PREST

A Comparative Analysis of Public, Semi-Public and Recently Privatised Research Centres

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Final Project Report
Part II: Methodology Report

Prepared by PREST on behalf of the project consortium

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A Comparative Analysis of Public, Semi-Public and Recently Privatised Research Centres

Consortium Composition

PREST, University of Manchester UK, CSI, Ecole des Mines, France; SISTER, Sweden; RUSTEP, CSIC, Spain; and ECOTEC, UK; with support from Technopolis France & The Netherlands, CNR Italy, Atlantis Greece, LuisaHenriques, Portugal and Andrei Mougatov, AGUIDEL, France

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Methodology Report

1. Introduction and Overview of the Methodology

The starting point for the project was to study a minimum of 40 major public or semi-public research centres in the European Union in order to analyse their specific features: status, organisation, research potential, performance and the resources at their disposal. The project aimed to develop a typology of research centres and indicators to describe them, their performance and their roles in the EU research and innovation system.

The project decided at an early stage that the development of a picture of European public research centres would fill a significant gap in the knowledge of European research performers. In particular, the non-university public research sector, including government institutes, private non-profit and regional centres have not been studied systematically across the EU. It was known that such public research centres have occupied roles of differing strategic importance in different member states and that the system overall was changing due to well-documented effects, such as funding pressures. The project offered a chance to explore how these roles were changing and examine issues such as path dependency in terms of how each national system was responding to common pressures.

Building upon the knowledge of the consortium members of their own national systems, it was decided to take full advantage of the project opportunity and compile:

I. a full data set of European public research centres
II. a set of around 40 case studies, and
III. a country report setting the public research centres of the member state in context, discussing specific issues in the selection of centres and collecting data about them, and setting out important policy developments in the national research system.

Each of I, II and III has been delivered to the Commission as an output of the project. Thus, the main task adopted by the consortium comprised the design and completion of a large experimental database of all identified relevant research centres: publicly owned, semi-public or recently privatised (within the last 10 years). The construction of the database involved determining appropriate fields which could be considered as delivering suitable indicators, as well as the design of the database as a research and information tool.

The case study research centres were selected on the basis of the criteria applied in the Second European Report on Science and Technology Indicators, particularly size, geographic location and type of centre, to produce a sample reflecting the diversity of means employed to implement public research policy in the EU countries. Some case studies where organisational change was recent were included to get a better understanding of trends and issues. The case studies aimed to provide more detailed information and analysis to aid with the interpretation of the database and to give a strategic view of the position of the research centres.

This report describes and evaluates the three elements of the methodology: creation of the database, the case studies and country reports. It presents the analytical frameworks which were used to interpret the database and also describes the experimental relational mapping work, which was added to the project to provide a further dimension to the interpretation of the data.

2. The Database

Selection Criteria
The consortium selected national (not European or international) research centres. Early on, the teams chose to build a picture of non-university public research, and so excluded centres which are effectively integrated with the university research systems of the member states. A major example of this type was the exclusion of the French CNRS. Regional centres, centres in social sciences, arts and humanities and technical centres were all in principle included, although to varying degrees in each national database. For each country, choices were made about coverage, both on criteria of relevance to the mission of the project and in relation to the resources available to the teams for collecting and validating the data. The evaluation section, below, contains a fuller discussion of the eventual comparability of the national samples. The consortium teams validated their national lists with an external person, for example the French national statistical office for the case of France.

Data Collection
Data collection comprised three stages:
  i. Gathering public sources of information directly from research centres, such as annual reports
  ii. Performing an Internet based 'pre-survey' to confirm and collect further information.
  iii. Validation through mailing the completed data sheets to the research centres for adjustments and adding missing data. In many cases, telephoning was used to collect missing data and clarify responses.

Database Construction
Details of the stucture of the database are presented in the guidelines issued to the research centres for the purposes of validation – annex 1 of this report.

The software package Microsoft Access was chosen for the database as it is widely available and, importantly, would allow data entry by the members of the consortium to be confined to the set fields and response options. This facilitated a coherent data set for comparative analysis.

The typology of possible indicators of comparison was discussed during the initial consortium meeting. This gave a list of classificatory variables, which was circulated amongst the consortium for testing against actual sources of information (eg annual reports, web sites). The resulting revised list became the first version of the database. The fields were then tested more thoroughly and further amendments included during the second consortium meeting. The final version of the database fields was then agreed.

Database forms and fields

The database consists of nine forms and 131 fields for the collection of data. The forms are given at annex 1. The first form collects the contact details of the organisations and the sources used for compiling the entry. It also contains the field of "*year of creation*". This field proved amongst the most problematic (see also evaluation discussion, below), as many of the centres have changed organisational form which makes it difficult to assess when the current organisation can be said to have been created. The agreed solution, which removed some of the interpretation bias issues, was to take the earliest date of inception.

Form two focuses upon the ownership, accountability and governance of the research centre. The inclusion of these was seen as useful in reflecting different national approaches to organising this part of the research system. Discussion about the terms used and the meaning of specific legal entities such as not-for-profit bodies in different countries took up a great deal of time among the consortium, but was essential to develop a comparative typology. The options used are shown in Annex 1.

The form (number 3) covering sources of income aimed to collect information on diverse potential sources of the centres, and specified denomination in Euros for 1999. A comment was provided for explanations and caveats. The fourth screen intended to give a picture of the relationships of the research centre with other organisations, and gave comment boxes for explanation. The strengths of the links are specified in each case as Major, Minor or None. Screen 5 covers location and organisational structure, including information about branches. Screen 6 refers to the type of activities carried out, using Frascati definitions for research, and including diffusion/extension, provision of facilities and certification and standards. There are ample comment boxes for explanation and elaboration. Screen 7 is concerned with the sectors addressed by the research centre and uses standard industrial classification, again with comment boxes. Screen 8 identifies the areas of capability, referring to fields and subfields as defined by the OECD, and asking for an assessment of the significance of the fields (see annex 1).

The final screen collects data on human resources, including number of research staff, temporary staff, and doctoral students, with a box for explanations. There is also a box to record the mission statement of the research centre.

The final database represented the 15 member states and contains 768 records of information from research centres.

Data Validation

Once a preliminary set of data for each research centre had been compiled, the work of validating began. Each record was printed and sent to the relevant research centre. The table below indicates that this approach of compiling the data from available sources and then requesting validation produced a high response rate, much higher than had the data been collected by survey alone. All the research centres in the database were given the opportunity to check their entries. Consequently we have assumed that where a validation form was not returned, the data is correct. In a few cases, research centres were not included due to a high proportion of missing information which was not completed in the validation rounds.

