Bibliometric profiling of Framework Programme participants

FINAL REPORT and EXECUTIVE SUMMARY
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1.1 Objectives of the study

The objectives of this study are twofold:

- to use the available information to construct an impact assessment of the scientific outputs of the various framework programme participants and their affiliated research infrastructures by profiling and assessing their citation profiles;
- to make practical recommendations based on the experience of the study to improve the methodology for evaluation and impact assessment of the scientific outputs of FP7.

This study assesses the impact of the scientific output of the various framework programme participants through investigating the publication patterns of the lead scientists, *i.e.* those in FP6 projects that are more likely to publish in the best journals. It compares the publication and citation performance of FP6 lead scientists with that of other scientists in the overall scientific community.

KEY DEFINITION

The project lead scientist is defined in the request sent to all FP6 project coordinators as the person whose name is most likely to appear on published articles resulting directly from the Project you coordinate.

This is a critical issue, since the involvement of first-class scientists is both an indicator of the attractiveness and importance of framework programmes, and a necessary condition for the delivery of top-quality work.

This question also raises important ERA-related issues. As well as their obvious role in the advance of the scientific frontier, lead scientists can have important wider influences, such as in facilitating the diffusion of knowledge and strengthening social networks within the EU. Hence the study also aims to assess whether the FP6 lead scientists co-publish more than their counterparts in the overall scientific community, particularly with regard to researchers in other organisations and countries.

1.2 Methodology: a 3-strep process

We used a purpose-built 3-step methodology in this study.

1.2.1 Step 1: Identification of FP6 lead scientists and analysis of the resulting "FP6 lead scientist database"

We identified lead scientists through a peer nomination process. More specifically, using an online survey, all FP6 project coordinators were asked to select lead scientist(s) in their project based on the following definition: "the person whose name is most likely to appear on published articles resulting directly from the project you coordinate". Project coordinators of STREPs and "large" FP6 instruments (NoEs and IPs) were requested to provide respectively one and three lead scientists for their projects, to take account of the difference in size of these instruments.

A database of nearly 2000 lead scientists was obtained using this method. They participated in 1681 projects, which represents nearly 53% of the total number of FP6 projects. The lead scientists database was quality-checked in order to verify that there was no bias that could diminish the reliability of the results. The structure of the database by project to which the lead scientists belong is very close to that of the overall FP6 project database (in terms of instruments and FP6 priorities).

1.2.2 Step 2: Identification of FP6 lead scientists publications and analysis of the resulting lead scientist publication database

The identified lead scientists were matched in turn to records in the Web of Science online publication database (hereafter 'WOS online' / Reuters-Thomson Web of Science© database) and to the proprietary OST WOS database. This 2–step process improves the reliability of the resulting lead scientist publication database, which consists of over 48 000 publications, and comprises the basic reference data for this study.

1.2.3 Step 3: Production of relevant indicators to compare the bibliometric profiles and performance of lead scientists with those of their counterparts in the overall scientific community

Three complementary types of analysis were used to assess the publication performance of FP6 lead scientists:

- Assessment of the overall citation performance of lead scientists;
- More detailed analysis of citation performance, with reference to scientists' country of origin and scientific field, and numbers of particularly highly cited papers;
- Assessment of the co-publication patterns of lead scientists.

The indicators were designed and calculated by the Observatoire des Sciences et Techniques (OST), which for over 15 years has produced indicators that are comparative, robust, and normalised. The OST production process is subject to quality-assurance controls to improve its performance. Some of the indicators used, especially the relative citation rate, which allows more meaningful and reliable comparisons of citation performance, are exclusive to OST.

1.3 Results: FP6 projects did attract the best scientists in their relevant communities

The key result of this study is that FP6 projects did attract the best scientists in their relevant communities. This result is supported by several separate pieces of evidence, based on complementary bibliometric analyses.

1.3.1 Evaluation of the relative citation performance of FP6 lead scientists

FP6 lead scientists outperform their counterparts in the relevant scientific communities:

- for all FP6 priorities and sub-priorities in which lead scientists participated;
- for all instruments in which lead scientists participated;
- for almost all countries from which lead scientists originate;
- for almost all disciplines and sub-disciplines;
- ...in the 1% most cited publications.

In order to account for variations in citation rates between journals, the analysis was carried out at journal level using the Relative Citation Ratio indicator. This indicates that the publications of these lead scientists were cited more frequently than the other publications in the same journal. This ensures that results are free of any 'journal effect', and also recognises that journals are in themselves an essential factor of segmentation of the scientific community. Each journal gathers a certain sub-community that is relevant both in terms of substance (the field, discipline, issues at stake) and in terms of expected quality of research. Taking account of journals used for publication is therefore the most appropriate level at which a comparison between FP6 lead scientists and their counterparts can be performed.

1.3.2 Evaluation of the distribution of publications and lead scientists by extent of citation

These results at journal level were reinforced and complemented by analysis of the most heavily cited papers. The results are consistent with those obtained at journal level: of the 1% top cited papers (the 'class of excellence'), two to three times as many are contributed, proportionately, by FP6 lead scientists compared with their counterparts in the overall scientific community. Again, this result holds for almost all countries of origin of lead scientists, FP6 priorities to which they have participated and field of science in which they publish. This result also holds when analyzing the number of lead scientists (as opposed to number of papers) contributing to the 1% top cited papers: the lead scientists with at least one paper among the 1% most heavily cited are proportionately more numerous than their counterparts. This is true overall, and for most individual scientific fields.

1.3.3 Assessment of FP6 lead scientists co-publication patterns

Finally, the analysis of the co-publication patterns of the lead scientists demonstrates that they have a higher propensity to collaborate than the scientific community as a whole. Lead scientists are also more inclined to publish outside their organisation and their national boundaries. However, patterns of collaboration vary greatly between countries.

In terms of nationalities, the proportion of FP6 lead scientists' co-publications which involve a joint publication with at least one individual from another country is 20% higher than for their counterparts in the overall national scientific community. For instance, FP6 Austrian, Finnish, French and Dutch lead scientists' publications are more internationally oriented than those of their respective national scientific community. For all other countries, the degree of internationalisation is lower. Also, the FP6 lead scientists co-publications which involve a joint publication with at least one individual from the same country is generally higher than for their counterparts in the overall national scientific community.

1.4 Lessons learned: three main areas of improvement

These results are important as they clearly challenge the pervasive and preconceived idea that most top-level scientists do not participate in the Framework Programme because they can obtain funds from other sources of financing.

Further work is now required to elaborate on these results. We have identified two major areas for improvements.

1.4.1 Qualitative research on the role of lead scientists and their effects in FP projects

This bibliometric study should be complemented by qualitative work on lead scientists in order to understand their role in the Framework Programme and, from a more general perspective, their specific behaviours and impacts on science and technology. We were able in this study to show that lead scientists participate in the Framework Programme, but could not explore their impact on the projects. Unfortunately the available body of knowledge on the impacts of lead scientists on research projects, programmes and communities is very limited (see papers by E. Garfield, L.G Zucker and M.R. Darby or Azoulay).

Several qualitative issues should be investigated:

- To what extent do lead scientists structure the research environment, attracting other researchers to a field or to a particular project?
- Do they add to project status and improve dissemination of results?
- To what extent are they actually contributing to the work and activities done in the project?

One interesting way forward would be to survey the best European scientists and question them about their experience and expectations of FP projects and other research networks. Other questions could relate to other sources of finance, the added value of the framework programme and, for those who do not participate, the barriers to participation...

Another useful development would be to include questions relating to the role of lead scientists in thematic ex post evaluations of Framework Programmes. It is, incidentally, very likely that the role and effects of lead scientists vary according to research areas.

1.4.2 Use of the FP information system to track project-related publications and systematically assess the scientific excellence of projects

It is of great importance that the Commission puts in place a system that enables the systematic tracking of publications (and also patents) that can be imputed to a given project. At present, final project reports represent the main source of information on published papers. As a result, proper bibliometric analyses are either impossible, or time-consuming and expensive.

A proper information system, could be useful not only for the type of study undertaken here, but also for regular thematic evaluations, and even for continuous monitoring of the quality of FP work.

Of course, such an initiative would be useless without a standardisation of the data entry process: all items identified as relevant should be standardised by distinguishing firstname of author, lastname, institution name, address, country etc., together with a similar standardisation of project bibliography.

Finally, the Commission should encourage the emergence of a shared and homogenous set of indicators and methods, so that bibliometric studies are comparable. In particular, we recommend the use of normalized indicators at the journal level such as the relative citation ratio, as used in this study, to allow comparisons between themes.

1. Introduction

This document is the final report (D6) of the study entitled “Bibliometric profiling of Framework Programme participants” (hereafter referred to as “the study”)[1].

This study has been carried out by Technopolis Group, as part of the EPEC consortium. It was commissioned and monitored by DG Research, Unit A.3: Evaluation and monitoring of programmes. The members of the steering committee are listed in Appendix A.

The report comprises the following sections:

- The construction of the lead scientists publication database: procedure and results;
- Results of lead scientist scientific excellence and visibility through:
  - Evaluation of the overall relative citation performance of FP6 lead scientists;
  - Evaluation of the relative performance of FP6 lead scientists’ papers in contributing to groups of most heavily cited papers;
  - Evaluation of the relative citation performance of FP6 lead scientists themselves as contributors to heavily cited papers;
  - Assessment of FP6 lead scientists co-publication patterns ;
- Lessons learned as to how to improve the evaluation of scientific excellence of the Framework Programme participants.

KEY DEFINITION

The project lead scientist is defined in a request sent to all FP6 project coordinators as the person whose name is most likely to appear on published articles resulting directly from the Project you coordinate.

This report also contains in a separate document: a 3-page management report (Deliverble 7).

1.1 Objectives of the study

1.1.1 General objectives

As set out in the terms of reference, the objective of this study is twofold:

- to use the available information to construct an impact assessment of the scientific output of the various framework programme participants and their affiliated research infrastructures by profiling and assessing their citation profiles;
- to make practical recommendations based on the experience of the study to improve the methodology for evaluation and impact assessment of the scientific output of FP7.

This study assesses the impact of the scientific output of the various framework programme participants by addressing the following key question.

[1] The contract was notified on June 15 2008.

KEY QUESTION

What are the scientific outputs of the lead scientists participating in FP6, and how do they compare with other scientists in the overall scientific community?

The status of the so-called "lead scientists" - *i.e.* FP participants identified by the project coordinator as the most highly-cited authors[2] - raises important issues for both the excellence of FP6 and the strengthening of the European Research Area.

The involvement of first-class scientists is both an indicator of the attractiveness and importance of Framework Programmes, and a necessary condition for the delivery of top-quality work.

This question also raises important ERA-related issues. As well as their obvious role in the advance of the scientific frontier, lead scientists can have important wider influences, such as in facilitating the diffusion of knowledge and strengthening social networks within the EU.

1.1.2 Specific questions

The objectives of the study can be split into a set of key questions to be addressed.

Regarding the excellence of high-level FP6 scientists:

- how successful have the STREPS, NoEs and IPs been in terms of attracting high-quality researchers and research teams?
- how do the publication profiles of FP6 lead scientists compare between areas of the FP?
- how do the publication profiles of FP6 lead scientists compare to the average performance of authors in the same field of science?
- are the most highly-cited FP participants also the most highly cited authors in their country/field?

Regarding the "ERA effect" of high-level FP6 scientists:

- are there any relationships between bibliometric impact and co-publishing?
- do the FP6 lead scientists co-publish more than their counterparts in the overall scientific community?
- are they more inclined to publish outside their organisational or national boundaries?

Lessons learned:

- what simple steps could be taken to improve techniques of bibliometric profiling in FP7?

1.2 Basic assumptions

Providing answers to these questions calls for a number of definitions and methodological approximations:

- In contrast to most of FP6 evaluations, individual projects are not the main unit of analysis in this study; lead scientists are. The latter were defined by DG Research as the "*the person whose name is most likely to appear on published articles resulting directly from the project*";
- The scientific excellence of FP6 lead scientists is assessed in this study through publication and citation indicators. This study does not consider other types of outputs and results of research.

[2] More details on the definition of "lead scientists" and how they were identified is provided in the methodological part of this report.

Other FP6 evaluations have taken a wider - but less deep - assessment of scientific outputs and results, including for instance patents, expertise, norms, public policy knowledge base or public awareness. The added value of the present study lies in the breadth and novelty of the bibliometric methods employed;

- The current information system of FP6 does not allow the systematic and reliable identification of the scientific publications from all FP6 projects. For this reason, this study is based on the whole set of publications of FP6 lead scientists, regardless of whether these publications are connected to a given FP6 project. Although the current information system and reporting procedures are improving, they are not yet adequate for distinguishing between publications which resulted directly from an FP6 project and those derived from other activities such as projects supported by a national programme. Recommendations for an improved information system are provided at the end of this report.

1.3 Types of bibliometric analysis and indicators

In this study, three main types of analysis are performed to assess the publication performance of FP6 lead scientists:

- Assessment of the overall citation performance of lead scientists;
- Assessment of the distribution of lead scientists' citations;
- Assessment of the co-publication patterns of lead scientists.

Theses analyses are based on the use of the following indicators[3]:

- Number of publications: the production of scientific articles can be measured in absolute terms (number of publications) and in shares (of publications, of citations, etc.). The latter can be calculated at various levels (e.g. geographically, as a national, area, continental, or world share).
- Citation analysis: citation analysis, which has been studied in a vast literature, measures the scientific utility, visibility, and international influence of a publication. It depends nevertheless on a number of factors such as the journal and the language of publication, the habits of citation in a certain discipline, the focus of the article (fundamental, applied, methodological, or other). The interpretation of citation data as a direct measure of quality is therefore incorrect (for example an article in English has at least five times more chance of being cited that the same article published in French).
- The "co-publication": the term "co-publication" is used for publications arising from collaboration among different laboratories that results in an article published with several signatures.
- Impact indicators: in bibliometrics, "impact" describes the number of citations per article. Direct impact is the average number of citations per article for a given actor (e.g. a university, a country...), according to a certain counting method and across a defined period of time. Relative impact is a ratio of the absolute impact of the actor for a given field to an average reference impact for that field (for example the average impact for a country, for the world).

  A relative impact above 1 indicates a greater visibility than the reference. This measurement is characteristic of a given level of observation and allows the comparison of one field with another at this level, for example among scientific fields, without translating the heterogeneity of characteristics within the scientific field.

  In order to take account of the heterogeneity of citation behaviour, it is necessary to turn to normalised indicators for scientific fields, for example by discipline or by journal. One form of normalised indicator is the relative citation rate (RCR), which effects a normalisation at the level of the journal. In this approach, relative impact is considered as resulting from combining the hoped-for relative impact with the relative citation rate. The RCR translates a normalisation by scientific journal, which is assimilated to a particular specialty with its own

[3] See Appendix A for a detailed presentation of indocators.

bibliometric characteristics. From this viewpoint, citations received by an author for an article are considered as resulting from two components:

- on the one hand the expected level of citation (the average impact for articles in a given journal);
- and on the other hand the ratio between the citations actually received and the number expected;
- In this way it is possible to characterise the RCR for each actor (institution, country...), which is by construction the ratio of real impact to expected impact. The RCR therefore shows for each actor the over- or under-visibility of this actor considering the journals in which it publishes.

- Bibliometric indicators for the analysis of lead scientist publications by extent of citations:
  - A voluminous body of literature in bibliometrics and evaluation studies is dedicated to the definition and measurement of scientific excellence, and it is valuable in this study to consider the top performers, and in particular to explore how the lead scientists perform against the top scientists in the overall community. This type of distribution analysis can be applied to both numbers of publications and citations.
  - Following the methodology described in Zitt, M., Bauin, S., Filliatreau, G. (2002)[4] and Zitt, M., Ramanana-Rahary, S. and Bassecoulard, E. (2005)[5], we have identified for each lead-scientist country of origin the number of publications which fall in the following groups: 1% top-cited, between the 1% and 4% most cited publications, 10-20%, 20-40%, 40-60%.
  - For each category (country, priority...), we then compared the distribution of the lead scientist publications by extent of citation and the distribution of the publications for the same category in the entire Web of Science. The corresponding indicator is called the activity index (Exhibit 1).

Exhibit 1 Definitions of bibliometric indicators by extent of citation

The **activity index** compares the relative number of lead scientists and scientists in the overall community by the extent of citation (*i.e.* the representation of FP6 lead scientists in the top X% most cited scientists in the overall community).

The top 1% of scientists is defined as the “excellence class”.

An activity index higher than 1 indicates that the representation of lead scientists publications in the top X% most cited publications is greater than that of the overall scientific community.

The analyses performed in this study are complementary; they have their respective strengths and weaknesses (**Exhibit 2**). Basically, the analyses differ according to:

- The database used (OST database, or the WOS without additional processing);
- The type of indicators used (simple ones such as traditional impact factors, or the more sophisticated Relative Citation Ratio);
- The unit of analysis (lead scientist publications or lead scientists themselves).

[4] Zitt M., Bauin S., Filliatreau G. (2002), Bibliometric of Public Research Organisation – 1997, Production coopérative d’indicateurs interinstitutionnels de production scientifique, OST – Ministry of Research (in French).

[5] Zitt M., Ramanana-Rahary S. and Bassecoulard E. (2005). Relativity of citation performance and excellence measures: From cross-field to cross-scale effects of field-normalisation. Scientometrics, Vol. 63, No 2 (2005) 373-401).

