnel considered important in one country may not be of same importance in another country and studies of human resource movements in key skill areas may not cover the same groups in other countries leading to incompatible information. This issue should be seen as a comprehensive one of highly qualified personnel mobility in general. The science and technology labour market is a global one and is perhaps best treated as such, rather than looking at these markets from a limited national point of view. This approach, if followed, will make it possible to establish mobility indicators in few years time.

33. It is also important to gain a better understanding of why people chose to move. Is it because of low wages (wages as a factor hindering/stimulating knowledge flows), because entire industries are moving, because people were afraid of unemployment, because of the opportunities that the EU offered, etc?

34. Brain drain/brain gain was claimed to be the most important mobility issue in the Federation of Russia and in Greece.

Regional effects

35. Although demographers are particularly interested in issues of region, gender and age, these are either not relevant as policy issues on their own or presume what key factors influence mobility patterns¹². It is perhaps more important to try to find out what factors actually influence mobility. Rather than being a policy issue of its own, regional effects should therefore be analysed in the context of the other policy issues, i.e. as a sub-issue of all others.

36. An important aspect to consider as part of regional mobility is teleworking. Once the infrastructure allowing for these kind of knowledge flows is in place (e.g. telephone lines that can allow people to communicate via phone/computer networks, etc.) people will no longer be restricted to having to work at a certain geographical location.

¹² Age may be the one exception in that it has obvious policy significance for replacement demand, although it is uncertain as to how important a policy issue this is in relation to many other policy issues, e.g. hiring practices of employers who can be prone to replacing “old” expensive highly qualified personnel with younger and less expensive recent graduates.

37. Regional or internal mobility was thought to be the most important mobility issue in the Czech Republic¹³.

Gender related mobility

38. Gender related mobility is a cross-cutting issue which like regional effects needs to be analysed together with all the other dimensions of mobility. Regarding for instance the interaction between industry and the public research infrastructure, women and men may not be equally distributed between the public and private sectors and this may affect the mobility between the sectors if the industry has a “preference” for men, whereas public institutions are required to offer “equal opportunities”. The concept of brain drain also needs to apply to the case of highly-qualified people not making full use of their qualifications, either because they drop out of the labour force or because they work in jobs for which they are over-qualified (with the risk in both cases of progressively losing their qualifications). This is more often the case for women than for men. Moreover, the increase of dual career couples is an aspect of gender related mobility that have implications for regional or geographical mobility. There may be a-symmetrical effects on women and men. The phenomenon of such couples may act to restrict mobility or lead these couples to move mainly to and between large cities.

39. Differences in mobility patterns of women and men on the labour market in general and also in the area of science and technology. This raises the question if such differences are reason for policy concern? From an equality perspective such differences are of policy concern if women are losing out on employment and career opportunities. Observed differences should also be of policy concern from a human resource perspective, if the potential contribution from women is not fully utilised¹⁴.

40. Gender related mobility was considered to be the third most important mobility issue in France. No other country however, gave gender related mobility a higher ranking than France.

General comments

41. In order to make it possible for meaningful international comparisons of mobility, it is important to consult the work of different international groups on definitions, etc. The definitions in the Canberra manual may not always correspond to those that are actually used in member countries and national definitions therefore need to be harmonised¹⁵. It is furthermore important to define exactly what is meant by mobility. Perhaps it is necessary to tie this concept somehow to an establishment level of the firm. This problem has become apparent through the work of the Nordic countries in the OECD National Innovation Systems (NIS) focus group on skills and mobility, where the operational definition used was perhaps not as functional as originally expected. Examples of complications were employees who took part in full time training during longer periods, people who moved in and out of unemployment from one year to another, etc.

¹³ Furthermore, Luxembourg presents an interesting special case as regards regional effects because of the daily regional flows/migrations of a vast number of commuters living abroad but working in Luxembourg. Apparently, as much as half of the work force in Luxembourg resided elsewhere.

¹⁴ For example, there is concern that too few women enroll in science and technology courses in Australia and the Netherlands.

¹⁵ The definitions of the European Union Labour Force Survey could be useful in this regard.

42. Because it is essential to relate the flow of highly qualified personnel to the knowledge flows, it may also be important to look at mobility in terms of skills. A definition of skills should probably include training and current area of research. It might also include research experience and areas of interest. It could moreover possibly be extended to competencies such as leadership, recognition (in the international science community) and communication skills, and may also extend to such issues as whether the person is working holistically across several disciplines or at the boundary between disciplines¹⁶.