The table below indicates the composition of the database by country and final status of the database in terms of records that were actually returned by the research centres:

Country	Frequency	Percent	Validation percent
Austria	31	4.0	42
Belgium	31	4.0	68
Denmark	48	6.2	67
Finland	36	4.7	75
France	105	13.7	44
Germany	76	9.9	60
Greece	52	6.8	62
Ireland	6	0.8	100
Italy	66	8.6	84
Luxembourg	4	0.5	50
Portugal	46	6.0	100
Spain	90	11.7	90
Sweden	48	6.2	81
The Netherlands	48	6.2	40
UK	82	10.7	53
Total	769	100	Average 60

Database Analysis
The analysis of the data gathered for the database was carried out in two ways. The data was imported to the statistical analysis package SPSS and the spreadsheet package Excel and used by the PREST team to produce category totals and cross tabulations. The resulting output is discussed in the Summary report and in the REIST Indicators chapter. The database contents are available on the accompanying CD-ROM.

3. Case studies

A complete list of completed case studies is shown in Annex 2 of this report. The full text of the 49 case studies is presented in a separate volume Part III.

Members of the consortium conducted the case studies according to an agreed common framework. In all cases, either the centre director or their representative was interviewed. In most cases, several other interviews were conducted, to cover financial management and data, human resources and research management.

The selection of case studies was based on several criteria, including representation of the member states, and the representation of different types of research centre - such as recently privatised research centres, hybrids and emergent non-government research centres. Research centres were also selected to make up "clusters" for

analysis of research centres with similar missions across EU countries (cancer research, metrology, agriculture, former nuclear research centres and social science centres). Some of this analysis is presented in the overall final report.

The objective of carrying out the case studies was to validate the use of the public data and web sites and to ask about the research centre's strategies and future directions. It was also an important opportunity to collect data not available from public sources such as discussion of publication and patenting patterns.

The consortium devised a case study template and each case study contains the following details:

1. Structure and History of the research centre
2. Situation Today
   - Structure, Organisation, Location, Mission, Outputs
   - Finance, Finance
   - Personnel
   - Relations with environment (linkages)
   - Commercialisation
3. Analysis of key dimensions and changes.
4. Synthesis and Conclusions.

4. The Country Reports

The objective of each country report is to contextualise the research centres selected for inclusion in the database, to helps to explain the database content. Each country report presents an overview of the organisation of research in the country and describes important recent policy initiatives impacting on the organisation of research.

The country reports are presented in a separate volume as Part IV.

5. Relational Mapping of EUROLABS Data Base: Method, Software and Application

Andrei Mogoutov, Aguidel

The relational mapping approach (RESEAULU Project) was initially developed for the exploration and analysis of heterogeneous data collections with internal links between items (social networks, socio-technical networks), with textual information (text collection, including comments and open questions) and with time-dependant data (historical and biographical data)[1]. This annex presents the principles of RESEAULU software for data transformation and mapping. It will use real EUROLABS data to illustrate the different steps of analysis.

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[1] www.aguidel.com

EUROLABS is a database of public non-university research centres of the 15 European countries. It contained beginning of 2002 some 770 entries with over 100 items per institution (including country, manpower, sectors addressed, domains of activities and main disciplinary competences).

RESEAULU software works in two main stages using different algorithms: (i) constructing association matrixes, (ii) mapping of specific relations.

The construction of association matrixes

The starting point is the simple cross tabulation of data collected. Table 1 presents the sectors addressed by the 770 institutions crossed per country of affiliation of these institutions.
This data is transformed in 3 steps: (i) weighted matrix, (ii) construction of matrix of expected values, and (iii) association matrix.

Table 1: Observed frequencies for sector distribution by country

Country	Agricul-ture	Defence	Government/ Public Services	Health	Industry	Natural Resources, Energy, Environment	Services, Infra-structure	*Total*
Austria	21	2	26	19	25	27	20	*140*
Belgium	12	4	16	13	16	19	9	*89*
Denmark	13	4	43	15	26	19	12	*132*
Finland	9	2	32	6	21	15	10	*95*
France	52	15	32	43	63	53	18	*276*
Germany	11	4	13	24	30	29	20	*131*
Greece	13	3	8	17	26	16	22	*105*
Holland	19	6	18	23	34	26	15	*141*
Ireland	4	1	5	4	2	3	2	*21*
Italy	28	1	9	26	29	18	10	*121*
Luxembourg	1		1	2	2	2	2	*10*
Portugal	12	7	19	12	29	26	14	*119*
Spain	14	6	18	13	65	25	18	*159*
Sweden	9	5	26	10	40	16	15	*121*
UK	31	7	22	25	15	26	20	*146*
Total	*249*	*67*	*288*	*252*	*423*	*320*	*207*	*1806*

Step 1 is optional. It enables to take into account specific criteria characterising items observed. The software offers to associate to any item a vector of numerical properties. For instance in this case, we have chosen a very simple vector based only on the number of staff per institution, because the number of institutions does not take into account their relative size, it thus gives more relative importance to countries who have numerous small size institutions compared to countries which have large multi-sectoral institutions (e.g. FhG in Germany).
It works the following way: the total of each record (that is the number of sectors addressed by one institution) is equal to its staff. The distribution is equal per sector since we have no information about their relative importance (in other variables where the latter is known, the ventilation depends on the degree of involvement).

Table 2: *Weighted matrix for sector distribution by country*

Country	Agriculture	Defence	Government/ Public Services	Health	Industry	Natural Resources, Energy, Environment	Services, Infra- structure	Total
Austria	888	256	770	1024	795	1263	692	5689
Belgium	841	62	963	973	2057	1043	592	6533
Denmark	946	354	2947	1093	2656	1645	859	10504
Finland	1345	80	3268	839	2374	2586	803	11299
France	6553	5403	9613	14680	12925	12272	6771	68220
Germany	4535	2649	1593	15573	14363	22044	7339	68099
Greece	1027	37	172	639	1631	1124	1697	6330
Holland	2675	519	3036	4040	4622	4307	1468	20670
Ireland	540	3	661	540	16	137	16	1917
Italy	1761	116	405	7092	2773	2893	2292	17336
Luxembourg	10		10	77	50	50	50	250
Portugal	1137	509	1430	727	1873	1875	843	8397
Spain	2587	642	3593	2901	5811	3797	3764	23098
Sweden	263	440	1161	355	2107	779	523	5631
UK	8134	7767	10065	12590	3790	7950	3083	53381
Total	*33246*	*18844*	*39693*	*63149*	*57849*	*63771*	*30800*	*307354*

Step 2 builds the matrix of the expected values corresponding to the 0 hypothesis of the complete statistical independence of the rows and columns of the table. The value of each cell is replaced by the combination of corresponding marginal values (i.e. multiplication of the totals of the corresponding raw and column divided by the general total).