Exhibit 2 Strengths and weaknesses of the different types of analysis performed in this study

Type of analysis	Main indicators	Strengths and weaknesses
Evaluation of the citation performance of lead scientist publications	Observed Impact Expected impact Relative Citation Rate	☺ Normalisation by Journals ☺ Lead scientists matched in the OST publication database, which is continuously quality checked and processed (corrections of addresses, etc. see *above*) ☺ Analyses according to OST proprietary classification of fields (8 broad scientific fields), 30 sub-fields... ☹ Unit of analysis is publications, not lead scientists
Evaluation of the distribution of citation performance of lead scientist publications	Number of lead scientists publications by class of citations Activity index by class of citation (top 1%, top 10%, etc.)	☺ Distribution analysis allows the benchmarking of the lead scientist publications against the top 1% most cited publications ☺ Lead scientists matched in the OST publication database, which is continuously quality checked and processed (corrections of addresses, etc. see *above*) ☹ Unit of analysis is publications, not lead scientists
Evaluation of the distribution of citation performance of lead scientist publications	Number of highly cited lead scientists	☺ Unit of analysis is lead scientists ☹ RCR cannot be applied, less sophisticated indicators ☹ Data are taken directly from the WOS, not from the OST database ☹ No comparison with the overall scientific community is possible, because of the problem of duplicate names on the level of the overall WOS database (hence no activity index for instance)

2. The construction of the lead scientists publication database: procedure and results

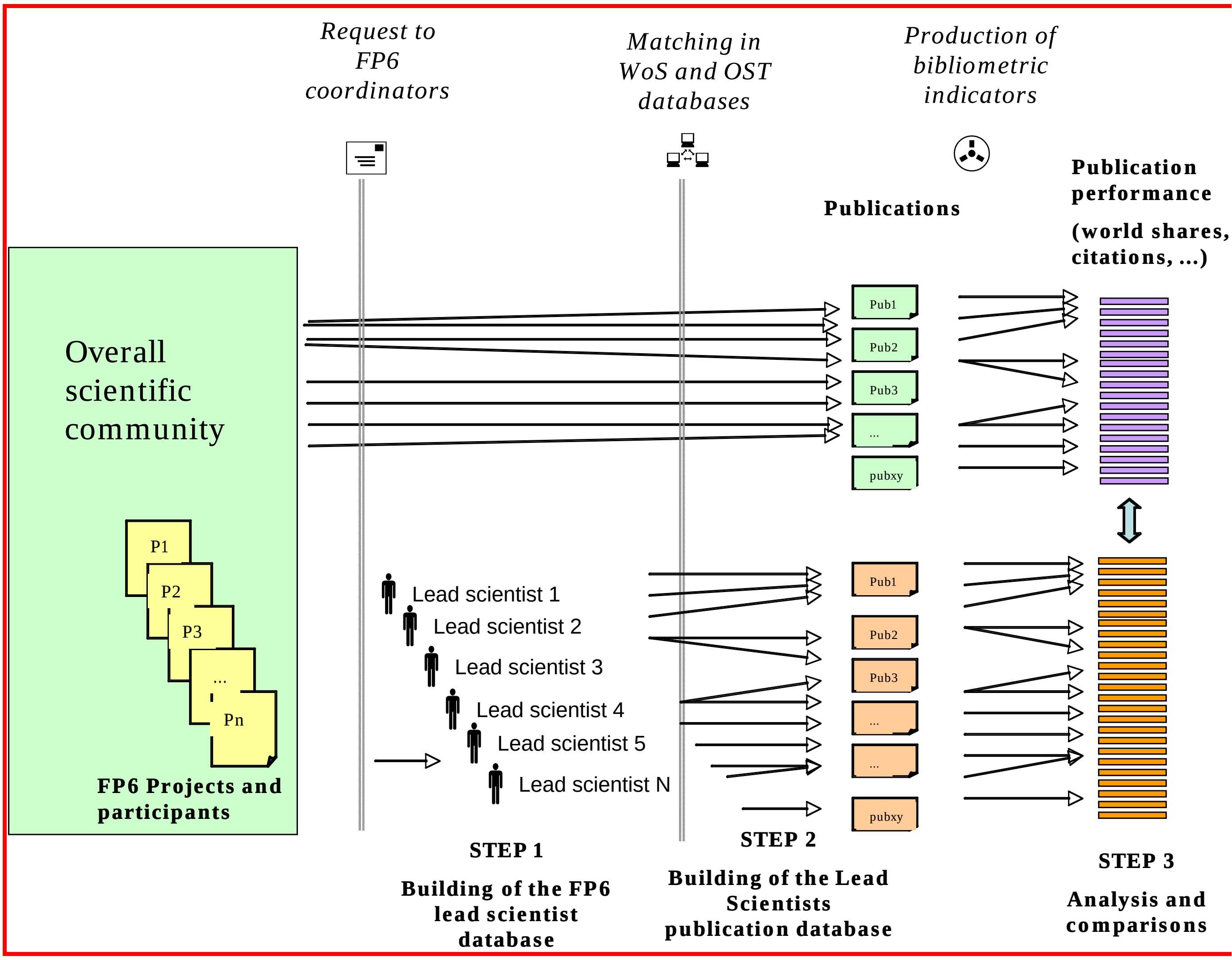
This section sets out the steps involved from the identification of the FP6 lead scientists to the assessment of their bibliometric performance.

A purpose-built 3-step methodology is used in this study:

- Step 1: Identification of FP6 lead scientists and analysis of the resulting "FP6 lead scientist database";
- Step 2: Identification of FP6 lead scientists' publications and analysis of the resulting lead scientist publication database;
- Step 3: Production of relevant indicators to compare the bibliometric profiles and performance of lead scientists with those of their counterparts in the overall scientific community.

The methodology is illustrated in **Exhibit 3**.

Exhibit 3 Overall view of the process: from the FP6 project database to the FP6 lead scientists publication database



2.1 STEP 1: Building the database of FP6 lead scientists

Lead scientists were identified through a peer nomination process. More specifically, using an online survey, projects coordinators were asked to select lead scientist(s) in their project based on the above definition. A database of nearly 2000 lead scientists was produced on this basis.

2.1.1 Request to FP6 project coordinators to identifiy FP6 lead scientists

The FP6 project coordinators were approached first by the European Commission (EC) through a request by email, then by EPEC consultants through an online survey.

2.1.1.1 Results of the initial request

Prior to launching the tender, the EC sent an email to all FP6 project coordinators in order to collect contact details of lead scientists (see Exhibit 4). Replies from coordinators were forwarded to the consultants.

Based on this set of emails, EPEC consultants have:

- built a database of lead scientists. At this stage, 825 lead scientists (one per project) were identified, covering 1760 projects (see Exhibit 45 - page 71);
- identified the missing data in the contact details of each lead scientist (see Exhibit 46 - page 71).

Further to the processing of the initial data provided by the EC, the number of projects with at least one named lead scientist rose from 825 to 992.

2.1.1.2 Results of the online survey

It was decided with DG Research to collect more lead scientist contacts in order to strengthen the analysis. An online survey was designed to reach:

- all project coordinators of "large" FP6 instruments (NoEs and IPs) – regardless of whether they responded or not to the initial request – in order to gather two more lead scientists;
- STREPS project coordinators who did not answer the initial DG Research email.

These coordinators were kindly requested to log on to the survey and provide details on their projects' lead scientists, using the same definition as that in the initial EC request. The survey remained online for 4 weeks (from the end of July to the end of August 2008), with two reminders sent to non-respondents in order to maximise the response rate.

Based on responses to this second request, the names and related contact details for 1681 projects were collected. This represents nearly 53% of the total number of FP6 projects.

KEY RESULTS

Contact details of lead scientists for 1681 projects have been collected. These lead scientists represent nearly 53% of the total number of FP6 projects.

Exhibit 4 presents the results of the process of collection of lead scientists contact details.

Exhibit 4 Summary of the results of lead scientist identification – by instrument

Instrument	IP	NOE	STREP	Total
Task 1: Number of Projects with data for at least one named lead scientist (Results of DG Research initial email)	229	43	720	992
Task 2: Number of projects with data for at least one lead scientist (Results of EPEC second email, without double counting)	232	84	373	688
Total number of projects in FP6	**703**	**171**	**2273**	**3147**
Distribution of projects in FP6 by instrument	**22%**	**5%**	**72%**	**100%**
Total number of projects with data for at least one lead scientist (without double counting)	**461**	**127**	**1093**	**1681**
Distribution of projects with data for at least one lead scientist (without double counting) by instrument	**27%**	**8%**	**55%**	**100%**
Percentage of projects in FP6 with data for at least one named lead scientist	**66%**	**74%**	**48%**	**53,4%**

It is worth noting that 47 % of coordinators declared they were the lead scientist of the project they coordinated (Exhibit 5).

Exhibit 5 Self-nomination of project coordinators as lead scientist – by instrument

	Total number of projects with at least one named lead scientist	Number of projects with self-nomination of coordinator as lead scientist	Percentage of projects with self-nomination of coordinator as lead scientist
IP	461	176	38%
NOE	127	61	48%
STREP	1093	530	48%
Total	**1681**	**783**	**47%**

2.1.2 Lead scientist database analysis

The lead scientists' database was analysed in order to identify potential biases related to:

- the FP6 instruments (STREPS, NoEs, IPs) of the lead scientists' projects;
- the FP6 priorities under which the lead scientists' projects fall;
- the country of origin of lead scientists.

2.1.2.1 Number of FP6 lead scientists by instrument

Exhibit 6 shows that the percentage of FP6 projects with data for at least one lead scientist varies between 48% for STREPs to 74% for NOEs. The average – all instruments taken together – is 53%. The average number of lead scientists by project is 1.1.

Exhibit 6 Distribution of lead scientists– by instrument

Instrument	IP	NOE	STREP	Total
Distribution of projects in FP6 by instrument	22%	5%	72%	100%
Total number of lead scientists identified (with requested information)	**671**	**164**	**1093**	**1930**
Distribution of lead scientists identified (with requested information) by instrument	**35%**	**8%**	**57%**	**100%**
Percentage of FP6 projects with data for at least one name of lead scientist	66%	74%	48%	53%
Average number of lead scientists identified by project (with requested information)	**1.5**	**1.3**	**1.0**	**1.1**

The comparison between the distribution of projects in FP6 by instrument and the distribution of lead scientists identified (with requested information) by instrument shows there is no significant bias in the analysis in relation to distribution by instrument (STREPS, NoEs, IPs).

KEY RESULTS

Usable contact details of 1930 lead scientists have been collected. 53% of FP6 projects have provided at least one lead scientist for the study.

2.1.2.2 Number of lead scientists by priority

Exhibit 7 presents the results of the different steps of the process of collection of lead scientists' contact details by priority. All but two priorities (Science & society and others) have at least one lead scientist identified for more than 40% of their constituent projects.

Exhibit 7 Distribution of lead scientists– by priority

Priority	Total number of projects with data for at least one lead scientist		Total number of projects in FP6	
	N	%	N	%
1 LIFE SCIENCE HEALTH	341	20%	475	15%
2 IST	329	20%	880	28%
3 NMP	264	16%	369	12%
4 AERO SPACE	77	5%	191	6%
5 FOOD	76	5%	103	3%
6 ENERGY	61	4%	94	3%
6 GLOBAL	84	5%	131	4%
6 OTHERS	6	0%	116	4%
6 TRANSPORT	58	3%	114	4%
7 CITIZENS	67	4%	115	4%
EURATOM	22	1%	37	1%
INCO	79	5%	144	5%
POLICY SUPPORT	212	13%	362	12%
SCIENCE SOCIETY	5	0%	16	1%
Total	**1681**	100%	**3147**	100%

Source: Technopolis Group – OST.

The comparison between the distribution of FP6 projects by priority and the distribution of lead scientists (with requested information) by priority suggests that the set of identified lead scientists are broadly representative in this respect.

2.1.2.3 Number of lead scientists by country of origin

The Exhibit 8 presents the distribution of identified lead scientists by country, comprising 38 different nationalities. Five countries (Germany, UK, France, Italy) account for more than 62% of the total number of projects with data for at least one lead scientist and 64% of the total number of lead scientists with required information.

This geographical distribution of lead scientists reflects the distribution of scientists in the overall European scientific community.

The five above-mentioned countries account for 57% of the European share of publications in 2006. Exhibit 8 shows that the distributions of lead scientists by country and of European shares of publications are similar: for all countries represented in the database of lead scientists, the difference between the share of lead scientists and the European share of publications never exceeds 3.5 percentage points.

Exhibit 8 Distribution of lead scientists – by country

Country of origin	Total number of projects with data for at least one lead scientist Nb	%	European share of publication %
Germany	316	18,8%	18,3%
UK	254	15,1%	18,7%
France	191	11,4%	13,1%
Italy	172	10,2%	10,5%
The Netherlands	120	7,1%	5,4%
Spain	85	5,1%	8,6%
Belgium	71	4,2%	2,8%
Sweden	64	3,8%	3,9%
Switzerland	64	3,8%	
Greece	58	3,5%	2,1%
Denmark	46	2,7%	2,9%
Austria	43	2,6%	2,0%
Finland	30	1,8%	2,7%
Norway	25	1,5%	
Portugal	29	1,7%	1,3%
Israel	26	1,5%	
Ireland	17	1,0%	0,9%
Poland	13	0,8%	3,6%
Hungary	10	0,6%	1,1%
Slovenia	8	0,5%	0,5%
Czech Republic	5	0,3%	1,5%
China	4	0,2%	
Bulgaria	4	0,2%	0,4%
Iceland	3	0,2%	
Russia	3	0,2%	
Slovakia	3	0,2%	0,5%
Turkey	3	0,2%	
Argentina	2	0,1%	
Estonia	2	0,1%	0,2%
USA	2	0,1%	
Canada	1	0,1%	
Japan	1	0,1%	
Kenya	1	0,1%	
Lithuania	1	0,1%	0,2%
Luxembourg	1	0,1%	0,3%
Morocco	1	0,1%	
Romania	1	0,1%	0,6%
South Africa	1	0,1%	
Total	**1681**	**100,0%**	**100,0%**

Source: Technopolis Group – OST.

2.2 STEP 2: Building of the database of publications of lead scientists

In order to improve the reliability of the resulting publication database, the identified lead scientists were matched successively with the Web of Science online publication database (hereafter 'WOS online' / Reuters-Thomson Web of Science© database) and with the proprietary OST WOS database. The lead scientist publication database is the result of this 2–step process.

2.2.1 Matching lead scientists in publication databases

2.2.1.1 Matching lead scientists using the WOS online publication database

Matching the lead scientist database with the WOS online allows us to identify the lead scientists' publications. This process consisted of the following:

- A semi-automatic matching by crossing (textual analysis[6]) the fields of the lead scientists database (names, organisation, zip codes, city, and country) and the corresponding fields in the Web of Science database online, by using the Reuters-Thomson Web of Science© electronic interface. When the three different fields matched, all associated publications between 2002-2007 were collected (Id_publication_code as the primary key of each document and related information);
- A filtering process was used to solve the problem of duplicate names: zoom of publications when the number of publications is higher than 50 by lead scientist in order to refine the sets of identified publications by analysing the complete first name of the lead scientist, the name of institution...;
- A manual matching for a set of projects, as a quality check on the results of the two first steps.

Nearly 69 000 lead scientists' publications have been identified in the WOS online database for the years 1997 to 2007.

Exhibit 9 Total documents matched with WOS online (1997-2007 and 2000-2006)

On line WOS database	1997-2007	Total number of documents 2000-2006
Number of documents	68 978	58 491

Source: Technopolis Group – OST.

KEY RESULTS

Nearly 69 000 lead scientists' publications have been identified in the WOS online database for the years 1997 to 2007.

The priorities of Life Science & Health, NMP, IST and Food have the highest numbers of publications matched in WOS on line[7].

As expected - given the size of national research system and the number of identified lead scientists - Germany, United-Kingdom, France and Italy contribute the highest number of publications. This result holds for all scientific fields and especially for Clinical Medicine, Physics, Chemistry, and Biology & biochemistry.

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[6] The approach is based on a multiple step procedure of query building and tests using the following search script as a first selection: (AU=(Levi F*) AND (CI=(VILLEJUIF) OR ZP=(F-94807)) AND CU=France) OR (AU=(Barthes-Labrousse M*) AND (CI=(Vitry Cedex) OR ZP=(F-94407)) AND CU=France) OR..., where AU=last name of lead scientist, CI=City address' institution of Lead scientist, ZP=ZIP code address' institution of lead scientist, and CU=country's institution of lead scientist.

[7] The distribution of documents matched on WOS online, by priority and country for the period (2000-2006) is given in Appendix I.

2.2.1.2 Matching using the OST WOS database

Once the publications of the sample of lead scientists have been identified and the corresponding keys collected in the WOS online, the resulting set of publications was searched and localised in the OST WOS database.

The main added value of the OST WOS database lies in the permanent updating and cleaning of the publication data (especially the authors' addresses, which are essential for the identification of publications in the database). Moreover, the OST database filters out the types of documents which are not relevant to bibliometric analysis. This is particularly important for Social Science and Humanities (SSH), which include very diverse types of documents that are not conducive to reliable bibliometric analysis. The OST WOS database also provides indicators for different modes of counting (namely presence and fraction counting modes – see Appendix G).

Basically, the OST WOS database filters out the following types of documents:

- documents with non-exploitable addresses;
- documents for which the matching between the two databases is impossible (problems of Identification keys);
- Social Sciences, Arts and Humanities publications: this means that the results for the priorities Social Sciences, Citizens and Inco must be interpreted with cautions;
- documents that are not articles, letters, notes, reviews or proceedings.

The result of this process is shown in Exhibit 10.

At this stage, over 48 000 lead scientist publications had been identified. The following exhibit presents the results of the matching and subsequent filtering in the OST WOS.

Exhibit 10 Total publications matched with WOS online and OST databases, 1997-2007 and 2000-2006

	1997-2007	Total number of publications 2000-2006
On line WOS database	68 978	58 491
OST WOS database	60 869	58 491
OST filtered	**50 271**	**48 213**

Note: Data are provided in presence counting mode (here, without double counting co-publications) and for individual years.

The set of 48 213 lead scientist publications constitutes the basic reference set for this study (hereafter referred to as the "lead scientists publication database"). All indicators presented in this study are based on this set of publications.

KEY RESULTS

The final lead scientists publication database consists of over 48 000 publications. This set of lead scientist publications is the basic reference set for this study.

2.2.2 Lead scientists publication database analysis

The following paragraphs present the structure of the lead scientists publication database according to:

- the number of lead scientists publications by year of publication (cf. **Exhibit 11**);
- the FP6 priorities (Exhibit 12 and Exhibit 13);
- the FP6 instruments (Exhibit 14).

2.2.2.1 Number of lead scientists publications by year of publication

As for the overall scientific community (and in the Web of science), the number of lead scientist publications increases between 2000 and 2006 (Exhibit 11).

Exhibit 11 Breakdown of lead scientist publications by year of publication

Year	Total number of documents	
	N	%
2000	5 703	11.8%
2001	5 845	12.1%
2002	6 173	12.8%
2003	6 754	14.0%
2004	7 387	15.3%
2005	8 034	16.7%
2006	8 317	17.3%
Total number identified	**48 213**	**100.0%**

Source: Technopolis Group – OST.
Note: Data are provided in presence counting mode (here, without double counting of co-publications) and for individual years.

2.2.2.2 Distribution of lead scientist publications by priority

Exhibit 12 and Exhibit 13 show that Life science, IST and NMP priorities account for the bulk of publications in the lead scientists publication database. This distribution reflects both the underlying distribution of lead scientists in the database and the well-documented variation in publication propensity in different scientific fields, especially life science.

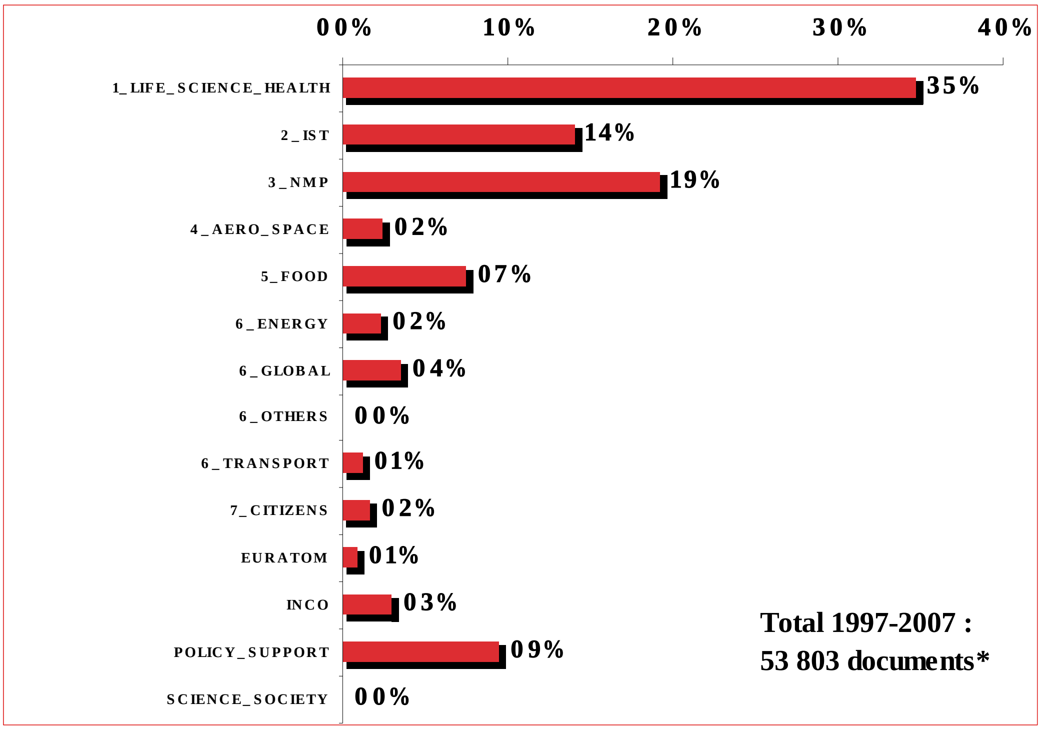
It is worth noting that this does not represent a bias in the analysis, since all indicators are produced by field of science and priorities. Overall indicators on the whole set of publications, regardless of fields of science or priorities, are not relevant.