43. Apart from harmonising definitions, national experts also pointed to other areas where further discussion is needed. For example, discussion is needed on whether limiting the studies of mobility to highly qualified personnel in R&D is a sensible first step¹⁷ and whether the value of incorporating highly qualified personnel who are not actively involved in the S&T system is justified in relation to the high costs of data collection. Another related item on the scope of data collection, is whether the focus should be exclusively on the natural sciences and engineering fields or if it should also be extended to include the social sciences and humanities¹⁸. Concentrating only on highly qualified natural scientists and engineers may be too narrow a focus if the ambition is to gain a better understanding of the relationship between the mobility of highly qualified personnel and knowledge flows. In that case, it may be important to also include groups, for example designers, musicians, etc. that are so important to the information technology industry. Furthermore, it is important not to simply study the level of qualification but also to focus on the field of specialisation which may be of more economic relevance.

44. Since the knowledge mobility issue is linked to employability and the quality of employment of highly qualified personnel, the experts from Australia, Canada and the United States suggested that important mobility issues, in addition to the ones above, were activities which resulted in the creation of jobs for the highly skilled and how well university graduates coped on the labour market, i.e. how successful they were in finding qualified jobs and how useful their qualifications were to potential employers.

45. The experts from the Federation of Russia, France and New Zealand furthermore suggested that the ageing of the highly qualified work force or age related mobility was an important issue that needed further consideration.

46. Along with these suggestions, several other mobility topics were also proposed by national experts¹⁹: (i) the potential "crowding out" by foreign multinational companies (Ireland); (ii) mobility between research fields or inter-field flows (Japan)²⁰; (iii) joint activities among universities and firms and the outsourcing of activities as a means of exchange of knowledge (Japan); (iv) the inflow into the Ph.D.

¹⁶ It was suggested by the experts from New Zealand that the Australian research classification framework could be very useful in this regard, as it uses a set of keywords to describe the skills of people.

¹⁷ Limiting the studies of mobility to highly qualified personnel in R&D, opens up for the possibility of collecting mobility data by adding questions to the R&D surveys.

¹⁸ See also the basic definitions in chapter 3 of the OECD/Eurostat Manual on the Measurement of Human Resources Devoted to S&T, the Canberra manual.

¹⁹ For further examples, see appendix C.

²⁰ In Japan, life-long employment is still a dominant employment feature for researchers. Reallocation of skilled personnel therefore usually takes place within firms.

programs at universities, i.e. the number of alumni that wanted to write a dissertation (the Netherlands); (v) the inflow of students to S&T-studies (the Netherlands); and (vi) retraining as a process of mobility and cross fertilisation between skill areas (New Zealand).

47. The Swedish experts furthermore suggested that an issue that could be expected to become of interest in the future, was the degree to which new forms of employment would influence the circulation of knowledge. Short term employment, teleworking and virtual organisations²¹ are developments that probably will be more widespread in a couple of years. Especially the latter development is likely to create difficulties in tracing the circulation of knowledge.

48. Several suggestions of additional dimensions of the issues the interaction between industry and the public research infrastructure, inter-firm flows of highly skilled human resources and the contribution of the national education system to industry, were likewise put forward: (i) R&D mobility or the mobility of personnel into, within and out of the R&D system - an example of such mobility would be someone who went from performing R&D at the university to doing something else in the private sector; (ii) the competency dimension - which kind of personnel are moving, personnel with certain education and certain competencies in addition; (iii) the question of substitution - for example, how could the lack of personnel with a certain educational background be replaced by personnel with other educational backgrounds (because of the many qualitative aspects involved in analysing substitutability, this was however not an issue that easily lent itself to mere statistical analysis).

49. In addition to these dimensions, the following aspects were suggested by the German expert as relevant basic background information: (i) population (demographic structure and development); (ii) structural information on labour market and employment; (iii) structural and regional aspects of the research and educational systems; (iv) the framework conditions (especially legal²²) for education, science and research; and (v) international co-operation.

50. Finally, for the purposes of international comparisons, structural information on the business enterprise sector needed to be taken into account²³. Aspects seen as relevant basic background information were: (i) employment and self-employment; (ii) start-up firms e.g. in R&D intensive industries; (iii) spin-off firms from the higher education sector and research institutions; and (iv) the absorbing power of enterprises²⁴.

²¹ Organisations with a large number of consultants and few employees on permanent contracts.

²² For example, a new law (Act n. 196, 1997) has recently been enforced in Italy to enhance employment. The law aims at getting researchers, scientists and engineer working in the public and governmental research institutions to work in SME's for the purpose of technology transfers. The public and governmental research institutions would, during a maximum period of 8 years, be compensated for the loss of personnel by being given the chance to employ a recent graduate or Ph.D. at no cost (the costs being covered by additions to the ordinary budget). The advantage to the firms was mainly getting free skilled labour, with payment of salary and social security being supplied by the public sector.

