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SERVICES R&D IN THE OECD DATABASE

**Contribution to the Tenth Meeting
of the Voorburg Group on Service Statistics
(Session 3)**

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*The views expressed in this paper are those of the author and do not necessarily reflect those of the OECD or its Member governments.

SUMMARY

The aim of this paper is to review the data on services R&D collected by Member countries and reported to OECD to see whether they already reveal any interesting facts about the level and type of R&D concerned and also to identify the main problems of comparisons between countries and over time. It does not pretend to be exhaustive and is merely intended to report on work in progress.

The degree to which national R&D surveys cover the service industries varies considerably. Some countries have made considerable efforts to extend this coverage recently following both national policy needs and the introduction of the revised OECD questionnaire, notably concerning the computer services industry/software R&D. The coverage and classification of special R&D institutes continues to vary between countries. The coverage and quality of the data is clearly improving but considerable further progress would be needed before the data services R&D could be used for integrated economic studies.

Despite these variations in coverage, the data already reveal something about the R&D efforts of the three "S&T intensive" service industries: communications; computer services and R&D services. As yet, there is little evidence about R&D in the "non-S&T based" services.

Following a discussion of these issues at the meeting of the Group of National Experts on Science and Technology Indicators in April 1995, a more systematic review of services R&D coverage is under way as part of the OECD R&D survey for reporting year 1993.

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1. Introduction

OECD work on S&T statistics is undertaken by the Group of National Experts on Science and Technology Indicators (NESTI) together with the staff of the Economic Analysis and Statistics Division (EASD) of the Directorate for Science, Technology and Industry (DSTI).

The NESTI Group is a subsidiary body of the OECD Committee for Scientific and Technological Policy (CSTP) and represents both users and producers of S&T indicators with two-thirds of its principal delegates coming from ministries of science and technology or associated bodies, such as research councils, and one-third from central statistical offices or similar producer agencies. Its annual meetings attract about seventy experts. All OECD countries are usually represented as well as Korea, which has recently become a full member of the parent committee. Observers attend from the Czech Republic, Hungary, Poland, Russia, the Slovak Republic and also from UNESCO. Users and producers from the European Commission are members of NESTI and there is growing co-operation between the organisations both on substance and organisation.

The work covers *methodology* in the "Frascati family" of Manuals on the measurement of scientific and technological activities as shown in Box 1, *data collection* from international sources and from OECD surveys (notably of R&D and of the technology balance payments) and policy and economic *analysis* as for example in the recent "Industry and Technology: Scoreboard of indicators" (OECD; 1995). The EASD is also responsible for the collection and analysis of industrial statistics and particular stress is placed on joint studies of technological and industrial data.

Box 1. OECD Manuals on the Measurement of Scientific and Technological Activities

Type of data	Title
R&D	Proposed Standard Practice for Surveys of Research and Experimental Development ("Frascati Manual" 1993)
R&D	Main Definitions and Conventions for the Measurement of Research and Experimental Development (R&D) (A Summary of the Frascati Manual 1993)
Technology Balance of Payments	Proposed Standard Method of Compiling and Interpreting Technology Balance of Payments Data (1) (TBP Manual)
Innovation	OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo Manual 1992)
Patents	Using Patent Data as Science and Technology Indicators (1) (Patent Manual , 1994)
Human Resources	The Measurement of Human Resources Devoted to S&T (1) (Canberra Manual 1995) (with EC/Eurostat,)

(1) Dealing mainly with the problems of classifying and interpreting existing information

Work is in progress on measuring S&T in the services industries under all three headings, *methodology*, *data collection* and *analysis* and covering three levels of activity, the production of knowledge i.e. *R&D*, the *diffusion of technology* embodied in intermediate and capital goods, and the application of S&T in the introduction of new products and processes, i.e. *innovation*.

Although the work on embodied technology will not be discussed at this meeting, participants may be interested to know about its main characteristics. It is based on input output tables for ten OECD

countries (United States, Japan, Germany, France, the United Kingdom, Italy, Canada, Australia, Denmark and the Netherlands). Technology is assumed to flow from one industry to another when the industry where R&D originates sells products embodying R&D to other industries to be used as inputs into their production processes. The technology embodied in the output of a certain industry is the sum of its own R&D expenditures and those embodied in its purchases from other industries in the form of:

- purchases of domestic intermediate products;
- purchases of domestic investment inputs;
- purchases of imported intermediate products;
- purchases of imported investment inputs.

The relative importance of acquired to performed technology differs among countries largely because of differences in inter-industry flows of commodities, the strength of their R&D effort, and their dependence on international trade.

At a more disaggregated level, the largest performers of R&D are industries such as communications equipment and semiconductors, aerospace, computers and pharmaceuticals, while industries making the greatest use of equipment-embodied technology are mainly in the services sector broadly defined. Social and personal services, an industry category covering, among others, equipment purchases by the education or health industry, appears in the top five technology user industries in eight out of ten countries. The transport industry, real estate and business services, and wholesale and retail trade are important users of technology. The construction industry also appears as an important embodied technology acquirer in eight out of ten lists.

Details of the model the methodology and detailed result will be published shortly (OECD; forthcoming).

The second area of work on services concerns the *methodology of measuring innovation activities.*

The Oslo Manual for *Collecting and Interpretating Technological Innovation Data*, first issued in 1992 and the associated draft questionnaire have recently been tested in a round of surveys, notably the CIS surveys organised by DGXIII and Eurostat. Following the decision at the last session of the last session of the Group of National Experts on Science and Technology Indicators to revise the Oslo Manual as a joint OECD/Eurostat exercise, a number of drafting teams were set up to prepare and propose amendments on a number of topics. One of these was the extension of the manual to cover innovation in the services. This project is led by Australia and Canada and is the subject of other papers for this Voorburg meeting.

The third area and the one covered by the present note is a review of the coverage and comparability of the R&D data for the services industries collected via the regular OECD survey.

An earlier version of the present note, was prepared for the 1995 session of the Group of National Experts on Science and Technology Experts who discussed it and decided to supply the Secretariat with further information together with their next full return to the OECD survey. Despite the fact that this additional information is only beginning to come in, it is hoped that members of the Voorburg Group will find some interest in this report on work in progress.