Exhibit 12 Breakdown of lead scientist publications by priority (2002, 2004, 2006)

Priority	Lead scientist publications 2002		Lead scientist publications 2004		Lead scientist publications 2006		Number of lead scientists	
	N	%	N	%	N	%	N	%
1 LIFE SCIENCE HEALTH	2 296	35.1	2 764	35.0	2 982	32.7	435	22.5
2 IST	867	13.3	1 098	13.9	1 297	14.2	380	19.7
3 NMP	1 339	20.5	1 489	18.8	1 828	20.1	320	16.6
4 AERO SPACE	161	2.5	186	2.4	212	2.3	80	4.1
5 FOOD	480	7.3	568	7.2	685	7.5	85	4.4
6 ENERGY	159	2.4	181	2.3	212	2.3	78	4.0
6 GLOBAL	226	3.5	294	3.7	310	3.4	93	4.8
6 OTHERS	*7*	*0.1*	*6*	*0.1*	*15*	*0.2*	5	0.3
6 TRANSPORT	55	0.8	119	1.5	163	1.8	58	3.0
7 CITIZENS	116	1.8	116	1.5	137	1.5	75	3.9
EURATOM	51	0.8	81	1.0	65	0.7	22	1.1
INCO	182	2.8	255	3.2	277	3.0	79	4.1
POLICY SUPPORT	593	9.1	746	9.4	923	10.1	215	11.1
SCIENCE SOCIETY	1	0.0	1	0.0	6	0.1	5	0.3
Total*	6 533	100.0	7 904	100.0	9 112	100.0	1930	100.0

Source: Technopolis Group – OST.
Note: Data are provided in presence counting mode (i.e. with double counting of co-publications) and for individual years.

Exhibit 13 Breakdown of lead scientists publications by priority (1997 to 2007)



Source: Technopolis Group – OST.
Note: Data are provided in presence counting mode (i.e. with double counting of co-publications) and for individual years.

2.2.2.3 Number of lead scientists publications by year and instrument

The publications of lead scientists in STREPs account for 55% of publications in the database (see Exhibit 14). IP and NOE lead scientists publications respectively account for 12% and 32%. This distribution largely reflects the initial distribution of lead scientists in the database.

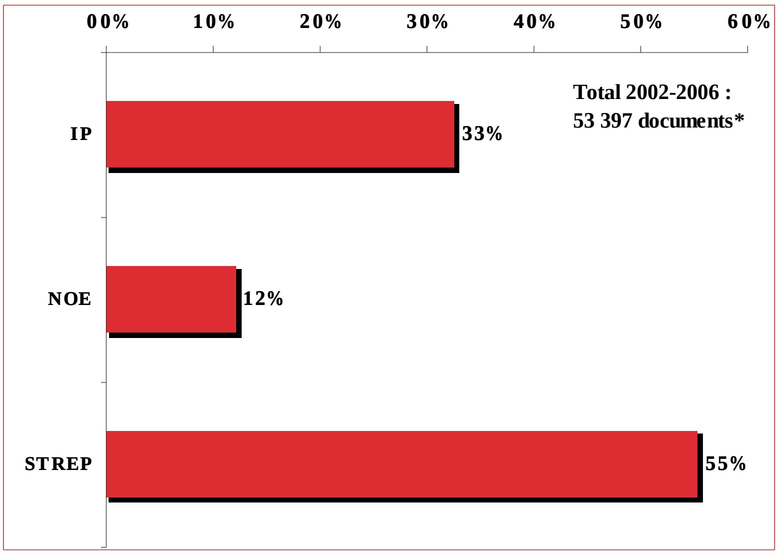
The average number of publications per lead scientist is almost equal for STREPS and IPs (around 25 publications per lead scientist), and is higher for NoEs (about 40).

Exhibit 14 Breakdown of lead scientist publications by instrument (2002, 2004, 2006, and Total 1997 to 2007)

Instrument	Lead scientist publications 2002 to 2006		Number of lead scientists	
	N	%	N	%
IP	17,380	32.5%	671	34.8%
NOE	6,473	12.1%	164	8.5%
STREP	29,544	55.3%	1095	56.7%
Total*	**53,397**	**100.0%**	**1930**	**100.0%**

Source: Technopolis Group – OST.
Note: Data are provided in presence counting mode (i.e. with double counting of co-publications) and for individual years.

Exhibit 15 Breakdown of lead scientist publications by instrument (total 2002 to 2006)



Source: Technopolis Group – OST.
Note: Data are provided in presence counting mode (i.e. with double counting of co-publications) and for individual years.

2.3 STEP 3: Production of bibliometric indicators

Bibliometric indicators are based on the final lead scientist database.

2.3.1 Comparisons with the overall scientific community

The indicators are used to compare the lead scientists publication performance against that of the overall scientific community (the "baseline"). The most meaningful comparisons are by scientific field, geographical origin of author, and FP6 priority.

This comparison is possible since lead scientists do not account for a significant share of scientists, publications or citations in the overall scientific community[8].

There are about 6.2 million (full time equivalent) researchers in the world according to the OST annual report, of which FP6 lead scientists account for 0.03%. However, the OST figure includes all researchers, regardless of whether they are "active", i.e. regardless of whether they actually publish or not. Another measure of the number of researchers is the number of authors in the WOS database. However, the problem of duplicate names makes it hard to come to a precise and reliable figure. When *all* duplicate names have been excluded from the database, there are 1.5 million "authors" (*i.e.* distinct names). With duplicate names, the figure rises to nearly 4.7 million "authors" (*i.e.* names), on average, over the period 2000-2006. The number of distinct authors is between these 2 figures... Hence, lead scientists accounted for between 0.04% and 0.14% of (publishing) researchers in 2006.

In terms of publications, lead scientists account for about 0.4% of the total, which is also very small and therefore does not affect the comparisons. For the priority that accounts for the largest share of publications - life science and health - lead scientists contribute only 0.1% of total world publications (see Exhibit 16).

Exhibit 16 Lead scientists share of World publications (per thousand) for all scientific fields taken together, by priority and year of publication (2002-2006)*

Priority / **Years** **per thousand**	**2002**	**2003**	**2004**	**2005**	**2006**	**2002-2006**
LIFE SCIENCE HEALTH	1.30	1.27	1.27	1.29	1.26	1.28
NMP	0.87	0.91	0.94	0.95	0.97	0.93
IST	0.62	0.68	0.71	0.74	0.74	0.70
POLICY SUPPORT	0.35	0.36	0.38	0.40	0.42	0.38
FOOD	0.33	0.31	0.30	0.31	0.31	0.31
GLOBAL	0.13	0.14	0.14	0.14	0.13	0.13
INCO	0.12	0.12	0.13	0.13	0.14	0.13
ENERGY	0.13	0.12	0.12	0.11	0.13	0.12
AEROSPACE	0.11	0.10	0.10	0.10	0.10	0.10
CITIZENS	0.07	0.06	0.06	0.05	0.05	0.06
EURATOM	0.04	0.04	0.04	0.05	0.04	0.04
TRANSPORT	0.04	0.04	0.04	0.03	0.04	0.04
OTHERS	*0.00*	*0.00*	*0.00*	*0.01*	*0.01*	*0.00*
SCIENCE SOCIETY	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Total	**4.10**	**4.13**	**4.22**	**4.30**	**4.33**	**4.22**

Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

8 It was not possible to exclude the lead scientists publications from the overall scientific community publications in the OST database.

In terms of citations, the lead scientists share is nearly 0.7% of the world total (higher than the lead scientists share of world publications). Lead scientists' highest share by priority is in life science and health, with 0.35% of the world citations.

KEY RESULTS

FP6 lead scientists (nearly 2000) represent a very small proportion of total world researchers, total world publications and total world citations. This allows us to use publications and citations of the overall world scientific community for comparison with those of lead scientists, even though lead scientists are themselves part of the overall community.

Exhibit 17 Lead scientists share of World citations (per thousand) for all scientific fields taken together, by priority and year of publication*

Priority / Years per thousand	2002	2003	2004	2005	2006	2002-2006
LIFE SCIENCE HEALTH	3.6	3.5	3.5	3.5	3.4	3.5
NMP	1.0	1.0	1.1	1.3	1.3	1.1
IST	0.6	0.7	0.7	0.7	0.6	0.6
POLICY SUPPORT	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.6*
FOOD	0.4	0.4	0.4	0.4	0.4	0.4
GLOBAL	0.1	0.2	0.2	0.2	0.2	0.2
ENERGY	0.2	0.1	0.2	0.2	0.2	0.2
INCO	0.1	0.1	0.1	0.1	0.1	0.1
AEROSPACE	0.1	0.1	0.1	0.1	0.1	0.1
CITIZENS	0.1	0.1	0.1	0.1	0.1	0.1
EURATOM	0.0	0.0	0.0	0.0	0.0	0.0
TRANSPORT	0.0	0.0	0.0	0.0	0.0	0.0
OTHERS	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
SCIENCE SOCIETY	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Total	**6.9**	**6.9**	**7.0**	**7.2**	**7.2**	**7.0**

Source: Technopolis Group – OST.
Note: *Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]). Windows of citations: 2 years.

3. Evaluation of the relative citation performance of FP6 lead scientists

3.1 Bibliometric indicators to assess the relative citation performance of lead scientists

One of the added values of this study lies in the development and use of improved bibliometric indicators.

The most common measure of excellence is based on highly-cited papers[9]. Further analyses often consider actual or observed impact, typically based on the estimated importance of the journal in which an article is published, as measured by the average numbers of citations of articles published in it (the 'impact factor') [10]. The impact factor is, however, a rather poor indicator, due to large variations in the number of citations between individual articles in a given journal. In addition, the selection of small numbers of prestigious journals is likely to yield unreliable results.

In order to avoid these problems, the principal indicator used to assess citation performance in this evaluation is the Relative Citation Rate (RCR). Essentially, the impact factor (or expected impact) is a proxy measure of the competition for access to the best journals; the RCR (observed impact/expected impact) is a measure of relative impact within each journal[11].

The definition and mode of interpretation of the RCR is given in Exhibit 18. The RCR for lead scientists is calculated by dividing the number of citations of their identified articles by the 'expected number', equal to the sum (over all journals in which they have published) of the number of their publications in a given journal, multiplied by the average number of citations received by articles in that journal.

Thus FP6 lead scientists' performance is here measured by comparing their citation levels with those of the scientific community as a whole. The advantage of the RCR lies in it being free of any "journal effect", which is the major bias of classical citation performance indicators.

Another – more classic – segmentation method, involving comparisons of numbers of most highly cited papers, is presented in Section 6.

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[9] See for example Towards a European Research Area, EU-STI, Key figures 2002.

[10] "Impact factor" was the first measure of the average impact at the journal level (E. Garfield, 1972, Citation as a tool in journal evaluation, Science, 178 (4060) 471-479).

[11] A. Schubert, T. Braun (1986) Relative Indicators and Relational Charts for Comparative Assessment of Publication Output and Citation Impact, Scientometrics, 9(5-6), 281-291.

Exhibit 18 The main bibliometric indicators to assess the citation performance

The *publication share* indicator (expressed as a percentage) is defined as: the number of publications of an actor (institution, country, etc.) as a share of the total number of publications within a certain frame of reference (world, for example).

$$\text{Publication share (\%)} = \frac{\text{number of publication by actor}}{\text{number of reference publications}} * 100$$

In 2004 EU 27's share of world scientific publication production (all fields included) was nearly 36% (Total number of publications in 1999 – OST Perimeter: 720,000) At the end of the 1990's, EU 27's world share was close to 34% (Total number of publications in 2004 – OST Perimeter: 760,000).

Over a specified time period including year N of publication, the *two-year citation share* (expressed as a percentage) is defined as: the number of citations received over a given time by all the publications of a given actor (institution, country, etc.) proportional to the number of citations over the same time period by all publications within the given frame of reference (world, for example).

$$\text{Two - year citation share (\%) for year N} = \frac{\text{number of citations received by actor during years N and N+1}}{\text{number of citations received by all reference during years N and N+1}} * 100$$

The ***relative citation rate indicator* (expressed as a positive number) is defined as**: the relative impact index of an actor (institution, country. etc.) in a given period of time and within a given frame of reference (world for example) proportional to the actor's expected impact index for the same period and within the same frame of reference. The relative citation rate expresses the individual impact of publications compared to the average impact of the journals where the publications appeared. For a given actor, it shows whether the actor is cited more or less than the average of the journals in which the actor's publications appear. It is an indicator that takes into specific account the choice of journals by the actor for its publications, and it enables an actor to identify possible over-visibility or under-visibility of its publications compared to the journal overall.

$$\text{Relative citation rate} = \frac{\text{two-years relative impact index}}{\text{two-years expected impact index}}$$

Note: when the RCR indicator is greater than 1 the actor enjoys a greater visibility than the average of all articles published in the journals in which its articles appear(or less than average if the indicator is less than 1).

The ***two-years relative impact index* (expressed as a positive number) is defined as**: the citation share received by the publications of an actor (institution, country. etc.) over a specified time (for example two years) within a given frame of reference (the World, for example), proportional to its share of publications within the same frame of reference.

$$\text{Relative impact index} = \frac{\text{two-years citation share of the actor in a given frame of reference}}{\text{publication share of the actor in the same frame of reference}}$$

Note: the relative impact index is normalised so that at the scale of the frame of reference the indicator is equal to 1. When the indicator is greater than 1 it signifies that the actor enjoys a greater visibility than the average for all actors in the frame of reference (or less than average if the indicator is less than 1).

The ***two-years expected impact index* (expressed as a positive number) is defined as**: the share of expected citations of the publications of an actor (institution, country. etc.) over a given period of time (for example 2 years) and within a given frame of reference (world for example) proportional to the share of these publications in the same frame of reference. The expected impact takes into specific account the impact of the journals in which the actor's publications appear. It is equivalent to the relative impact that an actor would obtain if in each of the journals where its articles are published these articles received the average of citations received for all articles published in the journal.

$$\text{Expected impact index} = \frac{\text{share of expected citations at two-years by the actor in a given frame of reference}}{\text{share of publications by the actor within the same frame of reference}}$$

Note: the expected impact index is normalised; therefore at the scale of the frame of reference this indicator is equal to 1. When the indicator is greater than 1, the actor has a greater expected visibility than the average for the frame of reference (or less than average if the indicator is less than 1).

Source: OST.

3.2 Citation performance of FP6 lead scientists publications by FP6 priority

The two-year relative citation rate of lead scientists is nearly 1.2 (see Appendix J[12]), indicating that, overall, lead scientists' publications have a better

citation performance than the average of all articles published in the same group of journals.

KEY RESULTS

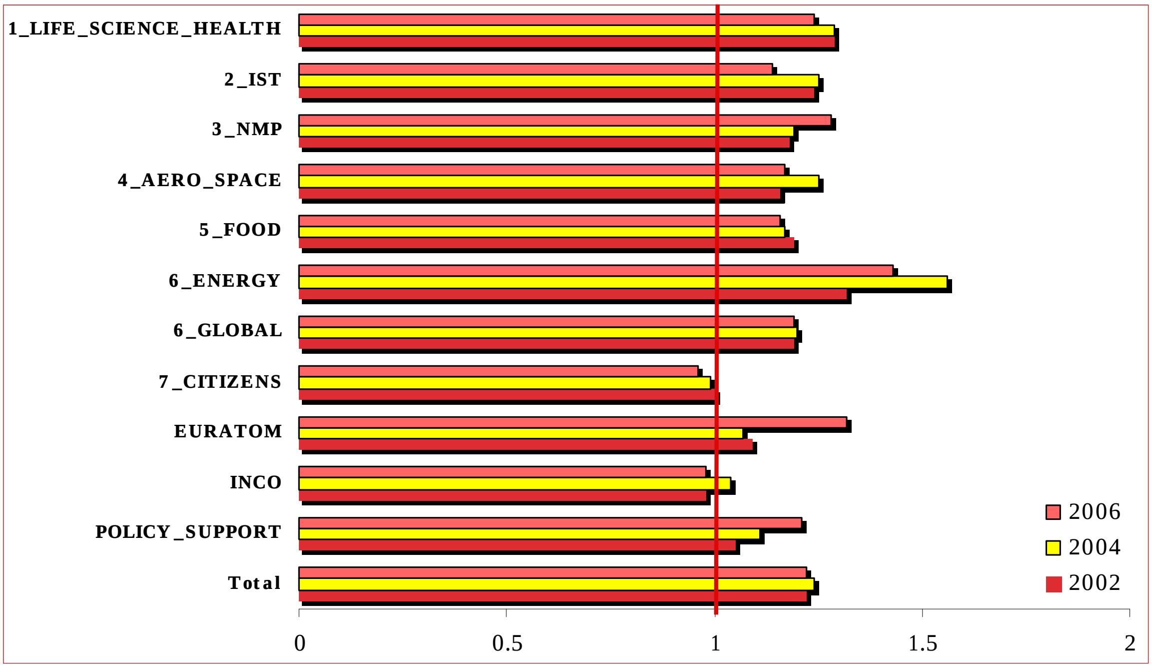
FP6 lead scientists' publications have a greater citation performance than all articles published in the same group of journals. This result is valid for all lead scientists taken together, and for most of the individual FP6 priorities.

This overall result is valid for the following priorities for the period 2002-2006: Energy, EURATOM, NMP, Life science & Health, Policy support, Global change, Aerospatiale & Space, Food and IST – see Exhibit 19.

In three priorities, lead scientists together have a citation performance lower than, or equal to, that of the average. These are Inco and two priorities related to social sciences and humanities (Citizens and Science and society).

Meanwhile, these underperformances are rather a limitation of the OST bibliometric database (that excludes documents published in the journals related to social sciences, arts, and humanities), than a poor performance of lead scientists.

Exhibit 19 Relative Citation Rate of lead scientists, by priority – year 2002, 2004, 2006



Source: Technopolis Group – OST.

Note: When the RCR indicator is greater than 1 the lead scientists enjoys a greater citation performance than the average of all articles published in the journals in which their articles appear.

[12] Appendix J shows the two components of the relative citation rate: the two-years relative (observed) impact index and the two-years expected impact index.

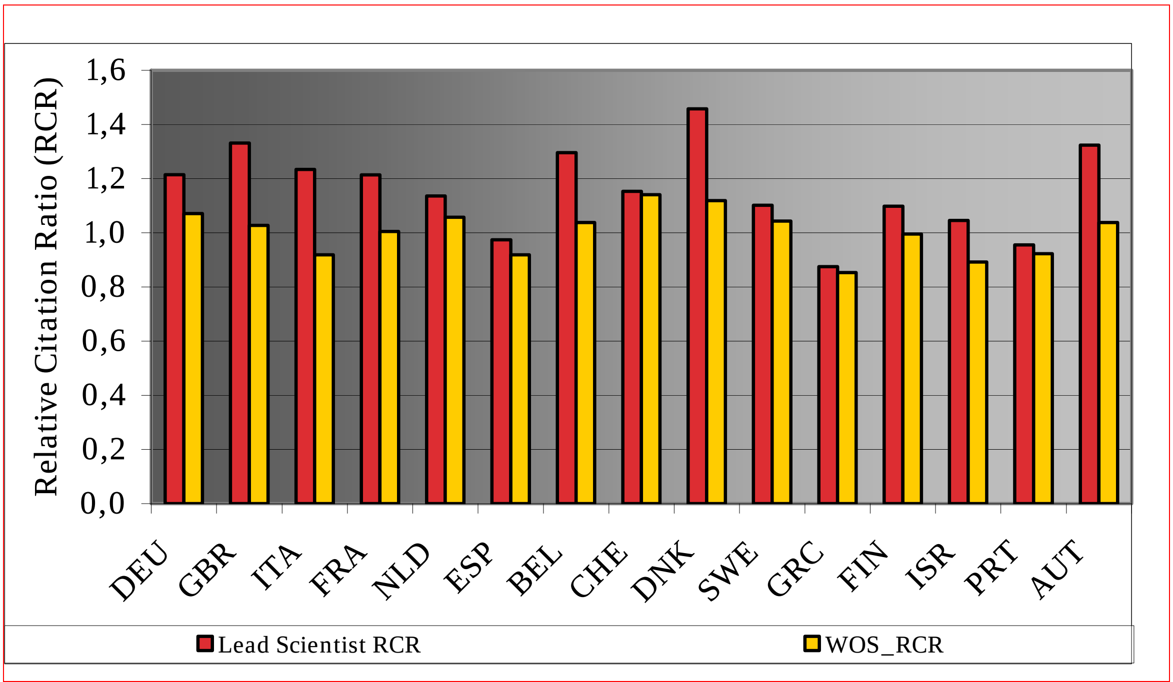
3.3 Citation performance of FP6 lead scientists publications by country of origin

In 2006, the publications of the lead scientists from individual countries each had a RCR greater than 1, except for Spain, Portugal, and Greece (see Exhibit 20, Appendix J - Exhibit 55, and Appendix K).