²³ One source for such data is the annual OECD/CERI publication: *Education at a Glance*.

²⁴ SME's do not necessarily innovate continuously and therefore must have access to qualified personnel and information to be able to fully exploit the benefits from these innovations.

6. Specialist studies and data sources: An overview

51. Given in appendixes D and E are lists of existing specialist studies and data sources/statistics along with the names of and contact persons suggested by national experts²⁵. Even though these lists are extensive, a widespread complaint was that no specific data was collected on the mobility issue covered by the inventory and that only partial data/information could be drawn from the suggested sources.

52. As can be seen from appendix E, the most commonly suggested data sources/statistics were: (i) the labour force surveys; (ii) the population censuses; (iii) the R&D surveys; (iv) the innovation surveys; and (v) education statistics. Several countries also performed graduate destination surveys. However, only a few countries had experiences with studies that focused directly on the mobility of highly qualified personnel. Mobility studies had nevertheless in one form or another been conducted in Norway since the 1960's, with full scale studies having been conducted in 1975 and 1981. Labour mobility surveys were also conducted every other year in Australia as a supplement to the labour force survey. In Hungary a panel survey of the mobility of personnel with scientific degrees had recently been ordered by the Ministry of Education and Culture and a general mobility survey, focusing on social or vertical mobility, was conducted every ten years. Furthermore, a publication on Korean labour mobility had been published by the Korean Labour Institute in 1992.

53. A survey of human resources for science and technology based on the Canberra manual will later this year be launched in Greece. The survey would be two to three years in progress and would be the largest survey that the Greek Ministry of Development had ever conducted. Moreover, in the Federation of Russia, a new comprehensive study of human resources for science and technology drawing information from the population census, the labour force survey, R&D and educational statistics was in the planning.

54. As a measure in trying to develop a comprehensive picture of human resources for science and technology in New Zealand, a review of available information on the supply of such personnel was published in July 1997. Similar reviews, due to be completed by the end of this year, were currently under way in Australia and Belgium.

55. On the basis of the data sources/statistics suggested by national experts, four different groups of countries can be identified: (i) countries with registers which possibly could be linked for the purpose of studying mobility, i.e. the Nordic countries, France and Israel; (ii) countries with specialist surveys providing information resembling that of registers, e.g. Australia and the United States; (iii) countries where partial mobility data/information can be drawn from various sources; and finally (iv) countries such as Greece where no data on the mobility of highly qualified personnel is available at present.

56. The crucial issue regarding the possibilities of conducting mobility studies of highly qualified personnel, seems to be whether or not countries have access to register systems (or data from specialist surveys resembling registers). However, building such registers in countries where they are not readily available is, apart from the issue of integrity, presumably also related to country size. It is probably much more difficult to set up functioning register systems in large countries, than it has been to set up such systems in the smaller Nordic countries.

²⁵ For the specialist studies and data sources where no specific contact person has been suggested, further inquiries should be directed to the national experts listed in appendix A.

57. In order to be able to produce internationally comparable statistics on the flows of highly qualified personnel, it is not only a problem is therefore not only of coming up with suitable indicators²⁶ but also one of harmonising data collection methods in the different countries.

7. Problem areas

58. Although national experts were asked to offer both specific and general commentson any data or methodological problems that they were aware of regarding study of the mobility of highly qualified personnel, the comments offered were mostly of a general nature. The most common problems seemed to be the general lack of systematic data to indicate the movements of highly qualified personnel²⁷ and the incompatibility of data from the different sources that existed²⁸. As is evident from appendix D and E, the availability of specialist studies and data sources vary greatly across countries.

59. Because the mobility of highly qualified personnel is such a complex area, it was suggested that it might be necessary to collect new data through a special harmonised survey. In order to provide longitudinal data one would have to follow the movement of people for a few years. This would of course be very expensive and apart from requiring some kind of register it would also require a high policy preference for these issues. Moreover, there is also the problem of getting people to respond properly to this kind of survey.

60. However, unless such a survey is conducted however, there no choice but to use the various ad hoc studies in existence²⁹. In order to be able to calculate indicators over time, there is thus a great need both for time and money to analyse and work with the problems of comparability between these studies. Firstly, the data have not collected for the purpose of mobility of highly qualified personnel. Furthermore, the data quality varies, have different focuses, are conducted with varying frequencies, cover different time periods, utilise different concepts/classifications, etc. As such problems already exist at national levels, international comparisons are therefore very difficult at present.