2. OECD R&D surveys and data-bases

OECD has been holding surveys of resources devoted to R&D in Member countries for getting on for thirty years, (the first survey was held in respect of 1963). The questionnaires for these surveys are based on the latest version of the Frascati Manual available at the time concerned. All the surveys have included tables on R&D expenditure and personnel in the business enterprise sector broken down by industry.

The original industrial classification was intended to identify those industries which were particularly heavy performers of R&D and was based on one first established by the National Science Foundation in the United States round about 1960. Since there was little thought of comparing R&D and regular industrial statistics compatibility with the standard UN classifications was not given much priority. Categories were identified as needed for S&T analysis and were subsequently described in terms of ISIC, sometimes with difficulty as the UN classification did not always identify R&D intensive industries. However, during the preparation of the latest version of the Frascati Manual it was decided to adopt a classification actually based on ISIC Rev3/ACE Rev.1. A version of this classification is shown as annex 1.

Until recently, the data for the OECD survey for R&D in the business enterprise sector broken down by industry (ISIC Rev.2) were stocked in a data-base named BERD and were published, as reported by the countries, in "Basic Science and Technology Statistics". However, mostly due to problems of confidentiality, the detail reported declined over time and it became increasingly difficult to use the data for analysis. In consequence a new data base was established called ANBERD. It is an estimated database constructed with the objective of creating a consistent data set, that overcomes the problems of international comparability and time discontinuity associated with the official business enterprise R&D data provided to the OECD by the Member countries. ANBERD contains R&D expenditure for the period 1973 to 1992 by industry (ISIC Rev.2), for 12 OECD countries: Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States (OECD; 1995). It covers manufacturing only.

Following a decision by NESTI to introduce all the changes in the fifth edition of the Frascati Manual in the OECD R&D questionnaire for reference year 1991, the new classification was applied in the tables on R&D in the business enterprise sector. A new data-base, entitled DIRDE, was established to stock the returns using ISIC Rev3/NACE Rev.1. In consequence there are now two segments of the EASD database dealing with industrial R&D as reported by countries, BERD based on ISIC Rev 2 which is no longer updated and DIRDE based on ISIC Rev 3 which is now updated. The old data (from 1981 onwards) were carried forward from BERD to DIRDE using a very rough key and countries were invited to provide retrospective revisions.

3. Services R&D in OECD data-bases

The new questionnaire differs significantly from the old one regarding the services. In the old version "utilities" and "construction" were included in the services subtotal whereas they are excluded in the new one. More detail on the service industries is now requested. A further problem is that the two classifications cannot be matched precisely. The old category "commercial and engineering services" did not correspond to an ISIC 2 category but had been specially established to identify "S&T intensive" service units notably those specialising in R&D. In the new classification most but not all of this category belongs in "R&D" and the rest probably in "other business activities".

Old Classification	New classification
(ISIC Rev 2)	(ISIC Rev 3 NACE Rev 1)(See Annex 1)
Transport and storage	Transport and Storage
Communications	Communications
	Post
	Telecommunications
	Real estate, renting and business activities[1]
	Computer and related
	Software consult.
	Other computer serve.
Commercial & Engineering	R&D
	Other business activities.
Other services	Financial intermediation
	Wholesale and retail
	Hotels and restaurants
	Community and personal services

(1) referred to hereafter as business services

Countries responded very differently to the change in classification and the request for backdating; from supplying a full revised set of data as in Canada to making no changes at all as in Japan and Germany. The usual response was to revise existing data by breaking out the "R&D" share from "commercial and engineering services" and by separating out "computer services" R&D where this was already included in the survey, often leaving a significant share of services R&D undistributed between the new categories.

The preparation of ANBERD has given the Secretariat detailed knowledge of the coverage and classification of national manufacturing R&D data. For services industries OECD only currently stocks the data as reported by countries with relatively little information on sources and methods. The material on national classifications and updates in the services has not yet been compiled in convenient form other than in the ANBERD country notes which are still based on ISIC Rev 2 so the following comments are based on incomplete qualitative information. They are based on examination of the data in the DIRDE segment plus data from draft national publications from the United States, and Denmark which have not yet been added to DIRDE. No data is yet available for Mexico. (From hereon the term BERD refers to total R&D expenditure in the business enterprise sector and not to the database segment).

4. International comparisons

Differences in the amount of services R&D reported by countries may be caused by real differences in the quantity of R&D performed, in how far it is covered by national R&D surveys and, if included, in the industry in which it is classified.

Half the OECD countries report little R&D outside manufacturing. R&D in the services is less than 10 per cent of BERD and under 0.1 per cent of GDP (Table 1) and other non-manufacturing R&D (agriculture, mining, construction, utilities) represents under 5 per cent of BERD (Table 2). These

countries are: Japan; Germany; France; Italy; Netherlands; Belgium; Sweden; Austria; Ireland and Turkey (probably plus Switzerland).

In 12 other OECD countries 10 per cent or more of BERD is carried out in the services. They are, in descending order: Norway; New Zealand; Australia; Greece; Denmark; Portugal; Canada and the United States (all about or above one quarter or more of BERD) plus Iceland, Spain, the United Kingdom and Finland. Most of them are also amongst the highest relative spenders on other non-manufacturing R&D though the sums involved are much lower than for services. However, Portugal, Denmark and possibly the United States (where it is not possible to distinguish agriculture, mining or construction from the services) are amongst the lowest spenders on other non-manufacturing.

In most of these 12 countries services R&D corresponds to more than 0.2 per cent of GDP rising to over 0.4 per cent in Denmark, the United States and Norway. However in Spain, Iceland, Portugal Greece and also New Zealand services R&D, though a significant share of BERD still come to less than 0.1 per cent of GDP (Table 1).

For explanatory purposes it is useful divide services R&D into groups according to their expected S&T intensity:

- commercial R&D firms and institutes (long standing, S&T intensive);
- computer services (new, S&T intensive);
- communications (changing, S&T intensive)
- transport and storage (changing to higher S&T intensity);
- other design and engineering services (long standing, S&T intensive);
- the rest (not expected to be S&T intensive).

Unfortunately it is not possible to distinguish between the last two in the data currently collected by OECD.

Table 3 reviews the data currently available from the DIRDE data-base. It shows that a low percentage of BERD devoted to services R&D is associated with a very low degree of detail about the services concerned and probably a low degree of coverage. For example the Japanese survey does not cover any business services at all.