Table 3: *Matrix of expected values*

Country	Agriculture	Defence	Government/ Public Services	Health	Industry	Natural Resources, Energy, Environment	Services, Infra- structure	Total
Austria	615	348	734	1168	1070	1180	570	*5689*
Belgium	706	400	843	1342	1229	1355	654	*6533*
Denmark	1136	644	1356	2158	1977	2179	1052	*10504*
Finland	1222	692	1459	2321	2126	2344	1132	*11299*
France	7379	4182	8810	14016	12840	14154	6836	*68220*
Germany	7366	4175	8794	13991	12817	14129	6824	*68099*
Greece	684	388	817	1300	1191	1313	634	*6330*
Holland	2235	1267	2669	4246	3890	4288	2071	*20670*
Ireland	207	117	247	393	360	397	192	*1917*
Italy	1875	1062	2238	3561	3262	3597	1737	*17336*
Luxembourg	27	15	32	51	47	51	25	*250*
Portugal	908	514	1084	1725	1580	1742	841	*8397*
Spain	2498	1416	2983	4745	4347	4792	2314	*23098*
Sweden	609	345	727	1156	1059	1168	564	*5631*
UK	5774	3272	6893	10967	10047	11075	5349	*53381*
Total	*33246*	*18844*	*39693*	*63149*	*57849*	*63771*	*30800*	*307354*

Step 3 builds the association matrix. It calculates the normalized difference between observed and expected values using the following formula (O-X)/SQR(X) where O is the observed value and X, the expected one.

Table 4: *Association matrix of sectors and countries*

Country	Agriculture	Defence	Government/ Public Services	Health	Industry	Natural Resources, Energy, Environment	Services, Infra-structure	*Total*
Austria	**11.0**	-5.0	1.3	-4.2	-8.4	2.4	5.1	*2.2*
Belgium	5.0	-16.9	4.1	-10.0	**23.6**	-8.5	-2.4	*-5.1*
Denmark	-5.6	-11.4	**43.2**	-22.9	**15.3**	-11.4	-6.0	*1.6*
Finland	3.5	-23.3	**47.4**	-30.6	5.4	5.0	-9.8	*-2.5*
France	-9.6	**18.9**	8.6	5.6	0.8	-15.8	-0.8	*7.6*
Germany	-33.0	-23.6	-76.8	**13.4**	**13.7**	**66.6**	6.2	*-33.5*
Greece	**13.1**	-17.8	-22.6	-18.3	**12.7**	-5.2	**42.2**	*4.2*
Holland	9.3	-21.0	7.1	-3.2	**11.7**	0.3	-13.2	*-9.0*
Ireland	**23.1**	-10.5	**26.3**	7.4	-18.1	-13.0	-12.7	*2.5*
Italy	-2.6	-29.0	-38.8	**59.2**	-8.6	-11.7	**13.3**	*-18.2*
Luxembourg	-3.2	-3.9	-3.8	3.6	0.5	-0.2	5.1	*-1.9*
Portugal	7.6	-0.2	**10.5**	-24.0	7.4	3.2	0.1	*4.5*
Spain	1.8	-20.6	**11.2**	-26.8	**22.2**	-14.4	**30.1**	*3.6*
Sweden	-14.0	5.1	**16.1**	-23.6	**32.2**	-11.4	-1.7	*2.7*
UK	**31.1**	**78.6**	**38.2**	**15.5**	-62.4	-29.7	-31.0	*40.2*
Total	*37.5*	*-80.6*	*72.0*	*-59.2*	*47.9*	*-43.9*	*24.7*	*-1.7*

Traditionally, the most positive values (e.g. in this case over 10) translate the most specific associations between items: UK and defence, Germany and natural resources and the environment, etc. A symmetric reading can be made about negative figures: Italy has far less involvement of its non-university public research in Government services and Defence. However there are strong limitations to such manual interpretation, this explains the software has a specific mapping interface.

The mapping of specific relations

The RESEAULU approach is object-oriented. The data is considered as a set of objects in a two dimensional space. Each object (that is one raw or one column: e.g. France or Defence) is characterised by 2 aspects: its properties and its links.
- Properties: in our example, its size is linked to its weighted frequency (in table 2), and its shape depends on its origin (either raw or column). There can be more complex sets properties like using colour for visualising the inclusion into clusters (such as those arrived through multivariate data analysis, etc.).
- Links: The association matrix provides the basis for the visualisation of links. Only the most specific couples (i.e. cells of the association matrix) are selected. The selection can be automatic or manual, which is taking into account the 15, 20, 30 or 50% of the most specific links. In this case we use the second option, between 15 and 30% depending on the number of objects. Additionally links can be differentiated (levels of thickness or colour) depending upon their observed weighted frequency (in table 2).

The RESEAULU algorithm optimises the positioning of objects in a two dimensional space focusing on the existence of "strong" ties.
The initial binary matrix of links can be represented without deformation only in a multidimensional space. To minimize the deformation of the final map in a two dimensional space, the software uses a dynamic positioning simulating the interaction between objects. It does so through a three step optimisation process: (i) global initial positioning of the object vis-à-vis all the other objects in the space; (ii) micro-optimisation of the positioning of the object vis-à-vis the other objects to which it is directly connected ("network neighbours"); and (iii) meso-optimisation of groups of

highly connected objects ("clusters"). The optimisation process depends on explicit rules defining symmetry properties, structural equivalence of points inside the structure, centrality and "betweeness" of objects.

The final map has no axes. The orientation of the map is determined by the three most connected or largest objects (in our examples the largest). It provides a triangular vision of the space with the first on the left side, the second on the right, and the third largest on the top.