61. Along with these crucial difficulties, various statistical problems such as low response rates and partial non response, problems with estimating missing data, changes in classifications, breaks in time series, data only being available with a time lag, etc. further complicated matters.

62. Given in appendix F is an overview of how compatible the national classifications systems used for national data sources/statistics are with the United Nations International Standard Industrial Classification (ISIC), UNESCO's International Standard Classification for Education (ISCED) and the International Labour Office's International Standard Classification of Occupations (ISCO).

²⁶ See also section 8. For discussion.

²⁷ This problem was pointed out by the experts from Denmark, Federation of Russia, France, Iceland, Luxembourg, Switzerland, and Turkey.

²⁸ This problem was pointed out by the experts from Germany, Hungary, Italy, Japan, Mexico, New Zealand, Portugal, Switzerland, Turkey.

²⁹ Another possibility for collecting data on the mobility of highly qualified personnel is, as has already been hinted at in footnote 16, to add questions to already existing surveys. See also section 8. The need for further work.

63. As these are the classifications proposed in the Canberra Manual, it is obviously important for the development of internationally comparable statistics on the mobility of highly qualified personnel that national figures are reported in line with these classification standards.

64. As can be seen from the table in the appendix G national classification systems seem, with varying degrees of success, to adhere to these standards. However promising as this may be, several problem areas are also evident. The use of descriptive terms such as "somewhat compatible", "basically comparable", "not always perfect", etc. hints that conversions from national classifications may not be without problems and may thus not always prove to be satisfactory. Closer scrutiny and comparisons of national classifications systems to ISIC, ISCED and ISCO is therefore needed, in order to be able to eliminate national inconsistencies, before international comparisons of the mobility of highly qualified personnel on the basis of these classification can be made with a satisfactory accuracy³⁰.

65. Even though the inventory has concentrated on the mapping of policy relevant issues as regards the mobility of highly qualified personnel and on the identification of specialist studies/data sources/statistics available for the study of these issues, national experts were also asked to offer comment on the two topics: (i) how to measure the flow of knowledge accompanying mobility and (ii) the links between human mobility and other forms of networking.

66. Regarding how to measure the flow of knowledge accompanying mobility the point was raised that it is also important to consider how to measure competencies³¹. The competency of a recent graduate for example, is much different from that of someone with work experience regardless of if they have the same educational background or not. Furthermore, even though the formal knowledge base of a recent university graduate is well defined, it may still not be true that it is easier to assess the knowledge flows linked to the mobility of such graduates as compared to that of more experienced personnel. In order for these recent graduates to function effectively in their new working environment, they may have to be given supplementary training and time to adopt to the new organisational culture. Hence, even though their knowledge base could be argued to be well defined they may initially constitute a drain rather than gain for the institution that hires them. This problem is further exacerbated by the difficulties of comparing educational degrees across countries.

67. Moreover, firms might in the future take a different view of the concept of knowledge flow and there might therefore be a need to redefine this concept. Future firms would perhaps take a more know-how oriented view of knowledge rather than a materialistic or personnel oriented view. In fact, it is not the employee himself/herself but the knowledge that he/she carries that is important to the firm.

68. In his Ph.D. thesis³² Dr. Eirikur Hilmarsson of Statistics Iceland, investigated whether Icelanders utilise in their jobs the skills they had acquired through education. The conclusion reached is that college graduates aged 25-44 work in the field of their education and that they make use of the knowledge they have acquired through their studies. However, research in Holland show that the field of study is relevant as a proxy for knowledge or competency only for the first 5 years after graduation. After that period so much new knowledge has been acquired that it is recommended that the educational background only be used as a proxy variable for the first five years after graduating.

³⁰ For a related discussion see also the OECD report *Evaluation Report on the 1995/96 Pilot Data Collection on HRST Stocks, DSTI/EAS/STP/NESTI(97)3* by Linda Hardy.

³¹ Aside from formal training, a persons competency may also be taken to include such things as work experience, communication and social skills, leadership qualities, etc. See also paragraph 41.

³² *The role of education in the Icelandic labour market*, 1989. University of Wisconsin at Madison, unpublished.

69. Quite the opposite problem is illustrated by the case of Greece where many young scientists are forced to join the lines of the unemployed or the under employed upon graduation. The problem in Greece is therefore rather one of stagnancy or immobility and the loss of knowledge that accompanied this under utilising of acquired skills.