Another example of differences in coverage which may affect the amount of services R&D reported is the degree to which respondents to industrial R&D surveys are requested to include R&D in the social sciences and humanities. In some countries such as Canada and the Netherlands the surveys only cover national sciences and engineering. In others, such as France, no distinction is made. In others again such as Spain industrial firms are requested to provide a breakdown of their R&D by main field of science including the social sciences.

Table 4 and graph 1 give further details for the countries which are high services R&D spenders. The data for Denmark and the United States have been updated from the latest sources and additional data

for New Zealand were taken from a national publication. In graph 1 transport and storage has been included in "other".

In Norway, Iceland and Portugal the services share of BERD is pushed above the average by the *R&D industry*. According to the Frascati Manual this category should only cover commercial R&D firms or research institutes controlled and mainly financed by industry and which are generalists rather than being funded/used by a specific industry. In the latter case, for example a co-operative research institute they should, contrary to ISIC general practice, be classified with the industry concerned. Research institutes serving enterprises which are mainly government funded and controlled should be included the government sector. The borderline is not easy to identify and Norway includes a number of such "semi-public" institutes in the Business enterprise sector and the Nordic countries have traditionally preferred to assign all R&D firms/institutes to the R&D service category rather than to distribute them to the industry concerned and this still seemed to apply in 1991 in Norway and Iceland. In Germany, by comparison, under 10 per cent of the R&D by institutes is counted in the services and the French have, since 1992, completely redistributed as R&D by commercial R&D firms. The R&D service industry also represent 5-10 per cent of BERD in Canada (possibly wider coverage) the United Kingdom and (probably) the United States amongst the high services spenders and Italy and possibly Belgium among the low spenders. In the remaining low services R&D spenders the percentage was generally very small dropping to zero in Japan where, as mentioned above, business services are not surveyed.

In Greece nearly one quarter of BERD is performed in *the computer services industry* as is about 10 per cent in New Zealand. In the other countries for which data is available the average is about 5 per cent which is roughly the same as for the computer hardware industry. In Italy and Spain, however, only 2 per cent of BERD is carried out in the computer services industries.

In 1994 the Secretariat undertook a mini-survey of the treatment of software R&D in countries responses to OECD for the BERD (ISIC Rev2), ANBERD (ISIC Rev2) and DIRDE (ISIC Rev3) data bases. In theory in DIRDE software R&D by firms principally engaged in computer services should be included in the latter whereas software R&D by firms in other industries should be included in the industry concerned. For countries which report by product field, R&D on software which is produced for sale should included in computer services whereas the development of new software for other products or processes should be included with the latter. Twelve countries replied of which four major services R&D spenders (Australia, New Zealand, Norway and the United Kingdom) and eight low spenders (Belgium, France, Germany, Ireland, Japan, Netherlands, Switzerland and Turkey.) Their answers are summarised in Annex 2. Three of the latter, Japan, the Netherlands and Turkey reported that their survey did not include any firms for which software was their primary product and Ireland included such companies in the electronics industry. The other low services spenders who replied did include such firms in the services.

The communications industries are particularly important R&D performers in Portugal (11 per cent). The average appears to be about 2-5 per cent of BERD. Only Australia (from 1992) and Norway have, as yet , reported the distinction between post and telecommunications and some countries still group communications with transport and storage.

In Australia Denmark and New Zealand about 20 per cent of BERD is carried out in *other services industries* as is 5-10 per cent in Canada Norway and Spain. The other countries supplying a full set of data report little R&D expenditure in the remaining categories (Table 3).

Denmark and New Zealand are the highest spenders on *other business services* partly because this class includes special categories of institutions (Technical institutes 8.7 per cent of BERD in

Denmark, Producer Boards 3.1 per cent of BERD in New Zealand) and also because they included R&D spending by design and engineering services (MRST: 1993). Australia, Norway and Spain also report 5 per cent or more of BERD as coming from other business services.

Australia, New Zealand Denmark and Canada attribute 4 per cent or more of BERD to the *wholesale and retail trades.*

5. Government financed R&D in the services

Data is available for only half of all Member countries including seven major services spenders (Australia, Canada, Denmark, Finland Norway, Spain and the United States) and five minor spenders (Austria, Germany, Italy, Japan, Sweden and Turkey). In several cases the sources of funds data does not add to the total figures owing to retrospective revision in the latter so any observations must be very tentative (Table 5).

In the United States (and in Sweden) (graph 2) the share of services (i.e. all non-manufacturing) R&D financed by government is lower than that for manufacturing probably mainly due to heavy defence and space spending in the aeronautical and electronics industries. In Japan the services receive no R&D funds from government. In all the others for which data are available governments fund a higher share of services R&D than manufacturing, rising to over 40 per cent in Austria and Germany and exceeding 20 per cent in Italy, Sweden, Norway and Spain.

Judging from the data from ten countries, (Table 6) these funds appear to go largely to business services and more especially to R&D services (and/or institutes). The funding pattern for computer services R&D varies considerably between the six countries for which data are available, ranging from a high of 44 per cent of intramural R&D in the United States to only 1 per cent in Australia. Similar variations occur for communications R&D. Except in Australia a very low share of government funds for services R&D go to the remaining "non-S&T intensive" industries.

6. Trends over time

There are a number of reasons to expect that the share of BERD carried out in the services would be growing to reflect their increased role in total production and employment. First the existing (low-tech) service industries may be actually carrying out more R&D. This may be formally organised R&D as described in the early Frascati Manuals or more informal R&D as identified by Kleinknecht (Kleinknecht 1987, Kleinknecht and Reijnen 1991) and as discussed at length during the preparation of the most recent version of the Frascati Manual (OECD; 1994). The second reason is the rise in software R&D and the grouping of units for which software provision is their main activity in the computer services industry. (Historically it was often included with the computer hardware industry). A third possible reason is that manufacturing firms are doing less intramural R&D (including software R&D) and are putting it out to professional R&D (and software development) firms which already existed or which they have created by hiving off their own R&D establishments. The fourth is that following changes in the status of some public service agencies, R&D institutes are being transferred to the business sector, as happened in France in their 1992 survey.

However, the main difference over time in the services R&D data currently available probably remains the coverage of R&D surveys. For example it is noticeable that in all the low services R&D spenders there was little or no growth over the 1980's in the share of BERD carried out in the services and

the percentage actually fell in Austria, Belgium, (where there are other coverage problems) Ireland and Japan, suggesting that their survey coverage may not have been extended to cover the new phenomena. However, in Ireland the percentage of GDP devoted to services R&D doubled, whereas the figure was stable or falling in the other three.