KEY RESULTS

Lead scientists of almost all European countries have a citation performance greater than the average of their counterparts in their national scientific community, the exceptions being Spain, Portugal and Greece.

Exhibit 20 Lead scientists' 2–year Relative Citation Rate (RCR), all priorities taken together (2006)



Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]). Data presented for the countries with at least 50 publications in the lead scientists database of publication for 2006.

Results by country and FP6 priority, where the number of publications is sufficient,[13] are provided in Appendix L. At this detailed level of analysis, the citation performances of lead scientists vary according to priorities. In the Life science & Health priority, the eight countries for which the number of publications is sufficient (Germany, United Kingdom, The Netherlands, France, Italy, Sweden, Switzerland, and Belgium) pass the "relative citation rate test": the relative citation rate (RCR) of all these countries is higher than 1. This result indicates that the lead scientists of these countries in the priority Life science & Health have stronger citation performance than their counterparts (for each country and for the same set of journals). This is especially true for Danish, Austrian, UK, Italian and Belgium lead scientists, who have a RCR near to, or greater than, 1.2. In most other priorities, the lead scientists outperform their national counterparts, as for the French lead scientists in the energy priority, and (to a lesser degree) the German lead scientists in the global change priority.

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[13] This calculation cannot be performed for all priorities and countries because of low numbers of publications. A minimum of 50 publications in each class (country/priority) is necessary to obtain reliable results.

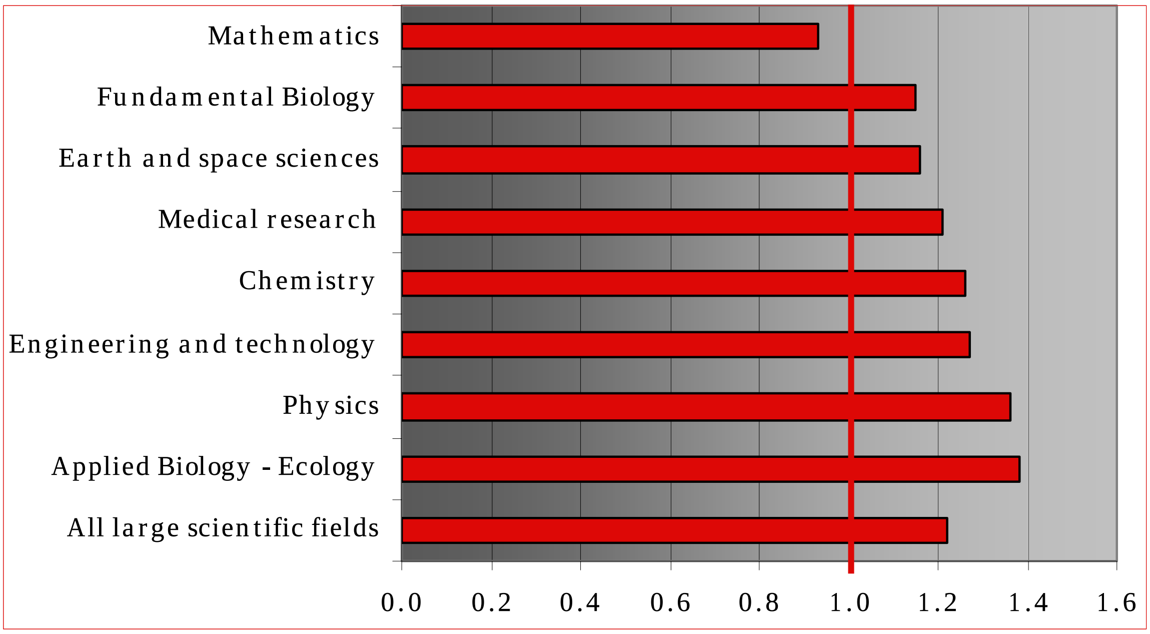
3.4 Citation performance of FP6 lead scientists publications by scientific field and sub-field

The citation performance of FP6 lead scientists is now analysed by scientific field and sub-field, and compared to that of world and EU27 averages of scientists in the same fields and sub-fields.

3.4.1 Classification in 8 broad scientific fields

Exhibit 21 shows clearly that the FP6 has attracted the best scientists in all fields but mathematics for which number of publications is not relevant and analyses must be performed with cautions.

Exhibit 21 Relative Citation Rate, by broad scientific field (2006)



Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

KEY RESULTS

Using a classification by 8 scientific fields, FP6 lead scientists from all priorities have a citation performance higher than the world and EU average in most areas

Exhibit 22 shows the FP6 priorities and scientific fields for which the lead scientists have a relative impact rate by priority higher than their counterparts:

- in the priority Life Science & Health, publications of lead scientists have a greater citation performance in fundamental biology, chemistry, and earth and space sciences;
- in the priority IST, publications of lead scientists have a greater citation performance in physics, and engineering technology;
- in the priority NMP, publications of lead scientists have a greater citation performance in engineering technology, chemistry, and physics;
- in the priority Food and policy support, publications of lead scientists have a greater citation performance in applied biology-ecology, and medical research.

Exhibit 22 Relative Citation Rate, by broad scientific field (2006)

	Fundamental Biology	Medical research	Applied Biology - Ecology	Chemistry	Physics	Earth and space sciences	Engineering and technology	Mathematics	All broad scientific fields
All priorities taken together	**1.15**	**1.21**	**1.38**	**1.26**	**1.36**	**1.16**	**1.27**	**0.93**	**1.22**
LIFE SCIENCE & HEALTH	1.21	1.22	**1.33**	**1.32**	1.03	**1.26**	1.10	0.97	**1.24**
NMP	1.12	1.02	0.53	**1.30**	**1.45**	1.20	**1.37**	0.77	**1.28**
IST	0.91	1.02	1.06	1.07	**1.38**	0.90	**1.29**	0.88	**1.14**
POLICY SUPPORT	**1.10**	**1.37**	1.41	1.05	1.31	1.34	1.16	0.80	**1.21**
FOOD	1.01	**1.20**	**1.68**	0.93	1.13	1.09	1.13	1.76	**1.16**

Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]). Data in bold character: number of publication higher than 50. Data in Italic character: number of publications lower than 50.

Exhibit 21b presents a comparison between the relative impact rates of the lead scientists (a proxy of the lead scientist impact factor) and the relative impact rates of authors in the Web of Science (average scientist impact factor). When the ratio is higher than 1, one can consider the lead scientist have a better impact factor than the average in the considered scientific field.

This exhibit clearly shows that the FP6 lead scientists from France, Germany, Italy, United Kingdom, and The Netherlands have the tendency to publish more than the average scientist in their respective scientific field in Journals with a higher impact factor. This is particularly the case in the two following scientific fields: medical research, and fundamental biology.

Exhibit 22b Comparison between the lead scientists and the average scientist impact factors, by broad scientific field (2006)

Country	Chemistry	Engineering and technology	Fundamental biology	Medical research	Physics
France	**1,1**		**1,4**	**1,8**	
Germany	0,9	1,0	**1,2**	**1,5**	1,0
Italy	**1,2**	**1,1**	**1,2**	**1,4**	
The Netherlands			**1,3**	**1,2**	
United-Kingdom	**1,2**	0,9	**1,2**	**1,4**	**1,2**

Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]). Data only calculated for the categories with a number of lead scientist publications higher than 50.

KEY RESULTS

FP6 lead scientists have the tendency to publish more than the average scientist in their respective scientific field in Journals with a higher impact factor. This is particularly the case in medical research and fundamental biology.

3.4.2 Classification in 32 scientific sub-fields

These results are also valid with a more detailed disciplinary classification (32 scientific sub-fields): except for the engineering and mining subcategory, the observed impact ratios[14] are higher than the EU's relative impact for each scientific sub-field (Exhibit 23).

This is particularly true in the following scientific sub-fields: Medical, Agronomy, Plant Biology; Multidisciplinary Journals; Mathematics; ICT-Electronics; Physics; Health Care Sciences & others.

KEY RESULTS

Using a classification in 32 scientific sub-fields, FP6 lead scientists have a citation performance (observed impact) higher than the World and EU average in most scientific sub-fields.

[14] For methodological reasons, RCRs are not calculated at the sub-field level in the OST database. The indicators used in this section are the lead scientists observed impact ratios and the observed impact ratios of the EU27 countries in the Web of Science. The comparison (see final column) of these two indicators provides meaningful results as to whether lead scientists outperform their counterparts in EU27 countries. However, it should be borne in mind that these indicators are not normalised at journal level, as would be the case with RCR.

Exhibit 23 Relative impact rates by scientific sub-field (2006)

Scientific Sub fields	Distribution of lead scientists' publications (%)	Relative Impact rates (2006)		
		All lead scientists	UE27 Web of science reference	Lead scientists' higher impact (%)
Physics, Condensed matter	10.7	1.7	1.1	35%
Biochemistry	8.9	1.6	1.0	38%
Materials, Polymers	6.9	1.7	1.1	33%
Microbiology & Virology, Immunology	5.7	1.3	0.9	30%
Medical, Others	5.6	2.3	0.9	59%
Neurosciences, Behavioural Sciences	5.5	1.5	0.9	39%
ICT-Infocomm	4.0	1.2	1.0	10%
Physics, Particles & Fields, Nuclear	3.7	1.3	1.1	15%
Biotechnology, Genetics	3.6	1.5	1.0	33%
Energy, Chemical engineering	3.5	1.5	1.0	28%
Cardiology & Pneumology	3.4	1.5	1.0	36%
Pharmacology, Toxicology	2.5	1.5	1.1	29%
Health Care Sciences & others	2.5	1.6	0.9	42%
Endocrinology	2.4	1.3	1.0	24%
ICT-Electronics	2.3	1.7	1.0	44%
Geosciences	2.2	1.5	1.0	32%
ICT-Robotics/Artificial Intelligence	2.2	1.3	1.0	20%
Bioengineering	2.1	1.3	1.0	22%
Agro-Food	2.1	1.8	1.2	31%
Physics, Multidisciplinary Journals	2.0	1.9	1.2	39%
Chirurgy, Gastroenterology, Urologie	2.0	1.3	1.0	26%
Chemistry, Multidisciplinary Journals	2.0	1.8	1.2	34%
Cancerology	1.9	1.5	0.9	41%
Environment	1.8	1.3	1.0	22%
Multidisciplinary Journals	1.7	1.9	1.0	48%
Chemistry, Analytical	1.6	1.6	1.0	33%
Chemistry, Organic, Inorganic, Nuclear	1.5	1.2	1.0	15%
Agronomy, Plant Biology	1.5	2.3	1.2	48%
Ecology, Marine biology	1.4	1.3	1.1	11%
Reproduction, Development Biology	1.1	1.5	1.0	35%
Engineering civil, Mining	0.7	0.9	1.2	-30%
Mathematics	0.5	1.9	1.1	45%
Astronomy, Astrophysics	0.5	1.1	1.0	10%
All scientific sub-fields	**100.0**	**1.7**	**1.0**	39%

Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

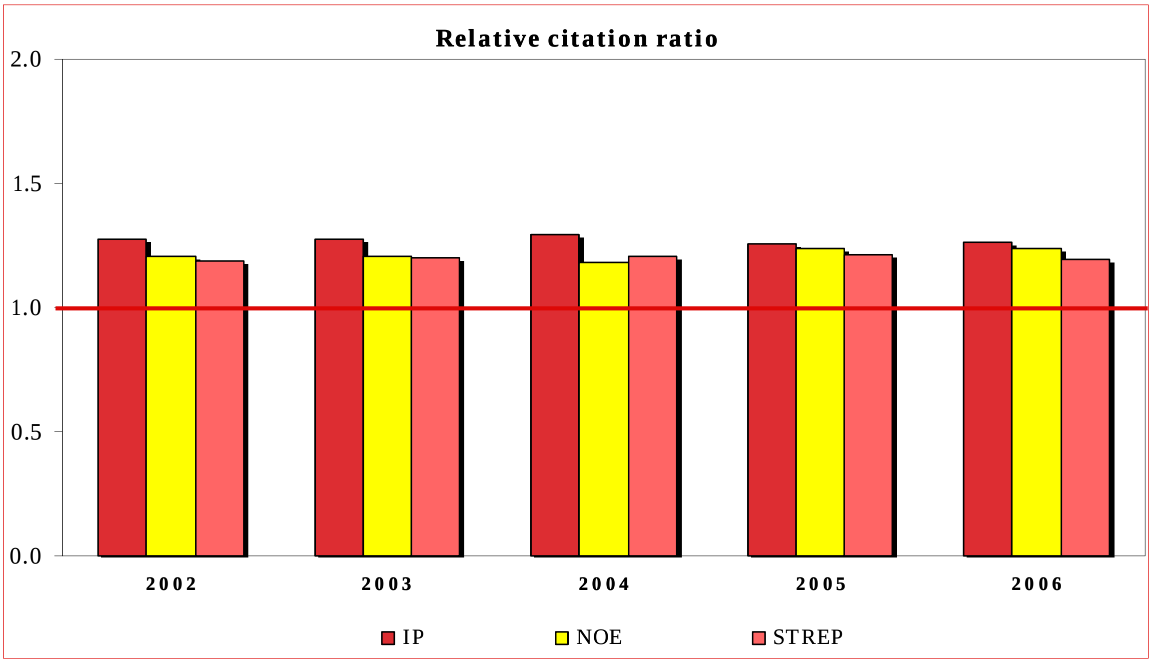
3.5 Citation performance of FP6 lead scientists' publications by instrument

FP6 lead scientists have a greater citation performance than the world average in all instruments, whatever the publication year considered (see Exhibit 24).

KEY RESULTS

FP6 lead scientists have greater citation performance than the world average in all instruments.

Exhibit 24 Relative Citation Rate of lead scientists, by instrument (2002 to 2006)



Source: Technopolis Group – OST.
Note: When the RCR indicator is higher than 1 the lead scientists enjoys a higher citation performance (visibility) than the average of all articles published in the same journals.

All instruments attract the best scientists in their relevant communities for almost all countries from which lead scientists originate (see Appendix M – page 85). The breakdown by instrument and country allows us to go more deeply into the lead scientists' performance by country of origin: it shows that the relatively low performance of the Spanish, Portuguese and Greek lead scientists largely derives from STREPs, rather than from IPs and NoEs.

KEY RESULTS

All instruments attract the best scientists in their relevant communities for almost all countries from which lead scientists originate.

4. Evaluation of the distribution of publications by extent of citation

In this section, distribution analyses are performed in order to provide some complementary (and more in-depth) indicators of FP6 lead scientists' performance. This section focuses on the distribution of citation performance, allowing comparisons in terms of, for example, the top 1% most cited publications.

4.1 Overall distribution of FP6 lead scientist publications by class of citation

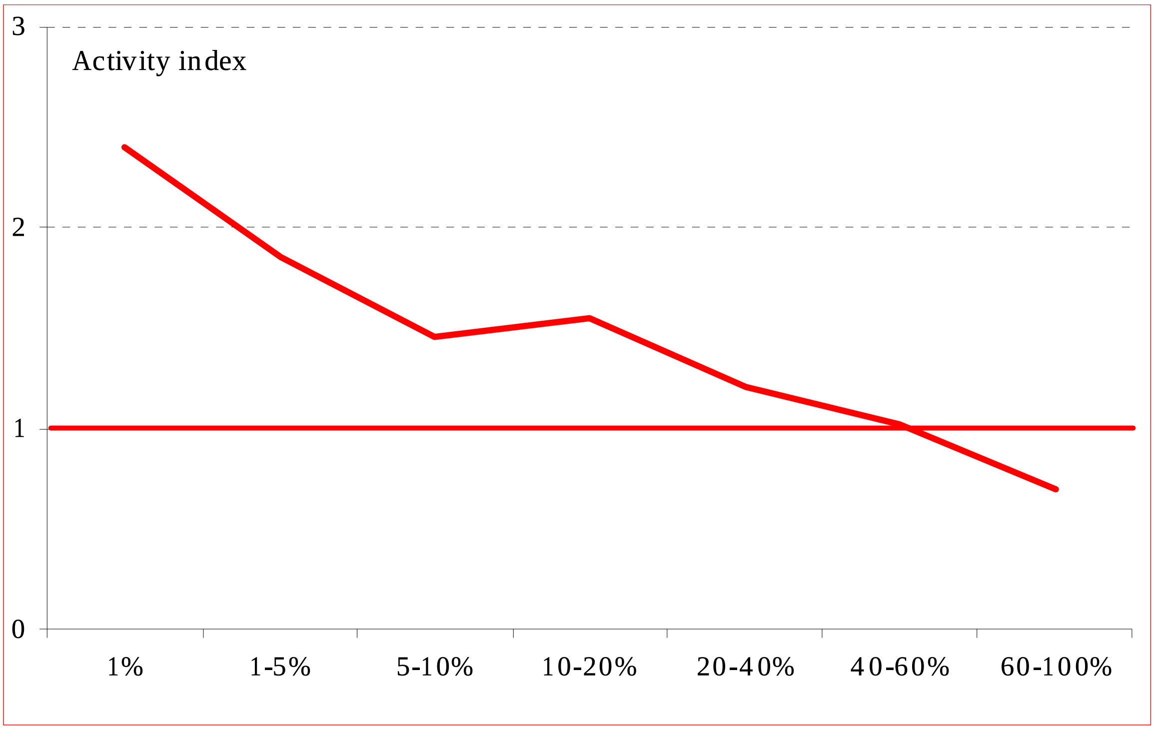
Taking all countries together, the percentage of lead scientists' publications belonging to the five top classes of citation is higher than the percentage of scientists publications belonging to these classes of citation in the overall scientific community. The percentage of FP6 lead scientists publications in the top 1% class of citation is nearly 3 times higher than the world average (see Exhibit 25).

This type of curve is completely consistent with the traditionally distribution of publications of Nobel prizes by class of citations.

KEY RESULTS

FP6 lead scientists have greater citation performance than the world average in the five first classes of citation, and particularly in the top 1% most-cited publications. For all countries together, the percentage of FP6 lead scientists publications in this "class of excellence" is 2 to 3 times higher than the world average.

Exhibit 25 Average activity index of FP6 lead scientist publications by class of citation (2006)



Source: Technopolis Group – OST.
Note: When the activity index is higher than 1 the lead scientists enjoys a higher citation performance (visibility) than the average in the corresponding class of citation.

4.2 Distribution of FP6 lead scientist publication by class of citation and country

In this section, we present an analysis of the distribution of lead scientist citation performance by class of citation for 15 EU countries[15]. For each of these countries, we compare the relative number of lead scientists' publications with publications from the overall community by class of citations (*i.e.* the level of citation performance of the top X% most cited scientists in the overall community). The indicator used to capture this ratio is the activity index, as described above.