70. Not very many proposals on how to practically measure the flow of knowledge accompanying mobility or how to assess the impact of knowledge flow were submitted. However, the following suggestions were put forward: (i) the use of field of study classification to indicate where one individual may have more than one research interest, where interests may change over time, or where a researcher has a unique combination of research skills across different fields; (ii) that it might be useful to contact different trade unions for information on the methods they use for weighing/valuing/measuring acquired knowledge; and (iii) that it might be necessary to conduct a separate survey to investigate how much of the knowledge acquired through education, that has actually been used in the various jobs that a worker has held upon graduating.

71. Concerning the links between human mobility and other forms of networking, several experts pointed out that information on innovation co-operation was available through innovation surveys³³. However, the nominal nature of these data tends to limit their usefulness, and there is thus a need to complement this information with data on the mobility between different industries using for example employment registers (where available).

72. Several experts moreover suggested that it would be useful to have a look at bibliometric data³⁴, co-authorship's and patents. It was also suggested that knowledge flows could be estimated through the evaluation of international co-operative programmes where several countries are involved. Examples of such programmes are: (i) the Framework Programme of the European Union and (ii) the CYTED Programme³⁵ that involved all the Latin American countries, Spain and Portugal in several co-operative scientific programmes.

73. Finally, it was recommended that it might be worthwhile to have a closer look at the 1994 NIFU³⁶ publication *Mobility patterns amongst Norwegian researchers* edited by Mr. Olaf Tvede and Mr. Svein Kyvik. One of the chapters in this study took a closer look at the patterns of co-operation amongst university researchers. The main findings were that co-operation among university researchers is related to their labour market experiences. Generally university researchers with labour market experiences outside the academia have more co-operation in research in general and more co-operation outside the academia than their peers without such labour market experiences and the co-operation is related to the sector where they had their labour market experiences.

³³ In the Community Innovation Survey II (CIS II) of the European Union there are questions on both (i) the source of information for innovation between 1994 and 1996; and (ii) innovation co-operation between 1994 and 1996.

³⁴ Studies of scientific publications, journals articles, patents, technical reports, etc.

³⁵ Ciencia y Tecnología para el Desarrollo (Science and Technology for Development)

³⁶ Norwegian Institute for Studies in Research and Higher Education. This publication is however available in Norwegian only.

8. The need for further work

74. As is evident from previous sections of this report, the national experts interviewed during the course of the inventory are in basic agreement regarding what aspects of the mobility of highly qualified personnel that are considered as policy relevant, i.e. they are in agreement that the mobility of highly qualified personnel is of concern to policy makers. However, as has also been evident the availability of specialist studies/data sources/statistics for analysing these issues, and hence also for the calculating relevant indicators, vary greatly across countries. In order to be able to produce a core set of indicators that might feasibly be collected and which could provide a basis for meaningful international comparisons, there is therefore a strong need for further work.

75. One well established way of proceeding, would be to set up different networks where groups of countries work together on comparing existing data sources³⁷, on developing the instruments necessary for collecting new data and on developing suitable indicators for each relevant policy issue. Perhaps it is possible to benefit from the experiences of the OECD Indicators of Education Systems (INES)³⁸ project in establishing these networks. The strength of the network approach is that groups of countries work together, which not only leads to strong commitments from the participants but also to creating a sense of “collective ownership” of the results³⁹.

76. If a certain country has shown strong interest in a particular question⁴⁰, it can perhaps be approached to act as a lead country regarding this issue and produce discussion papers with suggestions of suitable indicators. The other countries participating in the network would take part in the ensuing discussion. In a sense this is the approach taken towards developing indicators of social mobility in the

³⁷ The general nature of the current inventory does not allow for the in depth analysis and comparisons of the national data sources here called for. However, the national sources listed in appendix D and E can certainly be used as a starting point for this work. Such efforts are already under way in the Nordic countries where Denmark, Finland, Norway and Sweden are working together on developing indicators as part of the Nordic NIS group on skills and mobility. An important lesson that can be drawn from their work is that even though the register systems of the Nordic countries were beforehand seen as being more or less alike, in depth comparisons has pointed out several areas of divergences. See also the report *Formal competencies in the innovation systems of the Nordic countries - An analysis based on employment register data* by Christian Svanfeldt, Göran Marklund, Lars Blixt, Anders Ekeland, Svein Olav Nås, Johan Hauknes, Mikael Åkerblom, Markku Virtaharju and Ina Drejer.