A number of countries, notably, Denmark, Australia and perhaps also Canada and Portugal were, data already amongst the highest services R&D spenders in 1981 according to the second OECD S&T indicators report (OECD, 1986). Others, notably Norway revised their data retrospectively during the 1980's. However, the main changes are relatively recent and reflect, perhaps, a changed attitude towards industrial R&D surveys.

These surveys were originally set up in order to obtain an estimated total for Business Enterprise R&D plus details for industries of particular interest. Industries and firms known to have significant R&D (almost exclusively in manufacturing) were included in full whereas industries with little R&D were only sampled. Given the pressure to reduce the survey burden on industries the sample base was kept small in many countries except for rebasing years (every four years for example in the Netherlands or the United Kingdom and even longer in the United States). Historically the core R&D firms in aerospace, electronics, chemicals etc. were responsible for up to 80 per cent of total BERD in major OECD countries. Occasionally the picture was disturbed by data coming from other sources, notably information about firms receiving R&D aid (grants or tax relief) from the government as in France and Germany or from special studies (e.g. Kleinknecht op.cit.). This added a large number of firms (mostly SME's) but did not usually increase total BERD substantially and hence did not lead to immediate extension of official R&D surveys.

During the 1980's spending on industrial R&D as reported by regular surveys seemed to meet policy priorities as it grew steadily and the percentage financed by government fell, hence there was little pressure to change the surveys. At the beginning of the 1990's the situation changed. The work of the Voorburg Group and the revision of the Frascati Manual highlighted software R&D and computer services. The first round of innovation surveys based on the new "Oslo Manual" (OECD; 1992) brought to light even more SME's with some sort of R&D activities which were not included in the regular survey (See for example, Lhuillery and Templé; 1994) and the revised Frascati Manual (OECD; 1994) also deals with this issue (see Annex 3). The new OECD Questionnaire also encouraged interest in reviewing survey cover. This pressure was strengthened by the downturn in R&D spending reported by the "old core" manufacturing firms in the 1991 surveys.

A number of Member countries, for example the United States and the United Kingdom rebased their surveys in 1992/93 and have reported retrospective revisions which attenuate the major declines originally reported for 1991/92. In the United States the coverage of the services was clearly extended with the share of non-manufacturing in BERD reported for 1991 rising from 8 per cent to 24 per cent (Wolfe; 1994). In the United Kingdom where firms report by main product field, the list of products was extended to include computer services and commercial R&D leading some companies to reclassify R&D which they had previously included in manufacturing, leading to a rise for the services percentage from 11 per cent to 16 per cent.

7. Discussion by national experts

At the meeting of the Group of NESTI in April 1995 participants were invited to outline their own experience concerning:

- The general treatment of the services in their national industrial R&D survey.

- The possible influence on the amount of services R&D reported of the inclusion or exclusion of R&D in the social sciences and humanities.

- The questions of "informal" R&D in the services especially in SME's and the effect of the recommendation in the revised Frascati Manual (OECD; 1994) (See annex 3). of a minimum of one full-time equivalent worked on R&D per year for inclusion in "significant" R&D

- Any evidence of increased use of R&D service firms by manufacturing companies at the expense of their own intramural R&D.

The discussion confirmed that the coverage of services was inadequate in the R&D surveys of a significant number of countries and that there were also classification problems, notably concerning units whose main economic activity is R&D. The possibility of double counting in the case of consultancy was raised. The need to reexamine the interest of including R&D in the social sciences and humanities in industrial R&D survey was stressed. In brief it was clear that despite the evident demand for services R&D data for use in analysis, further progress would be required before the ANBERD data-base could be extended to cover the services. As a first step delegates agreed to supply details on the treatment of the services in their national R&D surveys together with their full responses [1] to the OECD survey for 1993 which would be submitted during 1995. A copy of the resulting "mini questionnaire" is given as Annex 4.

To date only one reply has been received -- from Japan. It confirms that in the Japanese industrial R&D survey, the services currently only cover (transport and) storage and telecommunications (broadcasting) but reports that improvements are planned including a pilot survey of the software industry and the possible inclusion of R&D in the social sciences and humanities.

[1] The OECD R&D questionnaire is in two parts: a short form which can be returned twice yearly with summary data for inclusion in the biannual "Main Science and Technology Indicators" publication and the long form which is returned for each full national R&D survey undertaken annually or every two (usually odd) years.

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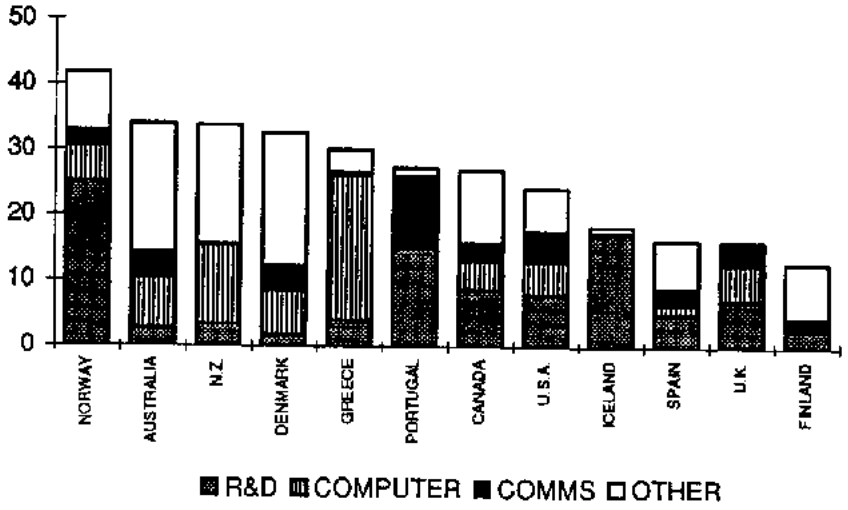
Graph 1. Services R&D as a % of BERD,1991