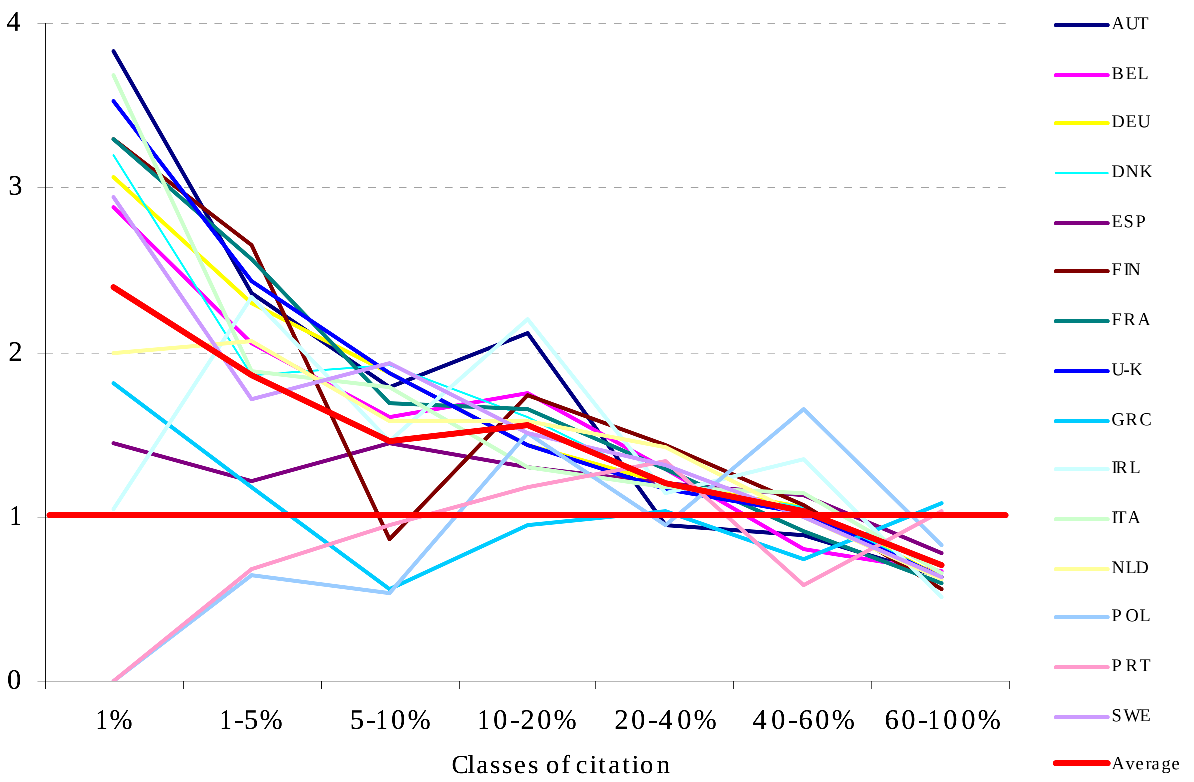
For all 15 EU countries except Poland and Portugal, the lead scientists have greater citation performance than the World average in the highest classes of citation (see Exhibit 26). The activity indexes of FP6 lead scientists for most countries are higher than 1, particularly in the top 1% class of citation.

[15] The data are not relevant for the other countries as regards the number of publications (Nb < 50 publications).

KEY RESULTS

For all 15 EU countries except Poland and Portugal, the lead scientists have greater citation performance than the World average in the highest classes of citation.

Exhibit 26 Activity index of FP6 lead scientist publications by class of citation and by country (2006)



Source: Technopolis Group – OST.
Note: When the activity index is higher than 1 the lead scientists enjoys a higher citation performance (visibility) than the average in the corresponding class of citation.

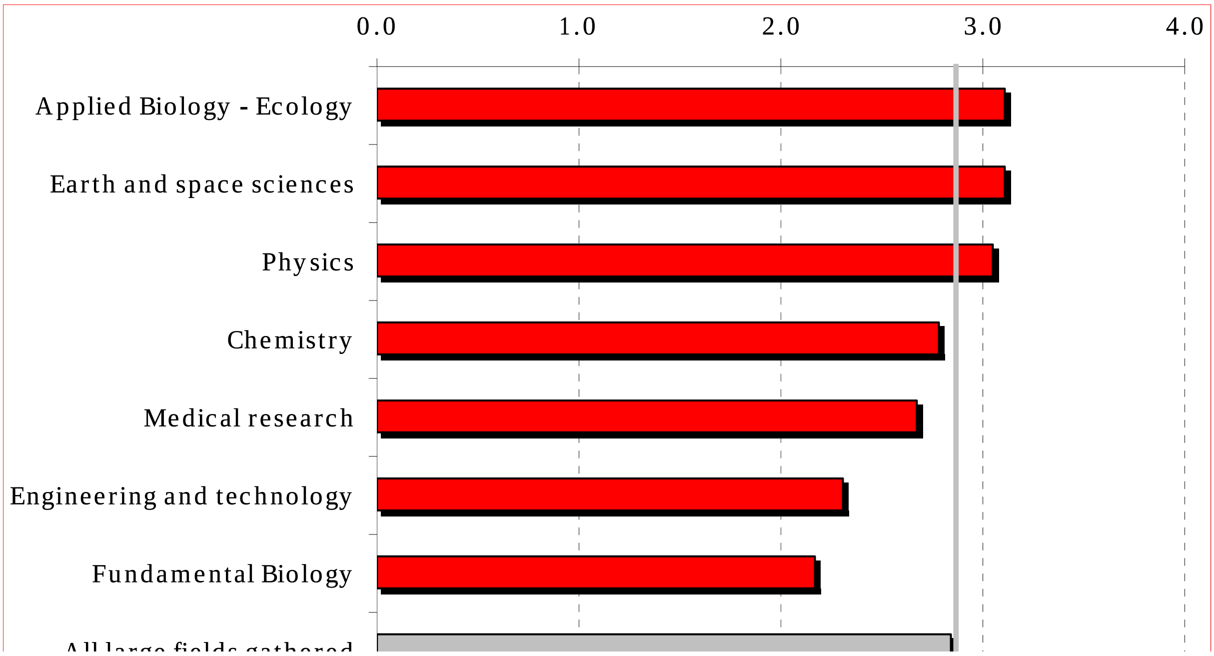
4.3 Distribution of FP6 lead scientist publications by extent of citation and scientific field

These results are valid for all scientific fields, and particularly for Applied biology & Ecology, Earth & Space Sciences, and Physics.

KEY RESULTS

For all scientific fields together, FP6 lead scientists have a citation performance better than the world average in the top 1% class of citation. In three fields of science the citation performance of lead scientists is more than three times greater than the world average: Applied biology & Ecology, Earth & Space Sciences, and Physics.

Exhibit 27 Activity index of FP6 lead scientist publications in the top 1% class of citation and by broad field of science (2006)



Source: Technopolis Group – OST.
Note: When the activity index is higher than 1 in a broad Field, the lead scientists in this field have a higher citation performance (visibility) than the average in top 1% class of citation.
(2006=mean [2004, 2005, 2006]).
Data for mathematics are not relevant.

4.4 Distribution of FP6 lead scientist publications by class of citation and priority

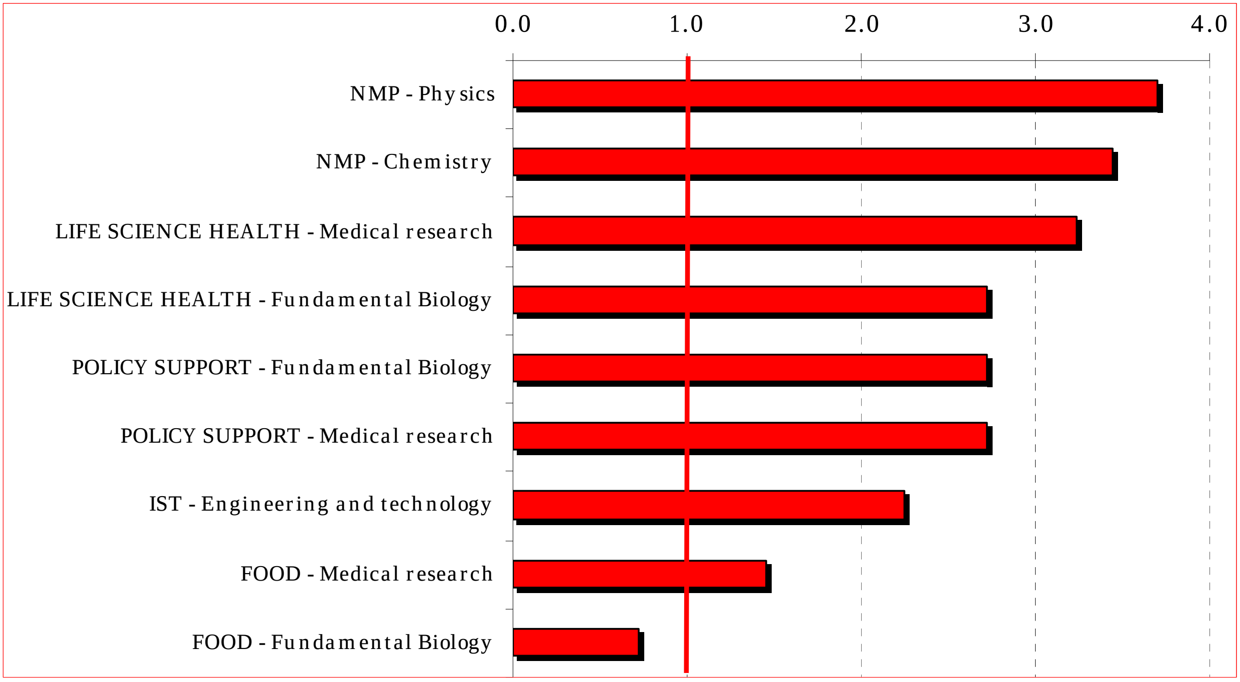
In all but one priority (Food), there are relatively more lead scientists in the excellence class of the top 1% most cited world scientists, compared with their counterparts in the overall community, by broad scientific field (see Exhibit 28). The broad scientific fields identified for each priority are those where the number of publications exceeds 20. Where fewer than 2o publications are involved, indicators are deemed to be insufficiently reliable.

In two priorities and their associated field of science (NMP-physics, NMP-chemistry and Life science & Health), the activity index is above 3, indicating a threefold over-representation of lead scientists in the most highly cited class of publications.

KEY RESULTS

All but one priority have relatively more lead scientists in the class of the top 1% more cited world scientists than their counterparts in the overall community, by relevant broad field of science.

Exhibit 28 Activity index of FP6 lead scientist publications in the top 1% class of citation and by priority (2006)



Source: Technopolis Group – OST.
Note: When the activity index is higher than 1 in a broad scientific field, the lead scientists in this field enjoy a higher citation performance (visibility) than the average in the top 1% class of citation.
(2006=mean [2004, 2005, 2006]).

5. The distribution of most heavily cited lead scientists

So far, we have considered indicators of performance of the whole group of lead scientists. The good results overall could reflect general high performance across lead scientists, or could derive from a limited number of "super" lead scientists.

In this section, we consider the distribution of lead scientists contributing to the top cited publications: what percentage of lead scientists in the database have published at least one of the top cited publications? To answer this question, the primary unit of analysis has to be the lead scientists themselves, rather than their publications.

Whereas indicators presented above were calculated from the OST database, calculations in this section are performed using the WOS database, without the additional processing performed by OST[16].

5.1 Bibliometric indicators for the analysis of lead scientist by class of citations

Using the data collected through the matching of lead scientists in the WOS online publication database, we estimated the distribution of lead scientists in the Reuters-Thomson scientific classification by 22 scientific fields, and by two classes of citation: the top 1% and top 10% most cited publications. A distribution analysis similar to that previously carried out with respect to publications is performed here with respect to lead scientists. Here, for instance, we consider the number of lead scientists that publish at least one publication in the top 1% or top 10% most cited publications in the corresponding fields of science or country.

However two differences should be noted:

- Lead scientists in this analysis are matched only in the WOS database. As a result, it is possible to provide some information on SSH, while bearing in mind the limitations of such statistics. Also, the WOS database is not processed and quality controlled as the OST database;
- When the unit of analysis is authors, not publications, the problem of duplicate names makes comparisons with the "overall community baseline" impossible, since the overall community cannot be processed at this level. Hence, contrary to the distribution of publication by class of citations, no activity index comparing the number of lead scientists and the number of overall community scientists in a given class of citation can be provided.

5.2 Overall distribution of FP6 lead scientist by class of citation

Exhibit 29 shows that 203 lead scientists (11% of the total) have at least one publication in the (world) top 1% class of citation. Similarly, 723 lead scientists (37% of the total) have at least one publication in the top 10% most cited publications.

Exhibit 29 Distribution of lead scientists in the two classes of citation top 1% & 10%

	Total Number of lead scientists	Percentage of lead scientists in the top 1% by field of science	Percentage of lead scientists in the top 10% by field of science
Total	**100%**	**11%**	**37%**
Total (distinct lead scientists)	**1930**	**203**	**723**

Source: Web of Science online – estimation Technopolis Group.

[16] See the pros and cons of the different types of analysis in **Erreur ! Source du renvoi introuvable.**.

KEY RESULTS

More than 200 lead scientists (11% of the total) have at least one publication in the top 1% most heavily cited papers, and more than 700 lead scientists (37% of the total) have at least one publication in the top 10%.

5.3 Distribution of FP6 lead scientists by class of citation and field of science

Exhibit 30 highlights the scientific fields with the highest percentage of lead scientists with at least one publication in the top 1% and 10%:

- Physics, Clinical Medicine, Social Sciences-general, Agricultural Sciences, Biology & Biochemistry, Chemistry have more than 10% of lead scientists with at least one publication in the top 1% most-cited publications;
- Clinical Medicine, Space Science, Biology & Biochemistry, Physics, Social Sciences-general, Agricultural Sciences, Plant & Animal Science, Materials Science, Chemistry, Psychiatry/Psychology have more than 35% of lead scientists with at least one publication in the top 10% most-cited publications.

Exhibit 30 Distribution of lead scientists in the top 1% & 10% most cited papers, by field of science

	Number* of lead scientists by field of science	Percentage of lead scientists in the top 1% by field of science	Percentage of lead scientists in the top 10%, by field of science
Agricultural Sciences	175	12%	38%
Biology & Biochemistry	644	12%	42%
Chemistry	550	11%	37%
Clinical Medicine	605	18%	52%
Computer Science	290	3%	23%
Economics & Business	31	3%	6%
Engineering	602	9%	33%
Environment/Ecology	237	4%	22%
Geosciences	152	9%	30%
Immunology	249	3%	24%
Materials Science	276	8%	38%
Mathematics	51	4%	24%
Microbiology	208	4%	26%
Molecular Biology & Genetics	362	8%	30%
Neuroscience & Behavior	212	4%	31%
Pharmacology & Toxicology	218	5%	24%
Physics	369	22%	41%
Plant & Animal Science	240	8%	38%
Psychiatry/Psychology	98	7%	35%
Social Sciences, general	128	13%	39%
Space Science	86	9%	45%
Multidisciplinary	313	32%	78%
All field of science together	Not relevant*	11%	37%
Total (Distinct lead scientists)	**1930**	**213**	**723**

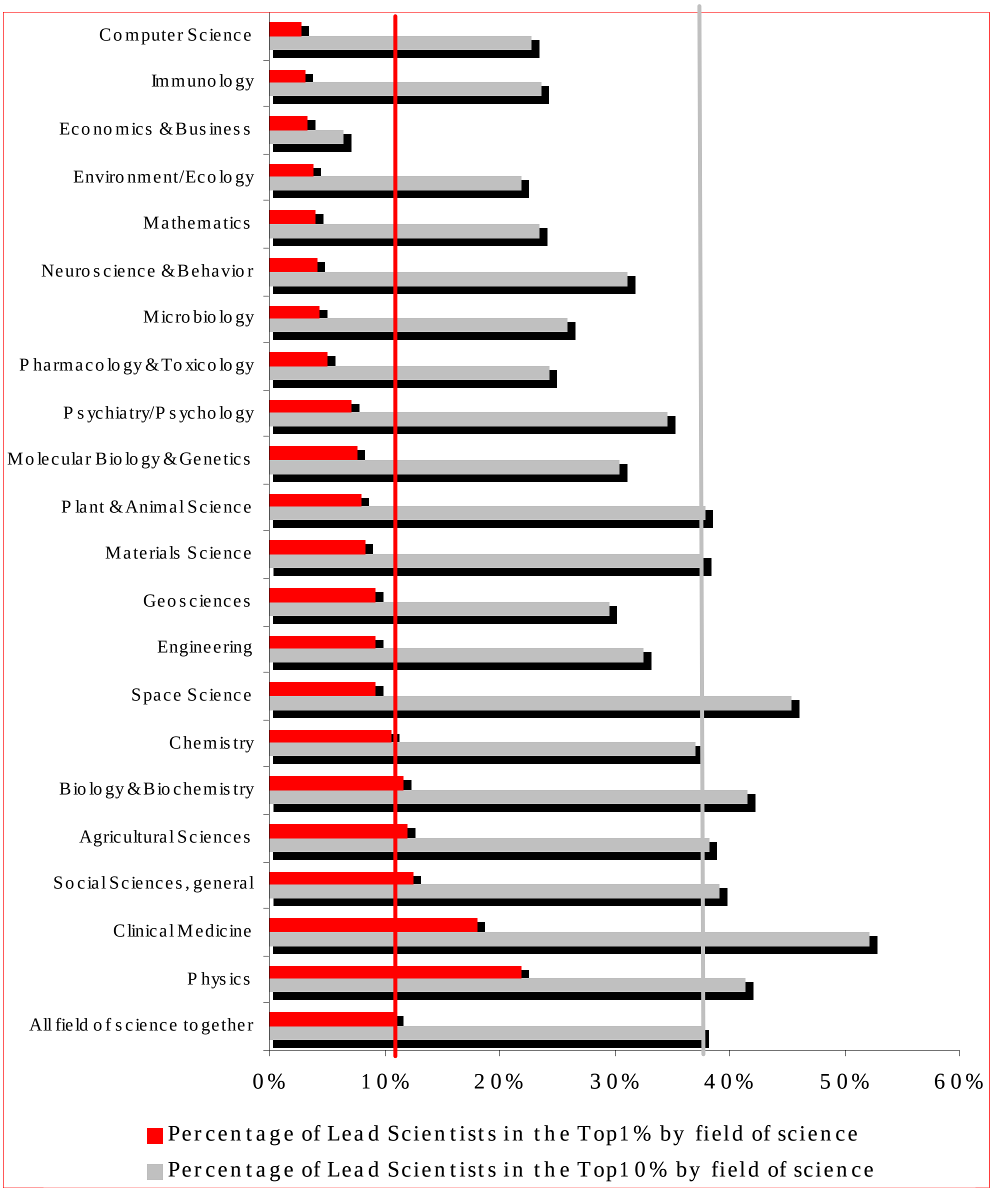
Source: Web of Science online – estimation Technopolis Group.
Note: *possible double counting.

KEY RESULTS

Physics, Clinical Medicine, Social Sciences-general, Agricultural Sciences, Biology & Biochemistry appear as the

scientific fields with the highest percentage of lead scientists with at least one publication in the world top 1% & 10% most cited publications.

Exhibit 31 Distribution of lead scientists in the top 1% and top 10% classes of citation



Source: Web of Science online – estimation Technopolis Group.

Appendix O shows that a high proportion of lead scientists have produced at least one publication among the top 1% most cited world publications in the field. This is especially true for physics and clinical medicine in Belgium and Ireland for instance.

6. Assessment of FP6 lead scientists co-publication patterns

6.1 The main bibliometric indicators of scientific cooperation

Bibliometrics has for a long time been used to measure collaboration between scientists[17]. Infometric and social network analyses are helpful for describing relationships between elements of scientific networks (actors, themes, etc.). Their application, in particular citation and co-word studies, goes back to the 1970s and 1980s[18].

We concentrate in this study on typical actor-actor networks (co-authorship). The main indicators are: the share of publications involving collaboration (co-publications); the share involving international collaboration, the share involving EU27 collaboration; and the share involving national collaboration.