³⁸ The origins of the INES project dates back to sometime around 1989/90 when the United States announced that it intended to become world leader in education. The US therefore began showing particular interest in performance and standards of educational outcomes across countries. Although some work on educational indicators had already been carried out in the in the US, it was not until the first round of meetings of representatives from the member states in the late 1980's, that work at the international level really got under way. The INES project is at present, apart from the Steering Group and different National Co-ordinators, made up of three different networks and a Technical Group (see below):

- (i) Network A on Educational Outcomes (Lead country: United States)
- (ii) Network B on Student Destinations (Lead country: Sweden)
- (iii) Network C on School Features and Processes (Lead country: the Netherlands)
- (iv) Technical Group on Educational Statistics and Indicators

³⁹ The INES has also benefited greatly from the close co-operation with Eurostat. Working together with Eurostat is important for the development of internationally comparable mobility indicators as well. Not only should benefits be drawn from Eurostats experience with related projects, but it should possibly benefit from Eurostat's extended potential in requesting member states to supply data.

⁴⁰ See also section 5, where lists of countries with particular interest in the specific issues are presented.

INES project, which amongst other things has led to discovery of the International Adult Literacy Survey (IALS) as a suitable source of data.

77. One possibility for collecting internationally comparable data on the mobility of highly qualified personnel is to add question(s) to national labour force surveys (LFS)⁴¹. The LFS's are perhaps the most obvious choice of surveys were to add questions, for several reasons: (i) the LFS's are firmly established and relatively standardised across OECD countries; (ii) in countries such as Sweden, a panel approach is used of in the LFS which makes it possible to "follow" individuals⁴²; and (iii) some countries e.g. Finland have already used the LFS for similar data collection purposes by incorporating additional questions.

78. In order to gain a measure of the quality of the indicators based on data collected through adding questions to LFS, it would perhaps also be possible to engage the Nordic countries in comparing indicators based on such data with indicators calculated on the basis of more accurate register data, i.e. by exploring ways of calculating similar indicators for other countries with less accurate data sources.

79. The possibilities of successfully pursuing work in line with what has been suggested above, is of course in the end dependent on the priority that it is given and on the resources that are devoted for this purpose. As Sweden would not be in a position to allocate the resources called for, it is strongly recommended that the OECD take a more active role in leading the project forward. In order for the OECD to do so, it needs to make a significant commitment both in terms of resources and staff. It is suggested that a permanent post be created at the Directorate for Science and Technology/Economic Analysis and Statistics Division (DSTI/EAS) making it possible for a permanent staff member to co-ordinate and supervise the work under way in the networks⁴³. Only by making such a commitment would it be possible to continuously keep à jour with the latest developments and to lead the project forward and to ensure that the mobility of highly qualified personnel is permanently placed on the agenda.

9. For discussion

80. Agreement has to be reached on how the work should be continued. Based on the rating of the issues in terms of policy importance supplied by the individual countries, the following topics and countries to be included could be proposed for the next stage:

- (i) The interaction between industry and the public research infrastructure: Austria, Belgium, Finland, France, Germany, Hungary, Iceland, Israel, Italy, Luxembourg, Mexico, Norway, Poland, Portugal, Sweden and the United Kingdom;
- (ii) Inter-firm flows of highly skilled human resources: Korea, Finland, Norway, Denmark, Sweden;

⁴¹ Such an approach is already followed in Poland, where certain questions from time to time are added to the core questionnaires of already existing surveys, in order to satisfy user data needs.

⁴² In Sweden, every individual participates in 8 consecutive LFS's over a period of 2 years.

⁴³ Since the departure of Mr. Gunnar Westholm from OECD/STI/EAS in June 1996, no permanent member of the OECD staff has actively worked with HRST (Human Resources for Science and Technology). The ad hoc solution of filling Mr. Westholm's post with various temporary consultants financed by national governments is not a sufficient solution for covering this area. With all the initial entry barriers, networking, and the problems of documenting and handing over work properly to a successor, such a solution cannot be considered neither very time nor cost efficient. Furthermore, such practice leads to loss of continuity and as a result work at the OECD in covering this area will most certainly suffer.

- (iii) The contribution of the national educational system to industry: Australia, France, Ireland, Japan and Spain;
- (iv) The importance of brain drain/brain gain: the Federation of Russia and Greece;
- (v) Employability and the quality of employment for highly qualified personnel: Australia, Canada and the United States;
- (vi) Age related mobility: the Federation of Russia, France and New Zealand.