Map 1: countries and sectors, most specific ties (cutting level 30%)
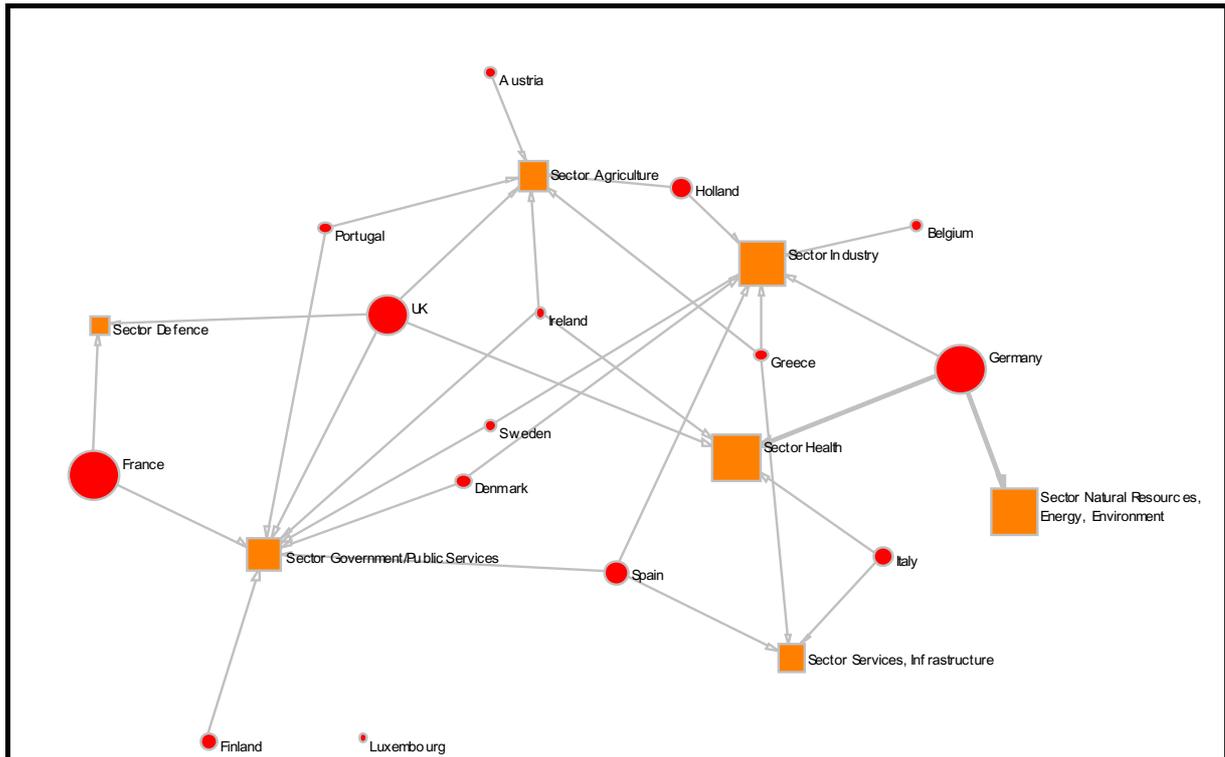
There are three complementary levels of interpretation: local, global and intermediate.
- At the local scale, the analysis deals with individual objects and is focused on drawn ties only. For instance Spain witnesses three sectors to which it is connected (industry, Government services and infrastructure), that is three sectors on which the Spanish non university public research institutions focus more that what could be expected if they followed the average European profile (that is the profile of the 15 countries together).
- At the global scale, the analysis deals with the poles that structure the space. It focuses on major oppositions in the relational profile of objects. For instance, France and Germany have opposite "privileged" relations with on one side defence and government services, and on the other Germany with industry, health and natural resources. While Spain, Sweden and Denmark, associating government services and industry, connect both poles.
- At the intermediate scale, the analysis focuses on given poles. For instance, Agriculture builds a pole of countries, which apart from this privileged connection, have all different profiles.

One of the interests of the method is to adapt the degree of specificity to the level of analysis. A strong degree of specificity (like the one used here: 30%) enables to develop global visions of the relative positioning of countries in the space of sectors. Increasing the cutting level to 40% as is proposed in map 2 for sectors Agriculture, Industry and Government/Public Services, enables to learn more on a pole, while a cutting level of 50% enables to visualise the full specificity of an object (cf. map 3 on Services/Infrastructure sector, red arrows correspond to strong ties).

Map 2: countries and sectors, most specific ties (cutting level 40%).
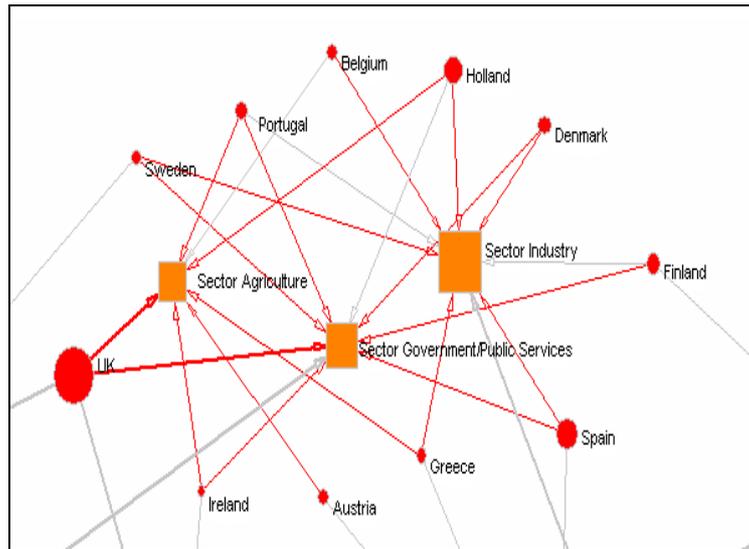
Map 3: countries and sectors, most specific ties (cutting level 50%)
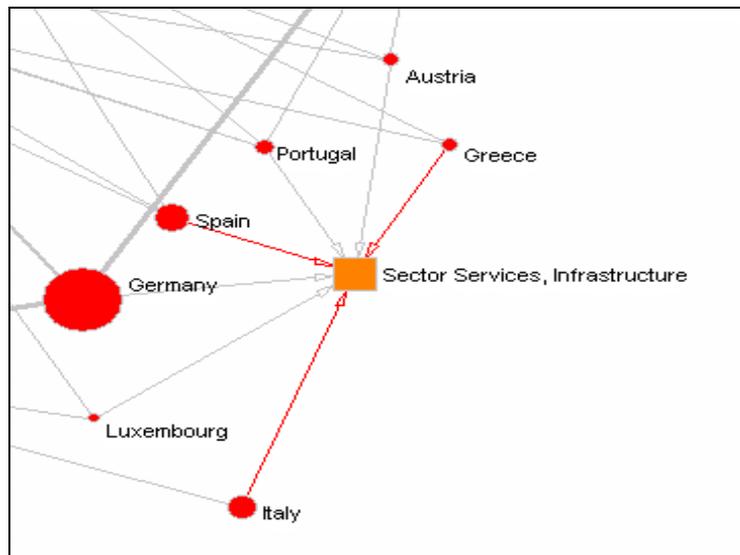
6. Evaluation of the database

It is worth stressing the experimental nature of this project. There have been a large number of comments and thoughts about the database content and what could and should have been included, from the team as they completed the datasheets, and from research centres. They have been the subject of detailed debate at consortium meetings and day to day interchange. Some of the more important considerations for future development of the database are presented below.

Issues of Data Collection
The strategy to use as much publicly available data as possible was chosen in part so that the Eurolabs database would contain publicly available information, and thus remove (or at least diminish) barriers to its open use. This strategy created some issues. Annual Reports were not consistent in their coverage, and were often a few years old (not being updated regularly). Web sites were similarly patchy in relevance and currency. It was a lot of work to construct each record from these public sources, and a good deal of interpretation was required. However, the validation attempted to rectify these problems, and overall had a good response rate.

Requirement for Expertise
The compilation of the database required a very good working knowledge of the research systems of each member state. This was necessary in the first instance to make coherent decisions about inclusions and exclusions and secondly in making judgements about the categories chosen to describe each research centre on the forms. This was the major reason by the decision to increase the membership of the consortium from the original four (PREST, Ecotech, CSI and SISTER), in order to employ experts in national research systems to cover each member state.