It is worth noting that a high intensity of collaboration should not be necessarily be considered as positive. At the country level, for example, the gross proportion of international collaboration is meaningless without consideration of the context (size of the research systems, dependency relations, etc.). Trivially, for example, most developing countries have very strong indexes of collaboration, which expresses a strong dependency rather than research efficiency.

6.2 Structure of collaboration of FP6 lead scientists

In-depth analysis of co-authorship indicators is carried out below, with a view to explore and better understand the specific scientific cooperation patterns of lead scientists.

6.2.1 Overall analysis of lead scientists' co-publication intensity

Exhibit 32 compares collaboration rates of lead scientists with those of all the authors publishing in the Web of Science.

Overall, 79% of lead scientists' publications involve collaboration (more than one author), which is 7 percentage points higher than the corresponding rate for all authors publishing in the Web of Science (72 %). Lead scientists thus have a higher propensity to collaborate than the entire scientific community. By country, lead scientists co-publication rates vary between 63% and 86%.

Exhibit 32 Ratio of collaboration (2006)

	FP6 lead scientists publication database			All publications in the Web of Science		Percentage difference in co - publications
Country	**Co publications (a)**	**Mono address publications**	**Total publications**	**Co publications (b)**	**Mono address publications**	
Min	63%	14%	42.7	62%	23%	-1
Max	86%	37%	1659.3	77%	38%	19
Average	79%	21%	507.9	72%	28%	7

Source: Technopolis Group – OST.

[17] Among the pioneers were D. De Beaver, and R. Rosen (1978), "Studies in Scientific Collaboration, Part I", Scientometrics 1 pages 65-84; S.J. Katz and B.R. Martin (1997) "What is Research Collaboration?" Research Policy 26, pages 1-18; T. Luukkonen, R.J.W. Tijssen, O. Persson, G. Siversten (1993), The Measurement of international scientific collaboration, Scientometrics 28, 1, 15-36.

[18] For contrasted views see on this early period H.G. Small, B.C. Griffith, The Structure of Scientific Literature. I: Identifying and Graphing Specialties, Science Studies, 4, (1974) 17-40; Callon M., Law J., Rip A., Mapping the dynamics of science and technology, Macmillan, 1986.

KEY RESULTS

Lead scientists have a higher propensity to collaborate than the entire scientific community. The average collaboration rate of lead scientists is 79%, which is 7 points higher than the corresponding rate for all authors publishing in the Web of Science (72 %).

6.2.2 Analysis of lead scientists co-publication intensity by country

Exhibit 33 compares the collaboration rates of lead scientists to those of all the authors publishing in the Web of Science, by country.

Between 63% (Greece) and 86% (Poland) of lead scientists' publications are published in collaboration with other scientists. In the Web of Science, authors from Finland and Portugal present the highest collaboration rates (77% in these two countries).

All but Greek and Portuguese FP6 lead scientists have greater collaboration rates than their counterparts in the overall community.

KEY RESULTS

All but Greek and Portuguese FP6 lead scientists have a greater collaboration rate than their counterparts in their respective national scientific communities. Lead scientists are more inclined to publish outside their organisation.

Exhibit 33 Ratio of collaboration by country (2006)

	FP6 Lead scientists publication database			All publications in the Web of Science		Delta in terms of co publications (a-b) in percentage point
Country	**Co publications (a)**	**Mono address publications**	**Total publications**	**Co publications (b)**	**Mono address publications**	
Austria	79%	21%	119,7	74%	26%	5
Belgium	78%	22%	409,7	75%	25%	4
Germany	76%	24%	1659,3	67%	33%	8
Denmark	84%	16%	334,3	76%	24%	8
Spain	79%	21%	449,3	67%	33%	12
Finland	82%	18%	203,7	77%	23%	4
France	84%	16%	831,3	74%	26%	10
Greece	63%	37%	152,0	66%	34%	-4
Ireland	70%	30%	85,3	69%	31%	1
Italy	83%	17%	878,3	75%	25%	9
The Netherlands	84%	16%	572,0	77%	23%	8
Poland	*86%*	*14%*	42,7	*62%*	*38%*	24
Portugal	73%	27%	117,0	77%	23%	-4
Sweden	83%	17%	324,7	75%	25%	8
Unite-Kingdom	76%	24%	1439,0	65%	35%	11
Min	63%	14%	42,7	62%	23%	-4
Max	86%	37%	1659,3	77%	38%	24

Source: Technopolis Group – OST.
Note: Presence counting mode (number of publications higher than 50).
*Average 2004, 2005, 2006
Copublications: publications with at least two distinct adresses labs.
Mono address publications: publications with only one adress lab.

6.2.3 Analysis of lead scientists' co-publication intensity by priority

Exhibit 34 shows, for each country, the extent to which copublication rates by thematic area differ from the average copublication rate for the country in question. This shows that the highest rates of collaboration occur in Life sciences & Health, Global change, Aerospace, Citizen, Euratom and Food. By contrast, Energy, IST and NMP show lower levels of collaboration than the average.

KEY RESULTS

Lead scientists in Life sciences & Health, Global change, Aerospace, Citizen, Euratom and Food collaborate more than the average of all priorities taken together. Conversely, lead scientists in Energy, IST and NMP priorities show lower rates of collaboration than the average.

Exhibit 34 Rates of collaboration* by priority and country compared with ratio of collaboration all priorities taken together (2006)**

Country	LIFE SCIENCES & HELATH	ENERGY	GLOBAL CHANGE	AEROSPACE	TRANSPORT	CITIZEN	EURATOM	POLICY SUPPORT	FOOD	IST	NMP	Number of co publications (all priorities together)
Austria								**8%**				94.7
Belgium								*0%*	**2%**	*-17%*	**4%**	320.3
Germany	**9%**	*-10%*	**13%**	**2%**		**24%**	**9%**	**1%**	*-25%*	*-7%*	*-6%*	1260.3
Denmark	**6%**							*-3%*	**8%**	**9%**	*-36%*	279.7
Spain		*-23%*					*-98%*	**8%**		*-5%*	**2%**	355.0
Finland											*-17%*	166.0
France	**5%**	*-17%*	**5%**					**4%**	**1%**	*-21%*	**2%**	696.3
Unite-Kingdom		*-167%*	**5%**		*-31%*		**20%**	**3%**	**7%**	*-5%*	*-23%*	1097.7
Greece										*-10%*	*-5%*	95.7
Ireland									**24%**		*-15%*	59.3
Italy				**2%**				*-9%*		*-10%*	*-8%*	733.0
The Netherlands							**9%**	**1%**	**2%**	*-88%*		482.7
Portugal										*-10%*	**3%**	85.7
Sweden									**4%**	*-62%*	**2%**	268.3

Source: Technopolis Group – OST.
Note: Presence counting mode.
* Expressed as percentage differences between the share of publications in copublications of lead scientists in each priority and the overall share of publications in copublications - by country (2006*)
**Average 2004, 2005, 2006.

6.2.4 Analysis of co-publication intensity by country

Exhibit 35, to 37 show the proportions of lead scientists' copublications which involve collaboration with international, EU27 and fellow national co–authors, and the corresponding proportions for authors in the overall community. These proportions provide a proxy measure of the degree of internationalisation of the lead scientists' networks.

Exhibit 35 shows that the structure of collaborations of the lead scientists from Austria, Finland, France and Italy are more international than those of the authors from their respective country.

KEY RESULTS

FP6 lead scientists do not have homogeneous structures of collaboration. Austrian, Finnish, French and Dutch lead scientists' publications are more internationally oriented than those of their respective national scientific communities. Lead scientists of these 4 countries are more inclined to publish outside national boundaries. For all other countries, the degree of internationalisation of collaboration is lower.

Exhibit 35 Structure of co publication: International co publications of lead scientists

Country	Proportion of lead scientists' copublications involving international collaboration	Number of co publications of lead scientists	Proportion of WoS authors' copublications involving international collaboration	Lead scientist / authors in Web of Science (in percentage point)
Austria	81%	94.7	72%	9
Belgium	70%	320.3	73%	-3
Germany	62%	1260.3	66%	-4
Denmark	56%	279.7	70%	-14
Spain	50%	355.0	57%	-7
Finland	62%	166.0	59%	3
France	64%	696.3	62%	2
Greece	48%	95.7	54%	-6
Ireland	69%	59.3	70%	-1
Italy	53%	733.0	52%	1
The Netherlands	56%	482.7	62%	-6
Portugal	56%	85.7	66%	-10
Sweden	57%	268.3	67%	-10
United-Kingdom	64%	1097.7	64%	-
Min	48%	59.3	52%	-4
Max	81%	1260.3	73%	8

Source: Technopolis Group – OST.
Note: Presence counting mode. Data for countries with at least 50 co publications.

Exhibit 36 shows that the structure of collaborations of the lead scientists from Germany, Finland, France, Ireland, Italy, and the United Kingdom are more EU27 oriented than those of most authors from these countries .

KEY RESULTS

FP6 lead scientists do not have homogeneous collaboration patterns at the EU27 level: German, Finnish, French, Irish, Italian and English lead scientists are more EU27 oriented than those of their overall national scientific communities.

Exhibit 36 Structure of co publication: EU27 co publications of lead scientists

Country	Share of EU27 co publications of lead scientists in their co publications	Number of co publications	Share of EU27 co publications of authors in WoS in their co publications	Lead scientist / authors in Web of Science (in percentage point)
Austria	52%	94.7	52%	-
Belgium	44%	320.3	53%	-9
Germany	39%	1260.3	36%	3
Denmark	37%	279.7	47%	-10
Spain	34%	355.0	36%	-2
Finland	47%	166.0	41%	6
France	43%	696.3	35%	8
Greece	36%	95.7	37%	-1
Ireland	53%	59.3	50%	3
Italy	38%	733.0	33%	5
Netherlands	37%	482.7	42%	-5
Portugal	39%	85.7	48%	-9
Sweden	35%	268.3	42%	-7
United-Kingdom	41%	1097.7	33%	8
Min	34%	59.3	33%	1
Max	53%	1260.3	53%	-

Source: Technopolis Group – OST.
Note: Presence counting mode. Data for countries with at least 50 co publications.

Except for Austrian lead scientists, lead scientists have a higher level of collaboration at the national level than their respective national scientific communities (see Exhibit 37).

KEY RESULTS

For most countries, the proportion of FP6 lead scientists' publications involving collaboration with fellow nationals is about 20% higher than for their counterparts in the overall national scientific community.

Exhibit 37 Structure of co publication: National co publications of lead scientists

Country	Share of National co publications of lead scientists in their co publications	Number of co publications	Share of National co publications of authors in WoS in their co publications	Lead scientist / authors in Web of Science (in percentage point)
Austria	39%	94.7	44%	-5
Belgium	56%	320.3	46%	10
Germany	70%	1260.3	52%	18
Denmark	66%	279.7	47%	19
Spain	73%	355.0	59%	14
Finland	78%	166.0	62%	16
France	71%	696.3	57%	14
Greece	80%	95.7	62%	18
Ireland	52%	59.3	44%	8
Italy	78%	733.0	70%	8
Netherlands	70%	482.7	55%	15
Portugal	70%	85.7	56%	14
Sweden	72%	268.3	52%	20
United-Kingdom	70%	1097.7	53%	17
Min	39%	59.3	44%	-5
Max	80%	1260.3	70%	10

Source: Technopolis Group – OST.
Note: Presence counting mode. Data for countries with at least 50 co publications.

6.3 Patterns of collaboration of FP6 lead scientists by country

Here we consider bilateral scientific linkages, descriptions of which typically include:

- numbers of co-publications by pairs of actors. This indicator generally very much depends on the size of collaborating groups;
- mutual preferences: these fully normalised indexes (probabilistic affinities) highlight the size-effects and give an idea of "mutual preferences" between two types of actors;
- partnership patterns (as measured with the following indicators: percentage of co-authorship with partners, mutual preference index, proximity indexes, etc.) can be drawn on any type of relations.

An outstanding question is whether the network configuration reflects scientific excellence. A simple hypothesis is that the social stratification of science, with competition and collaboration "among the few", encourages collaboration within homogeneous levels of prestige[19], where collaboration with excellent people appears in this context as a mark of "excellence". However, if one considers the example of France, patterns of collaboration seem to be much more the result of socio-political history than of the research of "excellent" partners[20].

Based on Exhibit 72 to Exhibit 75 (see Appendix Q), the following exhibits show comparisons of the percentages of co-authorship with partners between the lead scientists and all the authors in the Web of Science.

Exhibit 38 shows that the collaborations of lead scientists are more numerous in each country (except Austria) than in their respective national scientific communities. This is especially notable in the countries with the largest systems of research. The FP6 lead scientists have more intensive collaborations with Canada, China, Japan, Russia, the US, and Switzerland than their respective national scientific communities. There are also higher rates of collaboration of Czech lead scientists, than their respective national counterparts: the percentage co-authorship with Slovakian and Slovenian partners is 4.0% and 8.0% higher in the case of Czech lead scientists than in the case of Czech authors publishing in the Web of Science

KEY RESULTS

The FP6 lead scientists have more intensive collaborations with Canada, China, Japan, Russia, the US, and Switzerland than their respective national scientific communities. The FP6 lead scientists of the Czech Republic, Slovenia, and Slovakia, have more intensive collaborations between themselves than their respective national counterparts.

[19] This idea was operationalised in bibliometrics, by Kretschmer among others: Kretschmer H. (1993). Measurement of social stratification in science, a contribution to the dispute on the ORTEGA hypothesis, Scientometrics, 26, 1. 95 - 111.

[20] M. Zitt,, Y. Okubo, E. Bassecoulard, (2000) Shadows of the Past in International Cooperation: Collaboration Profiles of the top five Producers of Science, Scientometrics, 47(3): 627-657.

Exhibit 38 Differences in rates of collaboration (%) between networks of lead scientists and networks of Authors publishing in the Web of science (2006*)

	Country (lead scientists)															
Country (WoS)	AUT	BEL	CZE	DEU	DNK	ESP	FIN	FRA	GRC	IRL	ITA	NLD	POL	PRT	SWE	U-K
AUS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-2.7
AUT	-3.6	-	-	-2.4	-	-	-	-	-	-	-	-	3.1	-	-	-
BEL	-	7.8	-	-	-	4.8	-	-2.9	-2.1	2.7	-	-1.0	2.3	-	-	-
BRA	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-
CAN	11.4	-3.0	-	7.5	-	3.0	11.5	8.6	2.2	-3.0	6.8	-2.9	-	-	-	8.0
CIS	-	-	-4.5	6.1	-	-	6.5	11.2	-	-	6.7	-	-3.6	-	-	8.8
CHE	2.2	0.1	-	2.2	4.6	-1.9	10.1	-3.3	-0.6	-	-3.0	0.1	1.0	-0.9	-	-
CHN	-	3.5	-	-	-	-	-	11.9	-	4.3	-	-	-	-	-	4.8
CZE	-	-	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-
DEU	3.0	-2.2	-12.0	16.1	1.1	5.3	7.5	11.6	4.0	-1.2	7.6	0.0	5.7	-2.5	-1.6	9.3
DNK	-	-	7.4	-	18.0	-	-	-	2.4	-	-	3.3	-	-	-1.5	-
ESP	-3.5	-0.7	8.5	5.5	2.4	17.1	11.6	8.1	-2.9	0.4	6.4	-0.1	-2.4	-1.7	-	7.6
FIN	-	-	-	-	-	-	15.0	-	-	-	-	-	-	-	-0.9	-
FRA	1.5	-3.3	-8.0	5.2	0.5	1.5	-4.6	15.3	-2.2	-0.3	6.5	-1.4	-6.0	-5.9	-1.2	6.3
GRC	-	-	8.5	-	-	-	-	-	6.9	-	-	-	-	-	-	-
HRV	-	-	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-
IRL	-	-	-	-	-	-	-	-	-	6.2	-	-	-	-	-	-
ITA	-1.6	-0.9	2.3	5.5	1.2	2.9	8.4	8.2	0.0	-4.2	11.0	0.3	-0.5	-4.8	1.2	8.4
JPN	5.6	-	-	-	-	4.2	11.9	-	-	2.3	-	-	-0.2	-	3.9	-
NLD	2.7	-1.6	-3.1	4.4	-0.7	1.9	-3.9	9.4	-2.5	-3.8	8.3	16.3	10.9	0.8	0.6	6.7
NOR	-	-	-	-	-4.6	-	-3.1	-	-	-	7.7	-	-	2.6	-3.6	-
POL	-2.6	-	-4.4	-	-	-	-	-	-	-	-	-	43.0	-	-	-
PRT	-	-	-	-	-	-1.8	-	-	-	-	-	-	-	4.5	-	-
SVK	-	-	4.0	-	-	-	-	-	2.2	-	-	-	-	-	-	-
SVN	-	-	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-
SWE	-	-	-	-	-2.9	-	-8.5	-	-	1.4	-	-	3.1	-	19.5	-
U-K	0.8	-3.2	3.8	6.4	0.2	2.0	7.1	12.4	-2.5	-1.1	6.7	0.6	-4.5	-1.6	-1.2	18.5
USA	5.0	0.1	3.7	5.5	0.1	3.8	8.5	10.8	-2.2	-7.0	5.2	0.1	1.6	-0.7	2.0	9.7

Source: Technopolis Group – OST.
Note: Presence counting mode.
*Example: the percentage co-authorship with Austrian partners is 3.6% lower in the case of Austrian lead scientists than in the case of Austrian authors publishing in the Web of Science.

Exhibit 39 and Exhibit 40 respectively present intensities of partnerships of the FP6 lead scientists and of the scientists in the overall scientific community.

Exhibit 39 shows the country(ies) where lead scientists have the highest levels of collaboration relative to their national counterparts. For instance, Austrian lead scientists have a greater tendency to collaborate with Japanese authors than all Austrian and Japanese Web of Science authors (ranking 9 places higher). In Austria, Spain, Finland, Ireland, and Sweden, the FP6 lead scientists collaborate more intensively with Japanese authors than their respective national counterparts. The situation is similar in the following cases:

- FP6 lead scientists from Belgium, France, Ireland with Chinese authors;
- FP6 lead scientists from France and the UK with authors from Russia;
- FP6 lead scientists from Denmark and Finland with Swiss authors.

Exhibit 39 Partnerships where FP6 collaboration is much more intensive than in the Web of Science*

Country of the FP6 lead scientists	Country with a better positioning in the ranking of the lead scientist country partners than in the Web of Science	Gain in terms of place in the ranking
Austria	Japan	9
Belgium	China	10
Czech Republic	Denmark	8
	Bosnia Herzegovina	8
Germany	Canada	9
Denmark	Switzerland	9
Spain	Belgium	8
	Japan	10
Finland	Canada	8
	Switzerland	10
	Spain	7
	Japan	6
France	Russia	10
	China	8
Greece	Canada	8
	Denmark	7
	Slovakia	8
Ireland	Belgium	9
	China	6
	Japan	10
Italy	Norway	10
Netherlands	Denmark	9
Poland	Belgium	9
Portugal	Norway	8
Sweden	Japan	8
United-Kingdom	Russia	9

Source: Technopolis Group – OST.
Note: Presence counting mode.
*Example: Japan is at least 10 places higher in the the ranking of Austrian lead scientists first country partners than in the ranking of Austria first country partners in the Web of Science.

Exhibit 40 shows, for each country, the country(ies) with lead scientists showing a lower ranking (-5 to -10 places) relative to the Web of Science. For instance, there is a lower intensity of collaboration between Austrian lead scientists and Spanish (or Polish) authors than between Austrian and Spanish (or Polish) authors in the Web of Science (respectively -8 and -10 places).

The situation is similar in the following cases:

- FP6 lead scientists from Austria, Greece, and Poland with Spanish authors;
- FP6 lead scientists from Finland with French authors;
- FP6 lead scientists from the Czech Republic, Finland, Greece, and Ireland with Dutch authors;
- FP6 lead scientists from Denmark, Finland, and Sweden with Norwegian authors.