Graph 2. Share of R&D financed by government Manufacturing and services

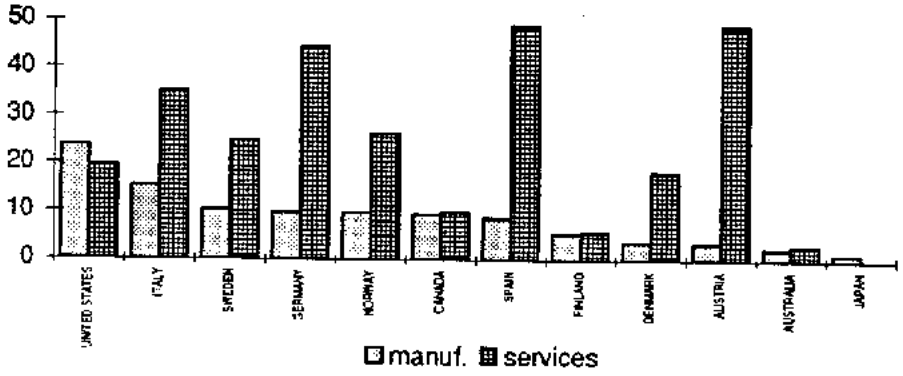


Table 1. R&D in the Services

	% of BERD		% of GDP	
	1981	1991	1981	1991
AUSTRALIA	17.1	33.8	0.043	0.203
AUSTRIA (89)	6.1	4.0	0.040	0.032
BELGIUM	11.6	5.8	0.118	0.062
CANADA	9.2	26.8	0.055	0.218
DENMARK	18.8	28.5	0.102	0.284
FINLAND	3.9	12.8	0.025	0.151
FRANCE	2.4	4.2	0.028	0.063
GERMANY	1.5	2.4	0.025	0.043
GREECE	5.7	30.0	0.003	0.036
ICELAND	0.0	18.3	0.000	0.046
IRELAND	3.6	3.4	0.011	0.021
ITALY	7.1	9.0	0.035	0.069
JAPAN	3.1	2.1	0.044	0.046
NETHERLANDS	6.0	6.7	0.059	0.068
NEW ZEALAND	..	35.2	..	0.098
NORWAY	38.8	41.8	0.261	0.419
PORTUGAL (82,90)	9.7	27.2	0.011	0.044
SPAIN	7.9	16.4	0.015	0.080
SWEDEN	5.6	3.7	0.082	0.072
SWITZERLAND	1.9	..	0.030	..
TURKEY	..	4.5	..	0.005
UNITED KINGDOM	1.3	16.5	0.019	0.234
UNITED STATES (82, 92)	4.2	24.8	0.078	0.505

1. Coverage varies between countries
2. Some growth may be due to wider survey coverage or the transfer of units from other sectors

Source: OECD/DIRDE data base July 1995 plus additional national sources

Table 2. BERD by main industry group 1991

		Agric	Mining	Manuf	Util	Const	Services	TOTAL
AUSTRALIA		..	6.4	57.2	2.3	0.2	33.8	100.0
AUSTRIA 89		0.2	0.4	94.1	0.6	0.7	4.0	100.0
BELGIUM		0.5	0.2	93.1	0.1	0.4	5.8	100.0
CANADA		0.6	2.3	65.7	4.3	0.2	26.8	100.0
DENMARK	1992	..	0.6	65.9	0.4	0.5	32.5	100.0
FINLAND		0.0	0.3	83.1	2.9	0.8	12.8	100.0
FRANCE		0.9	0.1	92.1	1.9	0.8	4.2	100.0
GERMANY		0.2	0.6	95.4	0.5	0.3	2.4	100.0
GREECE		0.3	5.9	61.4	2.2	0.3	30.0	100.0
ICELAND		5.9	0.1	65.5	4.3	5.9	18.3	100.0
IRELAND		1.2	1.0	94.4	0.0	0.1	3.4	100.0
ITALY		0.0	0.0	87.6	3.4	0.0	9.0	100.0
JAPAN		0.1	0.4	94.4	0.9	2.1	2.1	100.0
NETHERLANDS		2.5	0.0	89.9	0.3	0.6	6.7	100.0
NEW ZEALAND 90		1.8	2.1	59.7	1.2	1.6	33.7	100.0
NORWAY		0.4	9.7	47.5	0.1	0.5	41.8	100.0
PORTUGAL 90		0.0	0.8	70.8	1.1	0.1	27.2	100.0
SPAIN		0.9	1.2	78.4	2.5	0.6	16.4	100.0
SWEDEN		0.9	0.4	92.9	1.7	0.4	3.7	100.0
SWITZERLAND		..	..	..	..	..	..	..
TURKEY		2.0	0.0	90.6	2.8	0.0	4.5	100.0
UNITED KINGDOM		0.9	1.6	78.4	2.4	0.2	16.5	100.0
UNITED STATES r				75.7	0.2		24.1	100.0

r = revised.

Source: OECD/DIRDE data base July 1995 plus additional national sources

Table 3: **Services as a percentage of BERD 1991**

		Trans & St	Comms	R&D	Comp Services	Other	TOTAL
NORWAY (9)		0.4	2.3	25.0	5.4	8.6	41.8
NZ		1.4	..	7.5		26.3	35.2
AUSTRALIA		0.8	4.0	2.8	7.5	18.7	33.8
GREECE		..	0.6	4.1	21.9	3.4	30.0
DENMARK		..	2.9		4.1	21.4	28.5
PORTUGAL	1990	0.7	11.0	14.9		0.6	27.2
CANADA		0.4	2.8	8.8	4.3	10.5	26.8
ICELAND		0.8	0.0	17.5		0.0	18.3
UNITED KINGDOM		0.1	3.0	7.8	5.2	0.4	16.5
SPAIN		0.0	2.4	5.4	1.5	7.0	16.4
FINLAND		..	1.8	2.7		8.3	12.8
ITALY		0.0	1.4	5.5	1.8	0.2	9.0
UNITED STATES	unrev	..	..	1.2	4.1	2.7	8.0
NETHERLANDS		a)	a)			6.7	6.7
BELGIUM		0.0	..			5.8	5.8
TURKEY		1.9	2.6			0.0	4.5
FRANCE		0.3	a)			4.0	4.2
AUSTRIA	1989	..	..	3.9	..	0.1	4.0
SWEDEN		..	..			3.7	3.7
IRELAND		0.2	1.0	0.9	d)	1.3	3.4
GERMANY		0.4	b)	1.2(f)	..	..	2.4
JAPAN		0.2	1.9	e)	e)	e)	2.1
SWITZERLAND		..	..			0.0	..