Selection criteria and comparability of member states' samples
For each member state, the consortium had to make choices about which research centres could be covered. Partly these were choices driven by interpretation of what is non-university public research in each country. This then required an judgement of
- What is non-university?
- What is public?, and
- What is a research centre? (as opposed to promoting research or disbursing funds).

Each of these points provided much debate and many decisions to be taken. We will treat each in turn below.

Resource constraints were present too, as the scope of the project had been considerably expanded from the original brief. So, for Germany it was decided to include 100% of Helmholz research institutes, and treat Fraunhofer and the other types of centre by entering institutes with the largest staff numbers to give 66% of Max Planck and WGL institutes. For all teams, research centres were sometimes not included where there was not enough information about their status, budget, etc.

- *What is non-university?*
One of the findings of this study, confirming previous work, is that there is a proliferation of "mixed" forms of public research involving the universities and other

public bodies. In some cases, government institutes appear to be forming links to create more flexible structures, and some new forms of research centres are based within universities while being more or less independent of them. The rule for the teams to interpret was to include research centres which were independent of the main university structures and had their own identity. This was interpreted in various ways.

The Portuguese autonomous university institutes ICS (social sciences) and ITQB (Institute of Technology for Chemical Biology) were not included because their profile of activities is as for a typical university research institute and their personnel are mainly university professors. This excluded several centres with close links and ties to universities which had been created to deliver some organizational autonomy for university professors, or to perform collaborative research with other centres. So the Portuguese selection criteria appear to have been rather strict, and certainly it is not a straightforward judgement to decide when a research centre is clearly autonomous from a parent or associated organization.

In Germany there are close links between FhG institutes and universities (heads have to be university chairs) and also MPG and Helmholtz Associations have close links with universities. In the NL, there are close links between the NWO institutes and universities, although the NWO institutes are organisationally independent. TNO has developed "knowledge centres", which are research cooperations with universities where most of the research is performed at the university.

For the UK set, the institutes of the Research Councils were entered where they had a distinct identity, but not where they were smaller and effectively integrated within a university, as is the case for some of the Medical Research Council groups. Irish Programmes of Advanced Technology and Technical Centres were not included as they are located within universities and tertiary education institutes respectively. Spain and Italy did include any research centre owned by a business enterprise or university alone.

The Eurolabs database does not describe the large national research organisations of France, Spain and Italy. France and Italy decided to exclude CNRS and CNR as they are effectively integrated with university system. However, France included INSERM, which is also fairly integrated with the university system in order to balance the profile in medical and health research. This decision was arbitrary. Spain put in a single entry for its analogous organisation, CSIC, the largest research centre in Spain with 9,630 staff.

The French team decided to exclude about 100 or so not-for-profit organisations, which support university research, eg ARMINES, which act in a similar way to CNRS in supporting university research. The way that these "go-between" organizations have been treated varies from country to country and requires examination for comparative work. In future rounds of the database, this sector of not-for-profit organisations should be included.

- *What is public?*
Again, the proliferation of public/private forms, various not-for-profit organisational forms and transformations have been a clear phenomenon in this sector (see country reports for further details). In many cases it is not clear when a research centre is

public (notwithstanding the contractual obligation to include privatised public research centres). As the Portuguese team member stated "the not-for-profit sector forms a world". Forms found included learning societies, professional associations, patient associations, trade and sectoral industrial associations, farmers/producers associations, associations for regional development and municipalities, and associations for managing university-industry links, incubators and poles and associations/foundations of a university or faculty for contract and personnel management.

Spain and Italy did not include any research centre owned by a business enterprise alone. Spain have included some "soft" research centres, that is organisations resulting from collaboration agreements between different actors in the research system. Not for profit organisations represent the form for newer research centres, and these can be public or privately owned. Most in the database are privately owned, and represent "research associations" and "technical centres". In Sweden industrial research institutes have been the subject of policies to promote their role, converting from foundations to corporations with a minority holding from a government company and majority holding from a members association. These are included, as are the few government owned institutes. For Italy, some not-for-profit centres are included but information on this sector is incomplete. A few recently privatised stazioni sperimentali for industry are included in the Italian database.

The Belgian "sectoral research centres", and also 5 private collective research centres founded by business companies are included, as they receive significant public funding. The UK covered public research centres privatised within the last 10 years, and those privately owned not-for-profit research centres where dissemination of output into the public arena was a key mission. The UK did not include privately owned member based research and technical associations, although this should be considered for future versions of the database. They do not receive core funding from the government.

- *What is a research centre?*

This question is concerned with whether organisations actually perform research themselves, rather than acting as funding and/or promotion agencies, and the centrality of research to the mission of the organisation. There have been some different interpretations in the country samples.

France have included the main institutions which act mainly as funding agencies, such as CNES, ADEME and ANVAR, but excluded ministries as the core of their activity is to act as research funders rather than performers. Belgium and Portugal excluded did not include ministry organisations where research was not the primary purpose, and on the same grounds excluded museums and libraries. In the UK, these organisations were included where there was a significant research activity, even if it was not the primary purpose of the organisation. Portuguese excluded from their not-for-profit sector all types of organization where the performance of R&D was not a primary mission, although the organizations may have been involved in research. Italy did not include centres controlled by regional authorities since they do not yet have a critical position in the Italian system.

The Netherlands included a number of institutes linked to Ministries. The institutes of the Royal Academy for Arts and Sciences (KNAW) were not comprehensively entered due to their concerns with arts and humanities, collections and archives. This could be redressed in a future round of the database construction, as most countries did not exclude arts and humanities research centres, although perhaps had less comprehensive knowledge of them than their scientific and technical counterparts.

France included technological research centres and institutions, and also the "centres techniques" and "technology resource centres", quite a few of which have developed their own research capabilities. The "centres techniques" are not for profit and funded by compulsory taxes on industry sales, and represent around 50 organisations. Their analogues were not included in the German database. The technology resource centres would need better coverage in any follow up round of the database (requiring specific efforts). Again, it is debatable whether research is their main mission, but they represent nevertheless an important class of actor in the research system.

- *Defence research*

Comparability on defence research in the Eurolabs database is problematic because of the difficulty in including French defence research, since much of the research effort has moved with the different military services and production entities into specific companies, some of them privatised. At this point the details of the research capabilities are lost, since they no longer are reported on separately. The global figures only are available. This means that the French database is significantly under-reporting French defence research organisations.

- *Privatised industry research centres*

France Telecom was privatised in the 1990s, which took with it the CNET, one of the largest public research institutions in France. There must be analogous examples in other member states, for example in Britain the research associated with energy and other utilities which have become fully private companies. Data on the research centres is therefore not publicly available. This sector of former public research is not included in the Eurolabs database.

Evaluation of database fields

An evaluation of the datebase fields is presented below, going through the screens which are appended to this report.

- *Screen 1 - The organisation*

The year of creation proved very problematic, as so many of the research centres had undergone changes in legislation about public organizations, also merging, splitting, re-naming and re-creation. The rule of thumb, to include the earliest date of inception, did not always work well when research centres had undergone major changes and defined themselves as "reborn". The identification of the year of creation of the organisation could be expanded to allow space to document the important transformations. For the name of the research centre an additional field could be included for the name in the native language.