Exhibit 40 Partnerships with much lower FP6 collaborative intensity than overall

Country of the FP6 lead scientists	Country with a lower positioning in the ranking of the lead scientist country partners than in the Web of Science	Gain in terms of place in the ranking
Austria	Spain	-8
	Poland	-10
Belgium	Canada	-10
Ceck Republic	Russia	-8
	Netherlands	-10
	Poland	-9
Germany	Austria	-10
Denmark	Norway	-9
Spain	Switzerland	-8
	Portugal	-10
Finland	France	-6
	Netherlands	-8
	Norway	-10
France	Belgium	-9
	Switzerland	-7
Greece	Belgium	-10
	Spain	-7
	Netherlands	-8
Ireland	Canada	-9
	Italy	-6
	Netherlands	-7
Italy	Switzerland	-7
Netherlands	Canada	-10
Poland	Russia	-7
	Spain	-9
Portugal	Italy	-7
Sweden	Norway	-10
United-Kingdom	Austria	-9

Source: Technopolis Group – OST.
Note: Presence counting mode.
Exemple of reading: Spain and Poland respectively loose 8 and ten places in the the ranking of Austrian lead scientists first country partners in comparison with the ranking of Austria first country partners in the Web of Science.

KEY RESULTS

Patterns of collaboration of FP6 lead scientists with partners in other countries are significantly different from the traditional patterns of collaboration between countries. This might indicate that the FP is altering traditional collaborative relationships, by changing the usual boundaries between science communities, as determined by language, geography and history.

7. Lessons learned

These results are important as they clearly challenge the pervasive and preconceived idea that most of the best scientists do not participate in the Framework Programme because they can obtain funds from other sources.

Further work is now required to extend these results. We have identified two major areas for development: i) qualitative research on the role of lead scientists and their impact in FP projects; ii) an FP information system to track project-related publications and systematically assess the scientific excellence of projects.

7.1 This bibliometric study should be complemented by qualitative work on lead scientists in order to understand their role in the Framework Programme and, from a more general perspective, their specific behaviours and impacts on science and technology.

This study was mainly focused on the methodological challenge of the identification and analysis of citation performance of lead scientists, and the implementation of the methodology developed.. The results can be crucial for the competitive and networking dynamics of the Framework Programme. Unfortunately, the body of knowledge on effects of lead scientists on research projects, programmes and communities is very limited.

One of the principal and earliest scholars in the field was Eugene Garfield from the Institute for Scientific Information (ISI) who wrote several essays on highly cited articles and on Nobel prizes. His research is largely concerned with the systematic identification of the most highly cited articles and their authors in different fields of science. As regards Nobel prizes, Garfield has published citation analyses of each Nobel prize-winner's work. He demonstrated a key characteristic of Nobel prize-winners: they publish five times the number of papers and their publications are cited 50 times more than the average for scientists in general (1986, 1992). However, analysis of the role and effect of highly cited authors on their research community – whether Nobel prize-winners or not – is limited to consideration of the diffusion of their knowledge through the use of their publications by other scholars (as reflected by citations). There is no exploration of their specific behaviours and dynamics and their effects on the broader scientific community (attraction, reputation, creation of new fields etc.), which would require qualitative investigations.

Another strand of research on the "elites of science" is provided by L.G Zucker and M.R. Darby from the NBER. Their early work on the biotechnology industry draws two major conclusions:

- *"to understand the diffusion and commercialization of the bioscience breakthroughs, it is essential to focus on the scientific elite, the stars, and the forces shaping their behaviour";*
- the breakthroughs as embodied in the star scientists initially located primarily at universities created a demand for university-industry collaboration, with star scientists moving to firms or collaborating at the bench-science level with scientists at firms.

Therefore, their work shows that so-called star scientists' added value goes beyond scientific excellence: they can also be very important for technological developments and the creation of new firms. The authors have shown that in the biotechnology area (in 1995) publications by star scientists were loosely associated with the uptake of biotechnology by commercial firms. Further, they showed that the extent to which a company collaborated with star scientists was a powerful predictor of its success in this industry in terms of patents, market value and commercial achievements.

The authors' more recent and extended work in all areas of science and technology (2006) demonstrated that the star scientists themselves, rather than their potentially disembodied discoveries, play a key role in the formation or transformation of high-tech industries. The effect was associated with the whole individual, which emphasises the importance for the Framework Programme of attracting elite scientists. Their work also shows that measures of the stock of academic knowledge other than star scientists' citations have weaker and less consistent effects on the emergence and development of new industries, which reinforces the importance of the quality of lead scientists as an powerful indicator of research programme excellence.

Finally, some on-going research in the PRIME network (for instance in the nanotech area) suggests that lead scientists do have a specific role: the top 1% most cited authors are often those that create new research domains, and the top 10% are those that develop and consolidate these fields. This is one of the hypotheses that underly some very generous national support schemes that are competitively awarded to a few very good scientists. The objective is to provide these researchers with exceptional funds and working conditions so they are free to set up their team and start developing their own field of research. This is the case with the MERIT Awards (Method to Extend Research in Time) which are offered to a "*limited number of investigators who have demonstrated superior competence and outstanding productivity during their previous research endeavors and who are likely to continue to perform in an outstanding manner in the future*". It provides the awardees with the opportunity to obtain up to ten years of research support.

In this study, we have shown that lead scientists of high quality participate in the Framework Programme, but we have not analysed their impact on FP projects. The analysis of the pattern of collaboration in the last section of the report shows that they may have an important role in strengthening the ERA. Qualitative investigations should explore this effect further, and more generally examine their role in the framework programme and, from a more general perspective, in the communities to which they belong. Lead scientists' work is not performed in isolation – to a greater extent than other scientists, they are embedded in a community. This highlighted in a recent study by Azoulay et al. (2008), which supports the concept of the "invisible college" infused by the so-called superstar scientists. The study reveals a 5 to 10 percent decrease in the quality-adjusted publication output of superstar co-authors in response to the sudden and unexpected loss of a superstar. Moreover, the closer a collaborator is with the superstar in terms of topics and ideas studied, the greater the productivity loss.

In the 1970s, T. S. Kuhn, in his famous book "The structure of scientific revolutions", was very critical of attempts to explain paradigm shifts in the history of science in terms of individual discoveries, attributable to single scientists. Such an attempt would be even more inappropriate in the current context, described by Michael Gibbons as a time of "mode 2" knowledge production ("mode 1" knowledge production was investigator-initiated and discipline-based; mode 2 is interactive, problem-focused and interdisciplinary). In this context, the relationships of lead scientists with their environment, with other scientists in their discipline and with much beyond, including knowledge users, is crucial.

Qualitative issues to be investigated are the following:

- To what extent are lead scientists structuring their environment, and attracting other researchers to a field or even in to a given project?
- Do they add to the status of the Framework Programme, and facilitate the dissemination of results?
- To what extent are they actually contributing to the work and activities done in the project?

One interesting way forward would be to survey the best European scientists and question them about their experience and expectations of FP projects and other research networks. Other questions could relate to other sources of finance, the added value of the framework programme and, for those who do not participate, the barriers to participation. A list of 250 best scientists in 21 broad subject categories in life sciences, medicine, physical sciences, engineering and social sciences is provided by the ISI "ISIHighlyCited.com" portal[21] and could be used as the main source of identification of the sample of scientists to be considered

Another useful development would be to include questions relating to lead scientists in thematic ex post evaluations of framework programmes. It is very likely that the role and effects of lead scientists vary according to research areas.

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[21] http://hcr3.isiknowledge.com/

7.2 An efficient FP information system to track project-related publications should be put in place in the near future

It is of foremost importance that the Commission puts in place a system that allows the systematic tracking of publications (and patents) that can be imputed to a given project. Currently, publications are generally identifiable only from project final reports. As a result, proper bibliometric analyses are either impossible, or time-consuming and expensive.

A proper information system could be useful not only for the type of study undertaken here, but also for regular thematic evaluations, and even for continuous monitoring of the quality of FP outputs.

The few FP6 thematic evaluations that venture into bibliometrics have done so by requesting from project coordinators a sample of "best publications"[22]. This is not exhaustive, is hard work and is very time consuming. Experience has shown that it is unlikely that more, better and cleaner data could be obtained from voluntary requests to project participants. But having a reliable and complete list of project-related publications ready prior to evaluation would allow a proper assessment of scientific excellence which, given the objective of the Framework Programme, could be a stepping stone for evaluators to undertake other type of analysis (such as peer review, interviews and surveys).

Of course, such an initiative would be useless without standardisation of the data entry process: all items identified as relevant should be standardised by specifying firstname of author, lastname, institution name, address, country etc. This would not only improve processing time but would also allow more types of data to be processed, and therefore more accurate indicators to be obtained. If publications could be systematically identified individually – i.e. if their title, author and publication details were registered according to standard and separate formats – additional analyses could easily be made.

Finally, the Commission should encourage the development of a shared and homogenous set of indicators and methods so the bibliometric studies are comparable. In particular, we recommend the use of normalized indicators at the journal level, such as the relative citation rate used in this study, in order to allow comparisons between themes.

[22] Ex-post Impact Assessment of the FP6 sub-priority "Global Change and Ecosystems", DG Research, European commission, 2008, EPEC/Technopolis.

APPENDICES

Appendix A Scientometric approaches

A.1. Introduction

The appraisal of academic outcomes resulting from research activities is a central feature of an assessment of a country's scientific performance. But academic outcomes are very diverse, covering the production of codified knowledge (e.g. articles in refereed reviews), the production of embodied knowledge (such as in PhD theses) and other types of academic production (conferences, books, CDs, temporary or permanent exhibitions etc.), as well as Internet visibility (electronic working papers etc.).

Scientometrics, based on the enumeration and statistical analysis of scientific output in the form of articles, publications, citations, and other, more complex indicators, is an important tool in evaluating research activities, laboratories, programmes and research institutions, as well as scientists, scientific specialisms and the performance of countries.

The existing literature on scientometrics and indicators is extensive. Bibliometric indicators are calculated on the basis of articles published in scientific journals by research laboratories. The principal database available for these calculations is the Web of Science (WoS), the standard tool in bibliometrics for the exact sciences.

The limitations of scientometrics are also well known, and it is important to keep in mind the difficulties involved in evaluating published research in social sciences.

~~The general limitations and biases of ISI-based bibliometrics apply.~~ Results should be interpreted with caution, especially when analysing small datasets, such as those from small countries, or when analysing data obtained by cross-tabulations (discipline-country) or square linkages (co-publications). Results from such analyses are also likely to fluctuate markedly over time. Moreover, asymmetrical statistical distributions, common in bibliometrics, make some statistical conclusions extremely sensitive to contributions from relatively few highly productive individuals, a feature which applies to many of the countries studied in this report, which have relatively low levels of scientific activity.

Data on scientific publications are widely used by institutions, policy-makers, and other stakeholders for the analysis of national academic output. Bibliometric data are, for instance, frequently used to construct rankings and changes or to compare different actors (countries, institutions, research entities or individuals) by, for example, broad scientific field or sub-field. Uses include:

- Ranking actors' scientific production and specialisation (identifying strong and weak areas)
- Characterising publication strategies (one author, numerous authors, European co-publications, international co-publications...);
- Identifying main scientific partners and positioning each country in terms of its international co-publications (network analysis...);
- Analysing scientific visibility (citations analyses, impact indicators...).

A.2. Bibliometrics tools

A.2.1. Reuters-Thomson Scientific database

Bibliometric studies are subject to the de facto monopoly established by Reuters-Thomson Scientific - formerly known as the Institute for Scientific Information. This private company provides access to an information system which consists of five databases[23] that contain current and retrospective multidisciplinary information from approximately 8,700 of the most prestigious, high impact research journals in the world.

The Thomson Scientific database is therefore the standard tool in bibliometric for the exact sciences. It is a very selective database, somewhat oriented toward good quality academic scientific activity for well-internationalised fundamental disciplines. Its representativeness is less good in applied fields, or field research, or fields where research has a national tradition, or in disciplines where information is transmitted through other channels, most notably computer science.

This unique source tells only part of the story of academic production. Limitations relate to issues of definition, to the balance between disciplines, and coverage biases, including a strong positive bias in favour of English-speaking researchers. Studies have shown that adjustments designed to correct for coverage imbalances may change performance indicators significantly, and sometimes spectacularly. Changes to the perimeter of (ie the criteria for) journal inclusion cause variations in the classic comparative bibliometric indicators, such as world shares of publications or relative impacts. For instance, it has been shown in a study of the relative scientific performance of Russia that an adjustment in the perimeter of journal inclusion can modify performance indicators by a factor 2[24].

It is also important to bear in mind the well-known difficulty that evaluation of published research faces in social sciences. The documentary databases established under Thomson Scientific are generally considered to be inappropriate for analysing the production of researchers publishing in languages other than English, in that a number of the journals publishing in other languages, and which are considered to be important scientific references, are not included in these databases. The bibliometric evaluation of work published in some disciplines necessitates the construction of a list of journals considered as scientific by the community of researchers concerned, from which conventional bibliometric indicators can then be calculated.

A.2.2. Reference tables

Research activities can be classified at various levels of aggregation. OST, the French Observatory of Sciences and Techniques, has developed a classification which comprises 9 broad scientific fields:

- applied biology – ecology;
- fundamental biology;
- chemistry;
- multidisciplinary journals (not taken into account in this study);
- mathematics;
- physics;
- medical research;
- earth and space sciences;
- engineering.

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[23] Science Citation Index Expanded™, Social Sciences Citation Index®, Arts & Humanities Citation Index®, Index Chemicus®, Current Chemical Reactions®

[24] The inclusion of a sub-population of nationally-oriented journals creates large distortions. This can lead to an over-estimation of share and an under-estimation of impact, for countries with a national editorial tradition, while the impact of a few mainstream countries arguably benefits from the presence of this sub-population.

Michel Zitt, Suzy Ramanana-Rahary, Elise Bassecoulard, "Correcting glasses" help fair comparisons in international science landscape: country indicators as a function of ISI database delineation., Scientometrics 56, 2, 2003, 259-282

A.2.3. Three main principles

The scope of scientometric information can be described in terms of three principles.

Firstly, scientometric information is available at journal level and at three levels of scientific specialisation, which range from the most detailed to the most aggregated:

- Scientific specialism level - from the Reuters-Thomson Scientific Database – which encompasses nearly 170 categories;
- Sub-discipline level, which encompasses 30 scientific sub fields;
- Discipline level, which encompasses 9 categories.

Secondly, scientometric information can relate to different geographical units:

- regions (defined as NUTS 3) : more than 200 regions (in EU27);
- countries ;
- geographic area (EU27 + Commonwealth of Independent States / CIS + European Free Trade Association / EFTA...);
- World.

Finally, scientometric information available should relate to three features of scientific activity:

- Production (number and “market share” of articles, specialisation of production);
- Collaboration (profile of authorship – single author and various geographical patterns of co-authoring – and specialisation of collaboration);
- Visibility (number and “market share” of citations, direct impact and relative impact normalised as ratio of relative citation, profile of activities by class of visibility).

A.3. Types of Bibliometrics indexes / Vocabulary

A.3.1. Production and productivity indexes

The production of scientific articles can be measured in absolute terms (number of publications) and in shares (of publications, of citations, etc.). The latter can be calculated at various levels (e.g. geographically, as a national, area, continental, or world share).

Activities can be categorised according to “disciplinary field” at various levels of aggregation, as presented above.

A.3.2. Alternative counting procedures

Many scientific articles are of course co-authored by several individuals, often from different institutions. This raises the issue of how contributions should be weighted for the purpose of bibliometric analyses.

The basic alternative procedures are the 'fractional count' and the 'integer count'. The fractional count involves associating a unitary weight to each article, and attributing an equal fractional contribution to each author. Thus a sole author receives a score of 1 for his publication, while each contributor to a paper with five authors scores one-fifth. With the integer count, each co-author of each publication receives a score of 1. Hence, using the fractional count, the total score of all authors is equal to the number of articles, while with the integer count the aggregate author score is higher, and equals the number of participations.

As an example, France makes a contribution to 8% of world publications, but contributes just 5% using the fractional count. The fractional count is generally preferable for comparisons at the macro (eg country) level, ensuring as it does that shares will add to 100% overall; the integer count may be more appropriate at a micro (eg university) level, where comprehensive comparisons of respective shares are less meaningful.

A.3.3. Accounting for country size

The scientific production of a country is obviously linked to its size. Various methods have been tested for taking this into account. One approach consists simply of dividing the output produced (e.g. articles published) by the total inputs used in its production. Work by economists illustrates the variety of productivity ratios which can be envisioned, depending on whether the denominator concerns staff size, budget, population, and so forth.

A.3.4. Activity index

The sectoral specialisation (or 'activity') index relates a particular country's weight in a specific discipline to that country's weight in all disciplines combined, or the weight of a given discipline within the country to that discipline's weight world-wide. This index facilitates comparison of countries' profiles by scientific discipline. For any individual country, this index provides a measure of the overall level of specialisation in that country's research strategy. When the specialisation index is greater than 1, the country or region under consideration is more specialised in that discipline than the average of all countries/regions.

A.3.5. Collaboration indexes

The analysis of co-publications can be carried out for different sorts of measurements: absolute flows, normalised flows, mutual affinities, etc.

Scientific activity is by nature cooperative whether that being within a group or among groups. Bibliometric analyses are concerned mainly with institutional collaborations (related to the address data for the author) and very little concerned with collaboration among individuals.

The term "co-publication"

The term "co-publication" is used for publications arising from collaboration among different laboratories that results in an article published with several signatures.

As an example, the co-presence of two or more universities on the same article but that are giving different addresses identifies a "co-publication", whereas the co-presence of universities on the same article giving the same address can be thought of as collaboration by institutional arrangement (i.e. structural or affiliated co-presence).

Indexes of collaborations

Various indexes of collaborations can be calculated: for instance, the percentage of co-authored papers, the percentage of internationally co-authored papers, co-authored papers written with researchers from a given country or from a given institution.

A.3.6. Visibility Indexes

Scientific articles include a bibliography, the “cited articles”. The number of references made to an article (“citations received” by this article) is thus a measure of its visibility – or, as often said, its “impact”.

Citation analysis

Citation analysis, which has been studied in a vast literature, measures the scientific utility, visibility, and international influence of a publication. It depends nevertheless on a number of factors such as the journal and the language of publication, the habits of citation in a certain discipline, the focus of the article (fundamental, applied, methodological, or other).

The interpretation of citation data as a direct measure of quality is therefore incorrect (for example an article in English has at least five times more chance of being cited that the same article published in French).

The social character of the citation reflects also cautions against simplistic interpretation (accommodating citations, etc.); citation effects are amplified, for example, in the case of the most visible articles.

An important parameter is the variety of citation behaviour from discipline to discipline, resulting in the average number of citations per article varying widely between, for example, fundamental biology and mathematics[25]. Measurement is therefore sensitive to the chosen categories.

It is important to use indicators susceptible to allow a comparison from one field to another, like relative impact. Nonetheless, a defined field at a given level (say, by discipline) incorporates a heterogeneous situation at lower levels (by specialty, or by journal, for example). Different levels chosen for analysis (normalisation by journal, speciality, academic discipline) lead to differing evaluations.

Relevant indicators may provide information about the overall visibility of a university and relative impact by discipline.

Impact indicators

In bibliometrics, “impact” describes the number of citations per article. Direct impact is the average number of citations per article for a given actor (e.g. a university), according to a certain counting method and across a defined period of time. Relative impact is a ratio of the absolute impact of the actor for a given field to an average reference impact for that field (for example the average impact for a country, for the world)26.

A relative impact above 1 indicates a greater visibility than the reference. This measurement is characteristic of a given level of observation and allows the comparison of one field with another at this level, for example among disciplines, without translating the heterogeneity of characteristics within the discipline.

In order to take account of the heterogeneity of citation behaviour, it is necessary to turn to normalised indicators for scientific fields, for example by discipline or by journal. One well-known form of normalised indicator is the relative citation rate (RCR), which effects a normalisation at

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[25] This can be attributed to differences in the practice of referencing, to phenomena linked to the dynamics of certain fields ("age" of citations and growth), and to the position compared to other fields from which it can receive a flow of citations.