a) included in other services
b) included in transport and storage
c) included in communications
d) included in manufacturing
e) not surveyed
f) 1989
g) In 1993. R+D=O and total services = 21.1%

Source: OECD/DIRDE data-base July 1995

Table 4. Structure of Services R&D (Selected Countries) 1991

	Norway	Australia	N.Z.	Denmark	Greece	Portugal	Canada	US	Iceland	UK	Spain	Finland	Italy
			90	92									
SERVICE SECTOR	41.8	33.8	33.7	32.5	30.0	27.2	26.8	24.1	18.3	16.5	16.4	12.8	9.0
WHOLESALE,RET.TRAD., MOT. VEH. REPAI	0.4	8.8	7.2	5.3	0.2	..	3.8		..	0.0	0.0	..	..
HOTELS& RESTAURANTS	..	..		..	..	..	..		..		0.0	..	..
TRANSPORT & STORAGE	0.4	0.8			..	0.7	0.4	6.1	0.8	0.1	0.0	..	0.0
COMMUNICATIONS	2.3	4.0	0.2	3.7	0.6	11.0	2.8	4.6	0.0	3.0	2.4	1.8	1.4
- POST	0.0	..		..	..	..	..		..		..	..	..
- TELECOMMUNICATIONS	2.3	..		..	0.6	..	..		..		..	..	..
FINANC. INTERMEDIATION	1.1	4.1		..	2.5	..	4.4		..		0.0	..	..
REAL ESTATE, RENTING & BUSIN. ACTIV.	37.5	15.6	24.6	22.8	26.6	..	15.3	12.9	17.5	13.2	13.5	7.0	7.4
- COMPUTER&RELATED	5.4	7.5	12.0	6.7	21.9	..	4.3	4.9	..	5.2	1.5	..	1.8
- SOFTWARE CONSULTANCY	..	7.5		..	12.9	..	..		..		..	..	..
- OTHER COMPUTER SERV.	..	..		..	9.1	..	..		..		..	..	..
- RESEARCH & DEVELOPMENT	25.0	2.8	3.4	1.8	4.1	14.9	8.8	8.0	17.5	7.8	5.1	2.7	5.5
- OTHER BUSIN. ACTIV. NEC	7.1	5.2	9.1	14.2	0.6	..	2.3		..	0.1	6.8	..	..
COMM., SOC. & PERS. SERV. ACTIV.	..	0.6		0.8	0.2	..	..	0.5	..	0.2	0.4	..	0.2
BERD	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: OECD DIRDE data-base July 1995 plus additional national sources.

Table 5. **Sources of funds for R&D in the services 1991 or nearest year available**

		Ent	Govt	Other	Abroad	TOTAL
AUSTRALIA	a)	83.0	3.0	0.7	11.0	100.0
AUSTRIA		29.6	48.8	0.0	21.5	100.0
CANADA	a)	64.5	9.9	..	..	100.0
DENMARK		68.6	18.2	5.1	8.2	100.0
FINLAND		93.7	5.7	0.1	0.5	100.0
GERMANY	a)	61.7	34.5	1.0	1.6	100.0
ITALY	a)	36.4	35.1	0.0	2.2	100.0
JAPAN		99.9	0.0	0.0	0.0	100.0
NORWAY		69.5	26.3	0.3	4.0	100.0
SPAIN		66.7	24.8	0.6	7.9	100.0
SWEDEN		89.6	9.4	0.0	0.9	100.0
TURKEY	a)	100.0	0.0	0.0	..	100.0
UNITED STATES		80.6	19.4	0.0	0.0	100.0

a) Detail does not add to total
Source: OECD DIRDE database July 1995 plus additional national sources

Table 6. Government funded R&D in the Services 1991 o.n.y.a.

a) by industry

	Business services						
	R&D	Computer	Other	Total	Comms	Other	TOTAL
AUSTRALIA	44.9	8.1	27.1	80.1	0.0	19.9	100
AUSTRIA	97.5		2.4	99.9	0.0	0.1	100
CANADA	52.1	18.1		82.6	1.4	16	100
DENMARK		2.5	89	91.4	6.7	1.9	100
FINLAND	39.9				0.9	59.2	100
GERMANY	74.8					25.2	100
ITALY	80.1				5.1	14.8	100
NORWAY	88.5	0.8	10.3	99.6	0.3	0.1	100
SPAIN	53.5	5.4	36.1	95	1.9	3.1	100
USA a	24	46.3	0.0	70.3	22.2	7.5	100

b) as % of intramural R&D in each industry

	Business services						
	R&D	Computer	Other	Total	Comms	Other	TOTAL
AUSTRALIA	16.1	1.1	5.3	5.2	0	..	3.0
AUSTRIA	49.1		42.0	49.0		..	48.8
CANADA	15.7	11.2	14.6	14.3	1.3	..	9.9
DENMARK		3.1	29	23.7	11.9	..	18.2
FINLAND	10.7				0.4	..	5.7
GERMANY	48.3					..	34.5
ITALY	45.9				11.2	..	35.1
NORWAY	38.8	1.6	15.9	29.1	0.3	..	26.3
SPAIN	42.6	14.6	21.5	28.7	3.2	..	24.8
USA a	14.1	43.8		25.5	22.4	..	19.4

a) Nearest categories available
Source: OECD DIRDE data-base July 1995 plus additional national sources

ANNEX 1. REVISED INDUSTRIAL CLASSIFICATION USED FOR OECD R&D SURVEYS

REVISED INDUSTRIAL CLASSIFICATION FOR RESOURCES DEVOTED TO R&D IN THE BUSINESS ENTERPRISE SECTOR IN THE OECD 1995 R&D QUESTIONNAIRE AND CORRESPONDENCE WITH ISIC Rev.3, ISIC Rev.2 AND NACE Rev.1

(Correspond to items in 1989 ISIC Rev.2 Industry List arranged for R&D purposes)*