- *Screen 2 - Ownership and Governance*

One of the most problematic classifications has proven to be ownership. Increasingly, institutions belong to more than one source. A decision had to be made to select the majority owner. Non-profit organisations are very heterogeneous. A future database could ask also about founders and main shareholders. Private companies such as TNO and WUR gain the majority their contracts from government and should not be classed as strictly private but then again are not government owned. Further thought needs to be given to the options available for the ownership classification and additional fields introduced that will allow a larger more explanatory range of variables.

- *Screen 3 – Sources of Income*

As was to be expected, sources of income proved difficult to collect and deal with comparatively. Future collection of funding source data should be more rigorous. A specific financial year for data should be adhered to and that year only should be considered. A valid exchange rate for each country should be determined and only that rate used for specific currency conversions. With many countries now only using the Euro as the unit of currency this will make such data gathering more straightforward in the future. A number of research centres refused to provide the figures required, or were unable to provide the figures. Nonetheless, the weaknesses are not significant enough to discount the validity of the big picture of research centre funding in the EU.

It was suggested that in the functions category of fields a field for corporate venturing should be included and to specify the category of sales and services income. This is perhaps more relevant to former public research centres which have become private sector organisations   The number and size of start-up companies owned and sold over the last 5 years by the research centre was not a field included in the database but was an issue discussed in the case study interviews.

- *Screen 4 – Linkages*

Despite the explanation and definition of the linkages and how to assess their strengths, this data was still open to interpretation to a great degree.

- *Screen 5 – Structure*

The category of headquarters and branches proved difficult to interpret in some cases.

- *Screen 6 – Functions and Outputs*

The category of diffusion/extension could be expanded to include more specific mentions of different activities, again including spin off companies and incubators.

- *Screen 7 – Sectors Addressed*

Other than to break the sectors down into more precise ones, this screen appeared to work well.

- *Screen 8 – Areas of Capability*

The same comment as given for linkages could be applied here: the extent to which major and minor are subjective judgements, despite the definition given.

- *Screen 9 – Human Resources*

There were some difficulties with this screen. It was not always straightforward to define qualified researchers as opposed to qualified technicians (these were merged in the Portuguese case). Some "mixed" research centres and also non-profit organizations may have personnel on the university payroll. Where known, these personnel were included in the database entry.

The human resources fields could be further elaborated to enhance clarification. Qualified research staff should be qualified permanent research staff and doctoral students are those working on their PhD under the guidance of the institute.

User Interface
The construction of the database was an evolutionary process, which has meant that design considerations took second place to content in terms of the team's priorities. This has meant that there are inconsistencies in the presentation of the interfaces and weaknesses in navigation around forms, which inhibit user friendliness. However, as the data has now been gathered, further work on the database has improved upon the human computer interface elements of the database.

Conclusions on database evaluation
To summarise, comments received from research centres and from members of the consortium using the database endorse that the basic structure is fundamentally sound. Further elaboration is required for certain fields in order to facilitate more detailed analysis and to ensure that truly comparative data is gathered. This could be achieved in part by enhancing the detail available in the guide for data gathering.

Fundamentally the aim of the compilation of a database of indicators for comparison of major national/European institutes has been achieved. The project team also gathered data sufficient to portray a good representative coverage of other types of research centre including new and emerging research centre types. Key institutions are included in the database and this has been validated with independent observers in each country, for example the French teams worked with the French Statistical Agency in order to ensure complete coverage.

7. Evaluation of the Case Study Methodology and Relational Mapping

The case study methodology worked well, even while being conducted by different research teams. One comment is that for larger research centres, several interviewees are necessary to give a full picture of its activities. The case studies gave valuable feedback on the database structure and interpretation, as well as the key strategic issues.

The relational mapping was experimental. It gave some very interesting views of the data. However, care needs to be taken (with all comparative analysis from the database in fact) because of the national selection biases, discussed in full above, and also because it weighted research centres according to numbers of researchers. In the Eurolabs database, France, Germany and the UK account for 63% of all the researchers covered. So for small countries, there are some distortions.

8. Further development of Eurolabs

In order to capitalise upon the project outputs the database could be uploaded to a Web site and employed as an information resource. The research centres themselves could then consult the records and feedback to the host with updated data. The database could then become a dynamic resource presenting an up to date picture of the research centres in Europe. The alternative is to leave the database as a static 'picture in time'. The transformation from static to dynamic would be inexpensive in comparison to the utility of the information that would then be publicly available.

For future rounds of the database, a choice will have to be made about whether this methodology is maintained or whether to collect the data via site visits or by open questionnaire. Site visits would increase the accuracy, and possibly not be significantly more labour intensive than collecting and interpreting the public data sources. An open questionnaire would probably have a very low response rate.

The present work has identified in detail possible improvements for a future data collection instrument. The existing database and set of case studies has already provided much valuable information for policy makers and researchers, and much remains to be exploited. Any future work, particularly that concerned with revising and updating the dataset and indicators will require expert handling.

Annex I - Guidelines for validating the EUROLABS database

The Guidelines below provide details of the database structure

This note constitutes guidelines for those validating database entries for their institute. It is organised according to the screens as they appear in the database, with notes:
- explaining the meanings of the various fields; and
- where necessary, listing the possible entries where options are offered.

Screen 1: Organisation
The first section of the database is concerned with location and contact details of the institute and, as such, is reasonably self-explanatory.

Parent Organisation
This field refers to laboratories that are owned either by Government or by another organisation

Year of Creation
The entry for this field should refer to the earliest date when the institute was originally founded.

The section – 'Sources used to find information', does not require any entry by the research centre. It is for the EUROLABS project team only.

Screen 2: Ownership and Governance
This screen refers to the ownership of the institute and the nature of its governance.

Options for **Ownership type**:
- Central Government
- Regional or Local Government
- Not for Profit Foundation
- University
- Private Sector

Options for **Governance**:
- Accountable to shareholders
- Branch of Government
- Independent public organisation or Agency
- Accountable to foundation or regulator

Eurolabs Database

File Edit View Insert Format Records Tools Window Help

Eurolabs table 1

Ownership

Name of Organisation:

Ownership

Government

Not for Profit Foundation

If Privatised state Year

Other ownership type- specify

Governance and Accountability

Governance/Accountability

Comment:

BACK

Page 3

Record: ◄◄ ◄ 1 ► ►► ►* of 1

Comment box please clarify, particularly if the categories do not adequately describe your organisation

If your organisation does not fit into any of the specified categories, use the **Other Ownership** field

Options if owned by a **Not For Profit Foundation**:
- Professional Association
- Technical Centre
- Trust
- Patient Association

Options if owned by **Government**:
- National
- Regional
- Local
- Combination

Screen 3: Sources of Income
This screen deals with the institute's sources of income. Sources are typically diverse for any given centre, although it is not uncommon for a single source to predominate.