81. However, taking all these topics and requesting countries to do all the work would involve much more resources than are currently available and time frames well beyond the ones set for the "New S&T Indicators" exercise⁴⁴. It is therefore proposed, in a first stage, to narrow the exercise down by concentrating on topics which have high priority and where there are practical experience and sources on which to draw. Topics (i) and (iii) in the list above are, as shown in the survey of data sources (annex F), those for which the development of indicators seems to be most feasible. Moreover they are high in Member countries' priorities. They would be developed by consultants working with the Secretariat, in close connection with a core group of volunteer Member countries (to be selected among those identified above), which have either indicated a high priority for the topic and/or have a more advanced experience in the development of indicators pertaining to the issue. The outcome would be actual indicators, in addition to methodological considerations. For topic (ii), where there are broader methodological problems, a substantial work has already been done by the Nordic group. This experience should be used in order to develop ways of extending the calculations to other countries with less accurate data sources than the Nordic registers. A consultant could explore this possibility, propose ways of improving cross country comparability and, where it is possible, calculate actual indicators. For this project the work would be also conducted in close connection with a core group of countries.

⁴⁴ In spite of the differences in national experiences with quantifying mobility patterns of highly qualified personnel, the national experts interviewed during the inventory were asked to suggest suitable indicators based on available data sources. As is evident from appendix G the indicators suggested under each policy issues cover a wide spectra. It is important also to be aware that these indicators have been suggested with national data sources in mind, and they therefore are country specific. These suggestions should hence be regarded as a starting point for wider discussion and as a complement to the work by Eurostat on developing a methodology for the measurement of flows of human resources in science and technology, see the publication *Basic Indicators for describing the Flow of Human Resources in Science and Technology*, DSTI/EAS/STP/NESTI(96)14.

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Appendix B: Letter and discussion note sent to national experts**OCDE**ORGANISATION DE COOPÉRATION ET
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DSTI/EAS/DM/98.1

13 January 1998

OECD activity on new S&T indicators – Project 1: The circulation of knowledge embodied in human resources

Dear Ms. Pettersson,

At the meeting of the Committee on Science and Technology Policy (CSTP) at Ministerial level in September 1995, it was agreed that there was a need for the OECD member countries to collaborate to develop a new generation of indicators that could measure innovative performance and other related outputs of a knowledge based economy. In response to this ministerial concern, an international conference on new science and technology indicators was arranged in June 1996 with the objective of coming up with practical orientations for such future work. At this conference, several areas that deserved significantly improved statistical coverage and the development of indicators were identified. One of these areas was the circulation of knowledge embodied in human resources, for which Sweden⁴⁵ agreed to take on the role as leading country.

Developing indicators of the mobility of highly qualified personnel is considered important for several reasons: (i) Human mobility can be seen as a proxy for knowledge flows, especially when it concerns the highly educated; (ii) Mobility indicators would help to evaluate effects of different policy measures in the areas of education, research, labour market, regional development, etc; (iii) Indicators involving human resources (especially those highly skilled in natural sciences and engineering) complement traditional R&D statistics. For instance, technology in the service industries, as well as in small and medium sized enterprises, is incompletely reflected by these statistics; (iv) Stock data on human capital become more meaningful if inflows and outflows can be measured, e.g. the effects of educational specialisation can then be better understood.

The purpose of the above project is to trace the flows of highly qualified personnel (i.e. \geq ISCED 6 in natural science and engineering) from higher education to first employment/destination and subsequent moves between units (firms, laboratories, etc.), sectors, regions and countries. The objective is to try and produce a core set of indicators which might feasibly be collected and which could provide a basis for meaningful international comparisons. As part of the project an inventory of national efforts in OECD countries to quantify mobility patterns of highly qualified personnel is to be conducted.

⁴⁵ The Swedish National Board for Industrial and Technical Development (NUTEK) and Statistics Sweden in co-operation with the OECD Secretariat.

ROOM DOCUMENT NO.2

The inventory aims at identifying what types of studies would be of interest or have already been undertaken, the types and sources of data, the organisations responsible for collection, processing and analysis of the data, available documentation and contact persons. Furthermore, to note the sectors and types of organisations (e.g. size) and the categories of S&T personnel in terms of education background, occupation or other relevant categories which are covered by the studies and data and any methodological problems which have been encountered.

Mikael Rosengren is until the end of February at the OECD, on detachment from Statistics Sweden, to conduct this inventory. As your name has been suggested by Ms. Annemieke Ålenius as an expert in Sweden who could help Mr. Rosengren with this exercise, he will within the near future be in touch to arrange for a telephone interview. In preparation for the interview I enclose a brief discussion note that you may consider prior to discussing with Mr. Rosengren.

Once Mikael Rosengren has finished his round of consultation with national experts, the results of the inventory will be compiled in a document that is to be presented at the joint meeting of the OECD group of National Experts on Science and Technology Indicators (NESTI) and the working group on Innovation and Technology Policy (TIP) in June 1998. A copy of this report will of course also be sent to you by mail once it has been completed.