	Title	ISIC Rev.3 Division/Group/Class	Approximate correspond. ISIC Rev. 2 Div./Group/Class	Corresponding NACE Div./Group/Class
1.	**AGRICULTURE, HUNTING & FORESTRY***	**01+02+05**	**1**	**01+02+05**
2.	**MINING**	**10 thro' 14**	**2**	**10 thro' 14**
3.	**MANUFACTURING***	**15 thro' 37**	**3**	**15 thro' 37**
4.	**Food, Beverages & Tobacco**	**15+16**	**31**	**15+16**
5.	Food Products & Beverage	15	311 thro' 313	15
6.	Tobacco Products	16	314	16
7.	**Textiles, Wearing Apparel, Fur & Leather***	**17 thro' 19**	**32**	**17 thro' 19**
8.	Textiles	17	321	17
9.	Wearing Apparel & Fur	18	[	18
10.	Leather Products & Footwear	19	(322 thro' 324	19
11.	**Wood, Paper, Printing, Publishing**	**20 thro' 22**	**331+34+3832 (part)**	**20 thro' 22**
12.	Wood & Cork (not Furniture)	20	331	20
13.	Pulp, Papper & Paper Products	21	341	21
14.	Publishing, Printing & Reproduction of Recorded Media	22	342+3832 (part)	22
15.	**Coke, Petroleum, Nuclear Fuel, Chemicals & Products, Rubber & Plastics**	**23 thro' 25**	**35**	**23 thro'25**
16.	Coke, Refined Petroleum Products & Nuclear Fuel	23	353+354	23
17.	Chemicals & Chemical Products	24	351+352	24 less 24.4
18.	Chemical Products less Pharmaceuticals*	24 less 2423	351+352 less 3522	24.4
19.	Pharmaceuticals*	2423	3522	24
20.	Rubber & Plastic Products*	25	355+356	
21.	Non-Metallic Mineral Products ("Stone, Clay & Glass")*	26	36	23
22.	**Basic Metals**	27	37	27
23.	Basic Metals, Ferrous*	271+2731	371	
24.	Basic Metals, Non-Ferrous*	272+2732	372	
25.	**Fabricated Metal products (except Machinery & Equipment)***	28	381	28
26.	**Machinery Equipment, Instruments & Transport Equipment**	**29 thro' 35**	**38 less 381 & 3832 (part)**	**29 thro' 35**
27.	Machinery, nec*	29	382 less 3825+3829 (part)	29
28.	Office, Accounting & Computing Machinery*	30	3825	30
29.	Electrical Machinery*	31	383 less 3832	31
30.	Electronic Equipment (Radio, TV & Communications)*	32	3832 (part)	32
31.	Electronic Components (includes Semiconductors)	321		32.1
32.	Television, Radio & Communications Equipment	32 less 321		32 less 32.1
33.	Medical, Precision & Optical Instruments, Watches clocks (instruments)*	33	385	33
34.	Motor Vehicles*	34	3843	34
35.	Other Transport Equipment	35	384 (part)+3829(part)	35
36.	Ships*	351	3841	35.1
37.	Aerospace*	353	3845+3829(part)	35.3
38.	Other Transport nec*	352+359	3842+3844+3849	35.2+35.9
39.	Furniture, Other Manufacturing nec	36	332+39	36
40.	Furniture	361	332	36.1
41.	Other Manufacturing nec	369	39	36.9
42.	**Recycling**	37	NA	37
43.	**ELECTRICITY, GAS & WATER SUPPLY (UTILITIES*)**	**40+41**	**4**	**40+41**
44.	**CONSTRUCTION**	**45**	**5**	**45**
45.	**SERVICE SECTOR**	**50 thro' 99**	**6 thro' 9**	**50 thro' 99**
46.	**Wholesale, Retail Trade & Motor Vehicle etc. Repair**	**50 thro' 52**	**61+62+6(part)**	**50 thro' 52**
47.	**Hotels & Restaurants**	**55**	**63**	**55**
48.	**Transport & Storage**	**60 thro' 63**	**71**	**60 thro' 63**
49.	**Communications***	**64**	**72**	**64**
50.	Post	641		64.1
51.	Telecommunications	642		64.2
52.	**Financial Intermediation (including Insurance)**	**65 thro' 67**	**81+82**	**65 thro' 67**
53.	**Real Estate, Renting & Business Activities**	**70 thro' 74**	**83+932**	**70 thro' 74**
54.	Computer & Related Activities	72	8323	72
55.	Software Consultancy	722		72.2
56.	Other Computer Services nec	72 less 722		72 less 72.2
57.	Research & Development	73	932	73
58.	Other Business Activities nec	70+71+74	83(part)	70+71+74
59	Community, Social & Personal Service Activ., etc.'	75 thro' 99	9 less 932	75 thro' 99
60	**GRAND TOTAL**	**01 thro' 99**	**1 thro' 9**	**01 thro' 99**

a. Activities carried out in these industries by the Business Enterprise sector only. Figures are expected to be negligible: the heading is included as an aide-memoire.

ANNEX 2. THE CLASSIFICATION OF SOFTWARE R&D BY INDUSTRY: RESULTS OF THE MINI-SURVEY

Reasons for the exercise

When updating the notes for ANBERD the Secretariat had difficulty in understanding how countries had classified software R&D by industry. The design, production and supply of software, according to ISIC Rev 3 falls in class 722 "Software consultancy and supply " which is classified as a service industry in the R&D questionnaire (row 55 of the new tables).

Applying the guidelines in the Frascati Manual 1993 to the institutional classification by industry expressed in ISIC Rev 3, only enterprises whose main economic activity is the design and sale of software should be included in services and the software R&D by other enterprises should be included in the industry concerned. Only in the exceptional case of a very large enterprise with a software division which sold (or leased) software to outside users should any software R&D by a manufacturing enterprise be transferred to services.

The ANBERD data base sometimes uses product field data if the enterprise breakdown is thought not to be comparable with production or value added series. Here the "use of product" approach is appropriate and, hence, software R&D should be attributed to the product which it is used to produce or with which it is sold and should only included in services if it is a product in its own right. For instance, R&D on software performed in the pulp and paper industry to be used with its computer-controlled equipment is process R&D for the pulp and paper industry. The same software R&D carried out in the equipment industry and sold together with pulp and paper machinery is product R&D in the machinery industry. Even in product field terms, only if the software is sold or leased separately should it be treated as service R&D.

As it was not clear whether all countries have followed these guidelines when reporting to the R&D survey or supplying additional data for ANBERD, the questionnaire shown as table 2.1 was sent to national experts.