All figures given are in Euros using an exchange rate of (*insert country specific exchange rate*) and are for the year 1999 unless otherwise stated. Please complete the fields as thoroughly as possible – either in Euros or their local currency, with the choice of denomination indicated. Where necessary, we can make the conversion into Euros.

Government grant/core funding is defined as a regular allocation which is intended to support the institute, but which is not highly specified in terms of the research to be performed. It might cover salaries of permanent staff, for example, or cover a core programme of research, which the institute determines.

Subset of Government
Indicate contribution of funding received by national government and that of regional government where applicable.

All other includes for example, sales of publications, technical services or products.

Please use the box to comment on the figures provided. Identify the financial year used for data provided.

Eurolab

File Edit ... Help

Eu...

So... on:

Government grant/core funding:

Public sector contracts:

private sector contracts:

Industrial levy, hypothecated tax:

EU:

Other international:

All other:

Comment on budget figure:

Subset of Government

National government:

Regional Government:

Subscriptions:

Donations:

Investment income:

Budget for 1999 or nearest financial year in Euros:

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Record: |◄ ◄ [88] ► ►| ►* of 88

Public sector contracts: This refers to funding, which might be awarded regularly (or not) in return for specified services or research programmes. The contracts might be awarded by single tender or competitive tender and may be multi-annual.

Screen 4: Linkages

This screen is concerned with the relationships that the institute has with other organisations.

Eurolabs Database - [Form Financial Relations]

File   Edit   View   Insert   Format   Records   Tools   Window   Help

Linkages and Financial Relations

Name of Organisation: [   ]   Back   Page 5

Industrial Links [▼]   ☐ Financial Links Industry   Links with the Commission [▼]   ☐ Financial Links Commission

Comment Industry Links [   ]   Comment Commission Links [   ]

Links with National Authorities [▼]   ☐ Financial Links NA   Links with Regional Authorities [▼]   ☐ Financial Links Regional Authorities

Comment NALinks [   ]   Comment RA Links [   ]

Academic Links [▼]   ☐ Financial Links Academic   Links with Other Public Sector Labs [▼]   ☐ Financial Links Public Sector

Comment Academic Links [   ]   Comment Other Public Sector Labs Links: [   ]

International Links [▼]   ☐ Financial Links International

Comment International links: [   ]

Record: ◄◄ ◄ [88] ► ►► ►* of 88

> The drop-down boxes allow an evaluation of the strength of the relationship with a given organisation - Major, Minor or None. The tick boxes are provided in order to acknowledge a relationship that has a financial basis. The comment boxes allow for clarification of any relationship. An example is shown below.

EXAMPLE

Links with the Commission [▼]   ☐ Financial Links Commission

None
Minor
Major

Comment Commission Links [   ]

> A Major link is a link of considerable significance to the mission, activity or strategy of your institute. It might not necessarily be major in financial terms. A Minor link is of minor importance to the mission, activity or strategy of your institute in overall terms.

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Screen 5: Structure

Screen 5 is concerned with the details of location and organisational structure of the institute.

Options for **structure**:
- Single unified organisation
- Headquarters of series of semi autonomous labs
- Branch in series of semi autonomous laboratories
- Other – please specify in comments box

Eurolabs Database - [Form Structure : Form]

File Edit View Insert Format Records Tools Window Help

Structure

Name of Organisation

Page 6

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Structure

If multi branch No of branches: 0

Comment on branches:

Comment on other:

Location

Which countries?:

Number of locations: 0

Number of regions: 0

No of countries: 0

Number of operating units: 0

Record: 1 of 1

Operating units refer to sub-units of a single unified organisation, which have their own budget lines and some degree of autonomy. They might be 'departments' or 'laboratories' within the institution.

Screen 6: Function and Outputs

Screen 6 refers to the type of activities carried out by your institute. Here, we have used the standard OECD Frascati definitions for research (see Adjunct below), together with other variables that take into account those activities that are more difficult to classify using only the OECD research typology. Examples include diffusion/extension activities, the provision of facilities to third parties, and certification/standards work. Please do provide comments to explain these entries to us.

Facilities - where specialised research facilities are available for users from outside the institute. These may be provided with or without technical support.

Diffusion/Extension refers to functions related to the transfer of technology and/or knowledge to users. It might include a specific mission of the institute to transfer knowledge to industry, a professional group or the public sector. It might include dissemination of outputs to users and/or non-academic activities (e.g. the public). It might include the support of spin-off companies or a science/technology pack. It might include delivery of training, building upon the specific expertise of the research institute.

Certification/Standards work. This may include R&D aimed at underpinning the development of standards, certification services and/or participation by staff in standards, expert groups or negotiations.

Adjunct: OECD Frascati definitions

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Basic research analyses properties, structures, and relationships with a view to formulating and testing hypotheses, theories or laws. The results of basic research are not generally sold but are usually published in scientific journals or circulated to interested colleagues. Occasionally, basic research may be "classified" for security reasons.

- **Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods, or systems. Applied research develops ideas into operational form. The knowledge or information derived from it is often patented but may also be kept secret.

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

Screen 7: Sectors addressed
Screen 7 is concerned with the sectors of activity that the institute addresses. The sectors listed are taken from the standard industrial classification used by the OECD. Please elaborate further in the comments boxes assigned to each industrial sector.

Please tick all sectors in which the institute is involved.

Screen 8: Areas of Capability

Screen 8 identifies the areas of (scientific) capability of the institute. We use a standard OECD typology to do this and refer to general fields as well as more specific sub-fields.

Note that where sub-fields are acknowledged as a capability, they should be indicated as being either 'Major' or 'Minor'

Form capabilities

Areas of scientific and technological capability (OECD typology)

Sub Fields indicate Yes/NO   Major/Minor

Name of Organisation: ADAS

Natural Sciences

Engineering _Technology

Medical Sciences

Agricultural Sciences

Social Sciences

Humanities

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Maths _Computer sciences:

Physical sciences:

chemical sciences:

Earth _environmental sciences:

Biological Sciences:

Civil Engineering:

Electrical Engineering/Electronics:

Other Engineering sciences:

Basic Medicine:

Clinical Medicine:

Health Sciences:

Agriculture, Forestry, Fisheries and Allied Sciences:

Veterinary Medicine:

Psychology:

Economics:

Educational Sciences:

Other Social Sciences:

History:

Languages and Literature:

Other Humanities:

Options for **areas of S&T capability**:
- None
- Present but minor
- Significant
- Major for the institution

Defining Major and Minor. This should be done in terms of the size of research effort or expertise in the sub-field, compared to the overall activity of the institute.
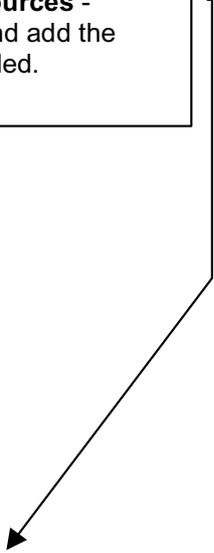
Screen 9: Human Resources

Screen 9 asks for the number of staff in the organisation and seeks to identify research staff and doctoral students. The mission statement of the organisation is also included on this final screen.