Should you have any questions please feel free to contact Mikael Rosengren directly at e-mail: mikael.rosengren@oecd.org; fax: (33-1) 45 24 18 48; or telephone: (33-1) 45 24 99 87.

Thank you in advance for your kind co-operation.

Yours sincerely,

Daniel Malkin

Enclosed: Discussion note

cc: Annemieke Ålenius, Statistics Sweden
Alison Young, STI/EAS
Dominique Guellec, STI/EAS
Mikael Rosengren, STI/EAS

Discussion note

A. Indicator and policy issue inventory

Below we have selected a few issues, listed in sequence of priority, that we feel are of special concern to policy makers. They should be regarded as a starting point rather than a limitation of the work. We would be happy to receive proposals for alternative policy relevant issues as well as suggestion of relevant studies we ought to be informed about.

1. The interaction between industry and the public research infrastructure

Indicators of the mobility of researchers between the public research infrastructure (universities, research institutes, etc.) and industry would help to assess the importance of public research efforts to different industries, visualise mismatches between public and private resources, etc. Indicators would involve the mobility of scientists and engineers between industry and the research infrastructure, both nationally and internationally. Such indicators would provide a complement to current R&D statistics.

2. Inter-firm flows of highly skilled human resources

Inter-firm knowledge flows entail the mobility of highly qualified personnel both between firms in the same industry as well as between firms in different industries. Some knowledge intensive firms have important roles to play in providing other firms with highly skilled human resources, and hence can be regarded as a second knowledge infrastructure complementing that of the formal higher education system. Industrial renewal also affect the highly educated. An important question is how well human resources from declining industries are reallocated to expanding ones, i.e., the flexibility of the human resources in science and technology.

3. The contribution of the national educational system to industry

The issue concerns the initial flows of knowledge and the mobility (of highly skilled) human resources from universities to other sectors. Indicators would be very important for the allocation of resources for higher education, since they would indicate bottlenecks and mismatches in the educational system as well as in how the labour market is functioning. To assess the importance of inflows to industry it is necessary to estimate the stocks in industry, as well as cross border flows.

4. The importance of brain drain/brain gain

The brain-drain/brain-gain debate has gathered a new momentum in some countries due to more volatile organisations, internationalised ownership, fiercer competition from larger number of countries, etc. Important questions that could more easily find an answer with the help of mobility indicators are how relocation of firms to other countries affect international mobility flows? Have international mobility increased with the EU? What are the effects of internationalisation of higher education on international labour mobility? etc.

5. Regional effects

Mobility indicators with geographical data content would permit the study of outflows from regional educational establishments, flows to and from regional research infrastructure, as well as region specific inter-firm knowledge flows. The effects of regional measures could hence be assessed.

6. Gender related mobility

Traditionally, the skilled personnel for science and technology have predominantly been men. However, with the increasing share in many countries of female science and technology personnel, new questions arise. E.g. do men and women show different mobility patterns? What are the effects on mobility when both spouses are employed? etc.

B. Questions to national experts

1. Do you consider the above items to be of policy relevance or do you have suggestions of alternative issues that are of greater concern to policy makers?
2. Do you have other comments or remarks regarding the above issues that you would like to share?
3. To your knowledge, have any specialist studies focusing on the issues above or on any other aspects of the mobility of human resources for science and technology been undertaken in your country? (Types of studies that would be of interest or have already been undertaken). Which research teams or units are in your country responsible for specialising in such studies?
4. What data sources/statistics are available in your country for studying these issues?
5. With these sources in mind, do you have suggestions of suitable indicators that could be used in the study of the here relevant policy issues?
6. Which organisations are responsible for collection, processing and analysing these data/statistics? (Available documentation and contact persons).
7. What sectors, industries, types of organisations (e.g. size), time periods and categories of science and technology personnel in terms of education background, occupation or other relevant categories are covered by the data/statistics? To what extent is use made of the international standards ISIC⁴⁶, ISCED⁴⁷ and ISCO⁴⁸?
8. Are you aware of any data and methodological problems which have been encountered during the course of these studies?

Associated topics

This exercise concentrates on measuring the mobility of highly qualified personnel. However, we would also be interested to have your comments on any associated topic which you think relevant. For example, how to measure the flow of knowledge accompanying mobility or the links between human mobility and other forms of networking.

⁴⁶ The International Standard Industrial Classification.

⁴⁷ The International Standard Classification of Education.

⁴⁸ The International Standard Classification of Occupations.