The replies

1. Twelve countries replied. The summary of their responses is shown as table 2.2.

Table 2.1. The Questionnaire

Country _____

1. ***Classifying software R&D by industry***
See attached text (DSTI/EAS/STP/NESTI(94)12 p. 8) for more information concerning these questions.

a. Firms (or divisions) whose main activity is software R&D. Please specify in which industries they have been attributed, for :

- National R&D survey _____
- OECD R&D ISIC Rev. 2 tables (1980-1989) _____
- OECD ANBERD ISIC Rev.2 tables (1980-1992) _____
- OECD R&D ISIC Rev. 3 tables (1987-1992) _____

b. Software R&D by firms with another principal economic activity. Have these expenditure been included in the industry of the principal economic activity? *Please check the appropriate :*

	YES	NO
■ National R&D survey tables	_____	_____
■ OECD R&D ISIC Rev. 2 tables (1980-1989)	_____	_____
■ OECD ANBERD ISIC Rev. 2 tables (1980-1992)	_____	_____
■ OECD R&D ISIC Rev. 3 tables (1987-1992)	_____	_____

If the answer is **NO** to any of the above cases please attach further explanations.

c. Product field data. If you collect product field data. *Please check the appropriate :*

	YES	NO
■ Do you identify all software R&D separately?	_____	_____
If the answer is **YES,**		
■ Can you distribute software R&D by industry of performance?	_____	_____

d. If your national Business R&D survey contains any other ad-hoc questions on software R&D.

■ Can you distribute software R&D by industry of performance?	_____	_____

Please attach copies of the questions concerned.

Table 2.2 Responses to the mini-questionnaire on the classsification of software R&D

	Reply		Software firms			Other	Product	Other
	No	Yes	BERD	change	DIRDE	Firms	Field	Ad hoc
Australia		X	Manuf	1986	Comp serv	OK	Y	N
Austria	X							
Belgium		X	Bus serv	1987	Comp serv	OK	N	N
Canada	X							
Denmark	X							
Finland	X							
France		X	Other serv	1992	Comp serv	OK	N	N
Germany		X	Other serv		Other serv	OK	N	N
Greece	X							
Iceland	X							
Ireland		X	Electronics		Electronics	OK	N	N
Italy								
Japan		X	None		None	OK	N	N
Netherlands		X	None		None	OK		
New Zealand		X			Comp serv	OK	Y	N
Norway		X	Other serv		Comp serv	OK	N	N
Portugal	X							
Spain	X							
Sweden	X							
Switzerland		X			Tech serv	OK	N	N
Turkey		X			None	OK	N	N
United Kingdom		X	"other"	1993	Comp serv	OK	Y	N
United States	X							

OK = Distributed to industry of main economic activity

ANNEX 3. CORE AND MARGINAL R&D RESOURCES

Extract from Chapter 7 of the Frascati Manual (OECD; 1994)

(392) R&D has two elements: R&D carried out in formal R&D departments and R&D of an informal nature carried out in units for which it is not the main activity. In theory, surveys should identify and measure all financial and personnel resources devoted to all R&D activities. It is recognised that in practice it may not be possible to survey all R&D activities and that it may be necessary to make a distinction between "significant" R&D activities which are surveyed regularly and "marginal" ones which are too small and/or dispersed to be included in R&D surveys. (para. 392).

(393) It is recommended that significant R&D should include all units where at least one full-time equivalent (FTE) is worked on R&D per year.

(394) This is mainly a problem in the business enterprise sector where it may be difficult and costly to break out all the *ad hoc* R&D of small companies. It may also be a problem in other sectors, e.g. local government or teaching establishments at ISCED level 5 (para. 394)

(395) Efforts should be made via other sources (e.g. innovation surveys) to establish estimates for units with even smaller R&D efforts. However, such small amounts of R&D should only be included if the R&D is undertaken on a basis consistent with the definition of R&D in paragraph 57. (para. 395).

ANNEX 4. MINI SURVEY OF THE COVERAGE OF SERVICES IN NATIONAL R&D SURVEYS

MINI-SURVEY 1995

1. Coverage of services in your national survey of R&D in the business sector.
(See DSTI/EAS/STP/NESTI(95)2 for more information concerning services R&D.)
a. Does your survey cover :

ISIC Rev. 3 (NACE Rev. 1) OR NEAREST NATIONAL CATEGORY		YES	NO	CHANGED SINCE 1973 YES	CHANGED SINCE 1973 NO
50...52	Wholesale, Retail Trade & Motor Vehicle Repair etc.	☐	☐	☐	☐
55	Hotels and Restaurants	☐	☐	☐	☐
60...63	Transport & Storage	☐	☐	☐	☐
641 (64.1)	Post	☐	☐	☐	☐
642 (64.2)	Telecommunications	☐	☐	☐	☐
65...67	Financial Intermediation (including Insurance)	☐	☐	☐	☐
70-74	Real Estate, Renting & Business Activities	☐	☐	☐	☐
722 (72.2)	Software Consultancy	☐	☐	☐	☐
72-722	Other Computer Services nec	☐	☐	☐	☐
73	Research & Development	☐	☐	☐	☐
70+71+74	Other Business Activities nec	☐	☐	☐	☐
75...99	Community, Social. & Personal Service Activ.,etc.	☐	☐	☐	☐

Additional comments or remarks especially regarding changes over time and from which year the data are affected:

b. Classification **Could you please take the time to fill in the following concordance table:**

Current concordance between national classification and ISIC, Revision 3 (NACE Rev. 1)		**National SIC codes**
50....52	Wholesale, Retail Trade and Motor Vehicle Repair etc.	
55	Hotels and Restaurants	
60...63	Transport & Storage	
641 (64.1)	Post	
642 (64.2)	Telecommunications	
65...67	Financial Intermediation (including Insurance)	
70-74	Real Estate, Renting & Business Activities	
722 (72.2)	Software Consultancy	
72-722	Other Computer Services nec	
73	Research & Development	
70+71+74	Other Business Activities nec	
75...99	Community, Social. & Personal Service Activ..etc.	

c. **Does the survey of R&D in the business enterprise sector include R&D in the Social Sciences and Humanities (SSH)?**

d. **If the SSH are not covered, do you have any idea from other sources, how this might affect your services R&D data?**

e. Do you have any evidence of manufacturing firms out-sourcing to service R&D firms? Please explain:

f. Are Small-Medium-Enterprises (SME) covered by your survey? If not, do you feel that this might significantly underestimate the R&D in the service industry?

g. Do you feel that your national survey sufficiently covers the R&D in the service industry?

h. If the answer is no, are you planning to change your national surveys to change the coverage of the business services sector?