No of qualified research staff may include research technicians.

Comment Human Resources - please elaborate here and add the year of the figures provided.

Doctoral Students - Please estimate the numbers of doctoral students registered in or attached to your institute. They may work at your institute but be registered elsewhere for their degree. They may be on placements with your institute as part of their studies.

If you have any further questions or queries about validating the existing entries in the database, or adding to the entries please email:
Deborah.Cox@man.ac.uk

Annex 2 – Case Studies

Austria		
Austrian Research Centre (ARCS) Seibersdorf A-2444 Seibersdorf Austria		
Belgium		
ITMA Antwerp Institute of Tropical Medicine Nationalestraat 155 B-2000 Antwerp, Belgium	**IPH - Scientific Institute of Public Health** Juliette Wytsmanstreet 14 - B 1050 Brussels Belgium	**BioVallée** rue des professeurs Jeener et Brachet 12 B-6041 Charleroi Belgium
Denmark	Finland	
RISÖ Risö National Laboratory Fredriksborgvej 399 Postboks 49 4000 Roskilde Denmark	**VTT - Technical Research Centre of Finland** Vuorimiehentie 5, Espoo P.O. Box 1000, FIN-02044 VTT	
France		
CETIM 52, avenue Félix-Louat BP 80 067 60 304 Senlis cedex France	**INED** 133, Bld Davout 75980 Paris cedex 20 France	**AFFSA** 23, avenue du Général de Gaulle BP 19 94701 Maisons-Alfort Cedex France
GENOPOLE 2 rue Gaston Crémieux CP 5721, 91057 Evry Cedex France	**CEMAGREF** Parc de Tourvoie, 92163 Antony France	**Bureau National de Metrologie** 1 Rue Gaston Boissier 75015 Paris France
Germany		
GMD - Forschungszentrum Informationstechnik	**Deutsches Krebsforschungszentrum (DKFZ)**	**Ifo Institut für Wirtschaftsforschung** Poschingerstr. 5

GmbH Schloss Birlinghoven D-53754 Sankt Augustin, Germany	Postfach 101949, 69009 Heidelberg Im Neuenheimer Feld 280, 69120 Heidelberg Germany	D-81679 München Germany

Bundesanstalt für Züchtungsforschung an Kulturpflanzen Neuer Weg 22/23 D-06484 Quedlinburg Germany		
Greece		
National Agricultural Research Foundation (N.AG.R.E.F) 19 Egialias & Chalepa, 15125 Maroussi Greece	**FORTH** **The Foundation for Research and Technology - HELLAS** P.O.Box 1527, Heraklion 71110, Crete, Greece	**National Centre for Scientific Research "Demokritos"** Agia Paraskevi Attikis, P.O. Box 60228, 15310 Athens, Greece
Italy		
ENEA **Italian National Agency for New Technology, Energy and the Environment** via Enrico Fermi 45, Frascati (Roma), 00044	**INFM** **Istituto Nazionale per la Fisica della Materia** corso Perrone 24, Genova, 16152 Italy	**Istituto Nazionale per la Ricerca sul Cancro IST** Largo Rosanna Benzi, 10 16132 Genova Italy
Istituto Elettrotecnico Nazionale "Galileo Ferraris" corso Massimo D'Azeglio 42, Torino, 10125 ITALY		
Ireland		
Economic & Social Research Institute 4 Burlington Road Dublin 4 Ireland	**TEAGSAC** 19 Sandymount Avenue Dublin 4 Ireland	**National Metrology Laboratory** Enterprise Ireland Glasnevin Dublin 9 Ireland
Portugal		
Instituto de Engenharia Mecânica e Gestão Industrial R. do Barroco, 174 , 4465-591 Leca do Balio Portugal		
Spain		
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas - CIEMAT c/ Avda. Complutense, 22 E-28040 - Madrid - Spain	**Instituto de Astrofísica de Canarias - IAC** c/ Vía Láctea, s.n. 38200 - La Laguna Tenerife - Spain	**Institut Municipal d'Investigació Médica - IMIM** c/ Dr. Aiguader, 80 08003 - Barcelona - Spain

Instituto Tecnológico del Calzado y Conexas - INESCOP Polígono Industrial Campo Alto Aptdo. Correos 253 03600 Elda (Alicante) Spain	**Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria - INIA** Ctra. de La Coruña, Km.7 28040 Madrid España	**Institut de Recerca i Tecnologia Agroalimentàries - IRTA** Passeig de Gràcia, 44-3ª 08007 - Barcelona Spain
CNIO: Centro Nacional de Investigaciones Oncológicas-Carlos III Ctra. Majadahonda-Pozuelo, Km 2. 28220 Madrid	**Centro de Investigaciones Tecnológicas IKERLAN** Paseo Jose Mª Arizmendiarrieta, 2. 20500 Mondragón (Guipuzcoa).	
Sweden		
SP – Swedish National Testing and Research Institute Sveriges provnings och forskningsinstitut. , Box 857, 501 15 Borås Sweden	**IVF – Industrial Research and Development Corporation** Argongatan 30, 432 53 Mölndal Sweden	**VTI Swedish National Road and Transport Research Institute** Statens väg- och transportforskningsinstitut 581 95 Linköping Sweden
NIWL National Institute of Work and Labour Arbetslivsinstitutet, Warfvinges väg 25, 112 79 Stockholm		
The Netherlands		
TNO Postbus 6030, 2600 JA DELFT Schoemakerstraat 97, 2628 VK Delft	**Wageningen University & Research Centre** Postbus 9101 6700 HB Wageningen, The Netherlands	**Nmi - Institute for Metrology and Technology** Schoemakerstraat 97 NL-2628 VK Delft P.O. Box 654 NL-2600 AR Delft The Netherlands
UK		
Biomathematics & Statistics Scotland James Clerk Maxwell Building, The King's Buildings, The University of Edinburgh, Edinburgh EH9 9JZ United Kingdom	**National Physical Laboratory** Queens Road, Teddington, Middlesex, TW11 0LW United Kingdom	**Building Research Establishment** BRE, Garston, Watford WD2 7JR United Kingdom
Imperial Cancer	**Southampton**	**AEA Technology**

Research Fund 61 Lincoln's Inn Fields, London WC2A 3PX	**Oceanography Centre** Waterfront Campus, European Way, Southampton, SO14 3ZH, UK	329 Harwell, Didcot, Oxfordshire, OX11 0QJ United Kingdom
National Foundation for Educational Research The Mere Upton Park Slough Berkshire SL1 2DQ. United Kingdom		