[26] It is also, for the actor, the ratio of its part of the citations market to its part of the publications market in this field.

impact actor = cit(actor) / pub(actor)

impact relatif actor = (cit(actor) / pub(actor)) / (cit(ref) / pub(ref)) = (cit(actor) / cit(ref)) / (pub(actor) / pub(ref))

For a particular actor whose articles are not very visible, for reason of choice of journal or research theme, this system will have quite different consequences on "market share of citations" and on the impact indicator. Adding an article of low visibility to a corpus of research articles published will have little effect on the "citations market share", but will tend to lower the indicator impact.

the level of the journal. In this approach, relative impact is considered as resulting from combining the hoped-for relative impact with the relative citation rate (RCR). The RRC translates a normalisation by scientific journal, which is assimilated to a particular specialty with its own bibliometric characteristics.

From this viewpoint, citations received by an author for an article are considered as resulting from two components:

- on the one hand the expected level of citation (the average impact for articles in a given journal)[27];
- and on the other hand the ratio between the citations actually received and the number expected;
- In this way it is possible to characterise the RCR for each actor (institution, country...), which is by construction the ratio of real impact to expected impact. The RCR therefore shows for each actor the over- or under-visibility of this actor considering the journals in which it publishes.

[27]The impact of each journal here is calculated differently from the "impact factor" of the ISI-JCR (where the type of document is taken into account, the calculation for each article is done for "year of citation", time spans are accounted for, etc.) The "hoped-for" impact used here follows the same logic than the "impact factor" by actor. There are variant forms of RCR in use, especially ones that include supplemental normalisations, and in particular by "type of document" (article, syntheses, letters, etc.):

Appendix B Steering committee

Chorakakis Georgios, European commission, Directorate General for Research, Unit for Evaluation and Monitoring of Programmes

Fish Peter, European commission, Directorate General for Research, Unit for Evaluation and Monitoring of Programmes

Reeve Neville, European commission, Directorate General for Research, Unit for Evaluation and Monitoring of Programmes

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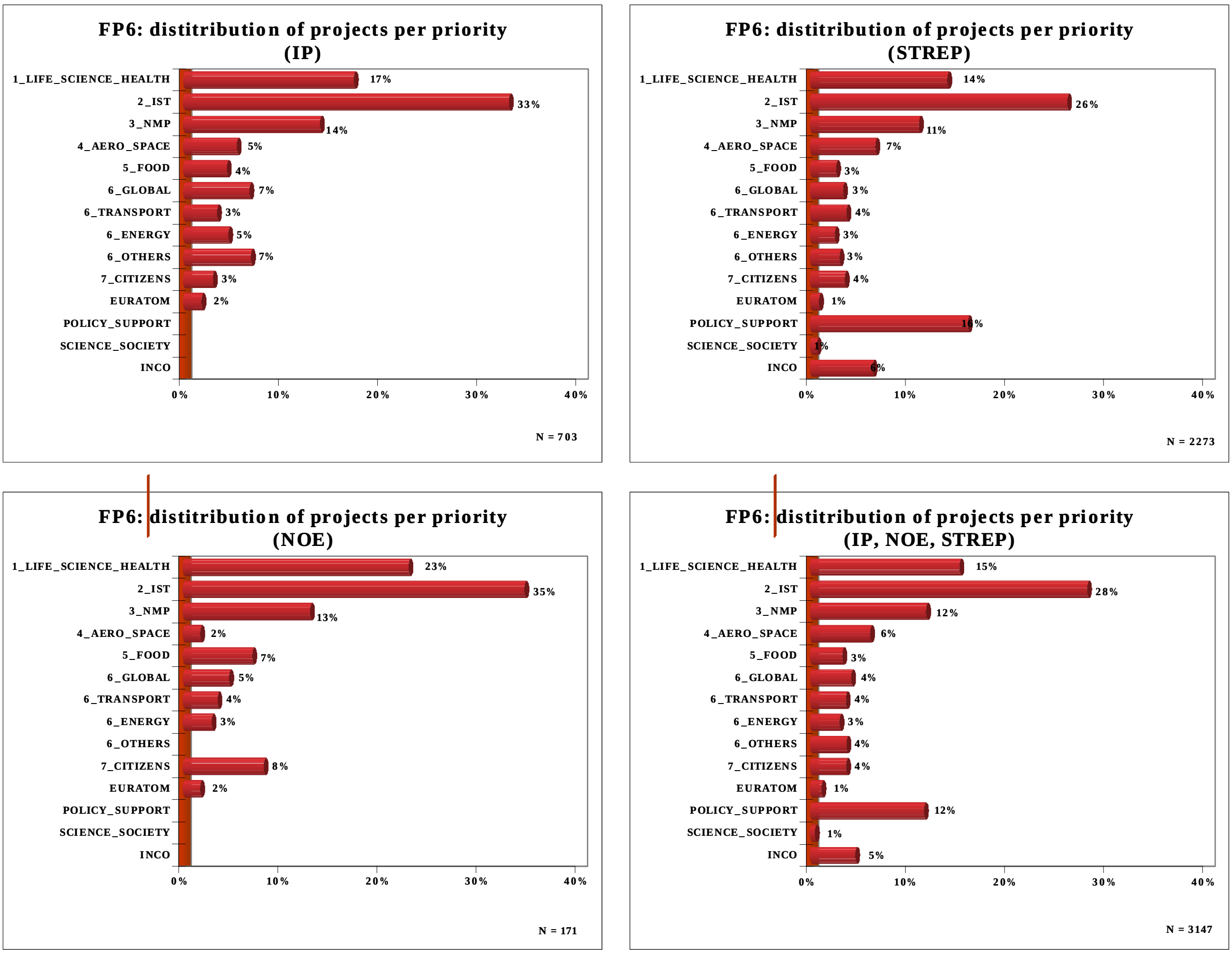
Appendix C Distribution of projects in the FP6

Exhibit 41 Distribution of projects in FP6



Appendix D Initial processing of the FP6 project database

The FP6 project database was restructured for present purposes, and the files provided by DG Research to the consultants (FP6 Contracts 20080602.mdb and outlook file provided by the Commission) were analysed.

The database in the file provided by the Commission (**FP6 Contracts 20080602.mdb)** contains 3147 FP6 projects: 2273 STREP, 703 IP, and 171 NOE (see Exhibit 42).

Exhibit 42 Distribution of FP6 projects

Number of Projects (contractNumber)	Instrument			Total
Priority	**IP**	**NOE**	**STREP**	
1. Life sciences, genomics and biotechnology for health	121	*38*	*313*	472
2. Information society technologies	231	59	590	880
3. Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices	97	22	252	371
4. Aeronautics and space	38	3	150	191
5. Food quality and safety	31	12	60	103
6. Sustainable development, global change and ecosystems	150	19	285	454
7. Citizens and governance in a knowledge-based society	*20*	14	80	114
Euratom	13	3	21	37
Policy support and anticipating scientific and technological needs	*1*		360	361
Research and innovation			*1*	*1*
Research infrastructures	*1*		*2*	*3*
Science and society			*15*	15
Specific measures in support of international cooperation		*1*	144	145
Total	703	171	2273	3147

Source: DG Research: FP6 Contracts 20080602.mdb

Further to a systematic checking of the database, several projects were reallocated to their relevant instrument and/or priority, without changing the total number of projects (see Exhibit 43). The main changes were as follows:

- Projects of priority 6. Sustainable development, global change and ecosystems have been divided into 4 sub-priorities: Global change, Transport, Energy and others (including Hydrogen and TREN calls);
- Projects concerning “Research and innovation” (1 project) and “Research infrastructures” (3 projects) have been distributed in the relevant priorities.

Exhibit 43 Revised distribution of FP6 projects

Number (N) of Projects (contractNumber & %)	Instrument						Total	
	IP		NOE		STREP			
Priority	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
1 LIFE SCIENCE HEALTH	121	17%	*39*	23%	*315*	14%	475	15%
2 IST	231	33%	59	35%	590	26%	880	28%
3 NMP	97	14%	22	13%	250	11%	369	12%
4 AERO SPACE	38	5%	3	2%	150	7%	191	6%
5 FOOD	31	4%	12	7%	60	3%	103	3%
6 GLOBAL	47	7%	8	5%	76	3%	131	4%
6 TRANSPORT	24	3%	6	4%	84	4%	114	4%
6 ENERGY	32	5%	5	3%	57	3%	94	3%
6 OTHERS	48	7%			68	3%	116	4%
7 CITIZENS	*21*	*3%*	14	8%	80	4%	115	4%
EURATOM	13	2%	3	2%	21	1%	37	1%
POLICY SUPPORT					362	16%	362	12%
SCIENCE SOCIETY					*16*	1%	16	1%
INCO					144	6%	144	5%
Total	703	100%	171	100%	2273	100%	3147	100%

Source: Technopolis Group – OST.

Appendix E Initial database of lead scientists

Exhibit 44 Structure of the lead scientists database

Contract Number	Acronym (Title of the project)	Lead scientist: Family Name	Lead scientist: Given name	Lead scientist: Organisation Name	Lead scientist: Organisation Address	Lead scientist: Organisation Town	Lead scientist: Organisation Country	Lead scientist: Organisation Postcode	Lead scientist: Email

Note: the contract number preserves the link with data in the DG Research FP6 project database.

Exhibit 45 Distribution of lead scientists – initial database (as of June, 27)

Number of emails	Unclassified	Delivery failure	To be followed-up	Success	Total
IP	115	38	71	173	397
NoE	9	11	23	43	86
STREP	509	114	45	609	1277
Total	**633**	**163**	**139**	**825**	**1760**

Source: Outlook file RTD-FP6-EX-POST-RESEARCHERS.pst before cleaning process of emails (emails unclassified and to be followed up).

Exhibit 46 Checking of lead scientists contact details - initial lead scientists database

Instrument	IP	NOE	STREP	Total
Number of Project	229	43	720	992
Number of Family Name	229	43	720	992
Number of Given_name	228	43	720	991
Number of Institution_Name	226	42	714	982
Number of Institution_Address	224	43	699	966
Number of Institution_Town	227	43	718	988
Number of Institution_Country	228	43	720	991
Number of Institution_Postcode	225	43	701	969
Number of Scientist_Email	229	43	719	991

Note: one name of lead scientist with required information by project.

Appendix F Endorsement Letter

EUROPEAN COMMISSION
RESEARCH DIRECTORATE-GENERAL

Directorate A - Inter institutional and legal matters – Framework programme
Evaluation and monitoring of programmes

Brussels, 6 August 2008
RTD.A.3/PF D(2008) GC/NR/gf **562050**

Subject: Endorsement of the 'Bibliometric Profiling of FP Participants' study on behalf of the Directorate General for Research

Dear Madam/Sir,

We hereby confirm that the study 'Bibliometric Profiling of FP Participants' with regard to which you have recently been contacted, is being carried out by Technopolis Group France on behalf of the Directorate General for Research (DG RTD) of the European Commission. This is one of several studies organised by DG RTD to support the ex post evaluation of the EU's 6th Framework Programme, which is being carried out by an independent group of experts and is due to be completed by the end of 2008.

The information that you are requested to provide will be treated strictly in accordance with the European Commission's rules on the protection of personal data and confidentiality. The information will remain the property of the European Commission. Technopolis Group will only use the information collected in the context of the 'Bibliometric Profiling of FP Participants' study.

Your contribution to this study is of great importance and is highly appreciated.

Thank you in advance for your collaboration.

Peter FISCH
pp Head of Unit RTD.A.3

Commission européenne, B-1049 Bruxelles / Europese Commissie, B-1049 Brussel - Belgium. Telephone: (32-2) 299 11 11.
Office: SDME 02/41. Telephone: direct line (32-2) 295.24.68. Fax: (32-2) 295.40.82.

E-mail: peter.fisch@ec.europa.eu

Appendix G The counting principle

The statistics by type of actor (country. region) are not calculated from the nationality of the authors but from the address of the participating laboratories and institutions. In other words, an Egyptian scientist working in UK will be counted as an UK scientist if he does not attribute himself to his home institution.

Scientific articles are often co-signed by many authors belonging to several laboratories and institutions. This means that different options for counting these articles can be chosen, in particular the fraction count and the integer count. The fractional count involves associating a unitary weight to each article, and attributing an equal fractional contribution to each author. Thus a sole author receives a score of 1 for his publication, while each contributor to a paper with five authors scores one-fifth. With the integer count, each co-author of each publication receives a score of 1. Hence, using the fractional count, the total score of all authors is equal to the number of articles, while with the integer count the aggregate author score is higher, and equals the number of participations.

As an example, France makes a contribution to 8% of world publications, but contributes just 5% using the fractional count. The fractional count is generally preferable for comparisons at the macro (eg country) level, ensuring as it does that shares will add to 100% overall; the integer count may be more appropriate at a micro (eg university) level, where comprehensive comparisons of respective shares are less meaningful.

Appendix H Filtering process in the OST WOS database

Exhibit 47 Total document identified after filtering OST WOS for the year 2006

Year 2006	Total number of documents
On line WOS database	10 183
OST WOS database	10 183
Documents with address	10 154
Citable documents	10 154
Documents with matching country FP6 author - country WOS database	10 154
Documents WOS excluding SSH	9 955
DOCTYPE selection (article, letters, notes, reviews, proceedings)	8 318
Total number without other defects (total number identified)	**8 317**

Source: Technopolis Group – OST.
Note: Data are provided in presence counting mode (here, without double counting of co-publications) and for individual years.

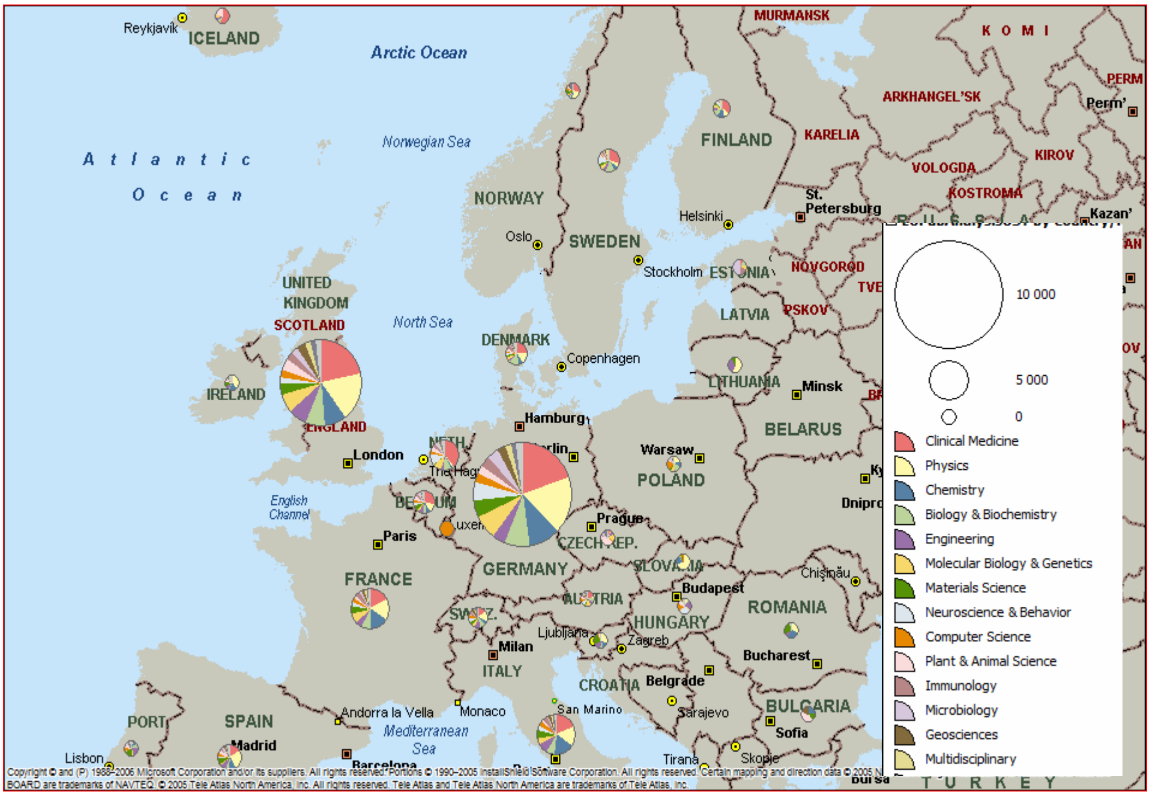
Appendix I Results of the matching in the WOS database

Exhibit 48 Lead scientists identified publications on the WOS online – by instrument and priority (2000-2006)

Instrument	Priority	Number of publications	Number** of citation	Number of FP6 project with required information	Number of publication / FP6 project	Number of citation / FP6 project
IP	1 LIFE SCIENCE HEALTH	10 775	333 066	121	89.0	2752,6
IP	3 NMP	2 830	40 580	97	29.2	418,4
IP	2 IST	2 471	29 933	231	10.7	129,6
IP	5 FOOD	1 117	18 370	31	36.0	592,6
IP	6 GLOBAL	821	15 204	47	17.5	323,5
IP	6 ENERGY	615	9 591	32	19.2	299,7
IP	7 CITIZENS	138	2 048	21	6.6	97,5
IP	4 AERO SPACE	126	646	38	3.3	17
IP	EURATOM	113	1 119	13	8.7	86,1
IP	*6 TRANSPORT*	*44*	*30*	*24*	*1.8*	*1,3*
IP	*6 OTHERS*	*17*	*140*	*48*	*0.4*	*2,9*
Total IP		**19 067**	**450 727**	**461**	**41,4**	**977,7**
NOE	1 LIFE SCIENCE HEALTH	2 376	81 149	39	60.9	2080,7
NOE	3 NMP	1 615	18 742	22	73.4	851,9
NOE	5 FOOD	1 086	23 569	12	90.5	1964,1
NOE	2 IST	974	10 203	59	16.5	172,9
NOE	7 CITIZENS	459	7 595	14	32.8	542,5
NOE	6 GLOBAL	125	2 843	8	15.6	355,4
NOE	4 AERO SPACE	20	246	3	6.7	82
NOE	*6 TRANSPORT*	*8*	*20*	*6*	*1.3*	*3,3*
NOE	*6 ENERGY*	*7*	*26*	*5*	*1.4*	*5,2*
Total NOE		**6 670**	**144 393**	**127**	**52,5**	**1137,0**
STREP	1 LIFE SCIENCE HEALTH	7 691	205 628	315	24.4	652,8
STREP	3 NMP	6 854	116 891	250	27.4	467,6
STREP	POLICY SUPPORT	5 231	100 406	362	14.5	277,4
STREP	2 IST	5 054	57 888	590	8.6	98,1
STREP	5 FOOD	1 887	29 439	60	31.5	490,7
STREP	INCO	1 634	18 829	144	11.3	130,8
STREP	4 AERO SPACE	1 161	21 214	150	7.7	141,4
STREP	6 GLOBAL	1 019	15 024	76	13.4	197,7
STREP	6 TRANSPORT	702	11 851	84	8.4	141,1
STREP	6 ENERGY	677	13 309	57	11.9	233,5
STREP	EURATOM	389	3 800	21	18.5	181
STREP	7 CITIZENS	314	6 323	80	3.9	79
STREP	*6 OTHERS*	*36*	*905*	*68*	*0.5*	*13,3*
STREP	*SCIENCE SOCIETY*	*16*	*122*	*16*	*1.0*	*7,6*
Total STREP		**32 665**	**601 629**	**1093**	**29,9**	**550,4**
TOTAL		**58 402**	**1 196 749**	**1681**	**34,7**	**711,9**

Source: Technopolis Group – OST.
Note: * data presented for the documents with collected information on citations; ** possible double counting of documents by instrument and priority.

Exhibit 49 Number of lead scientists' publications matched on the WOS online, by country and field of science (2002 - 2006)



Source: Technopolis Group – OST.
Note: WOS online classification of 22 scientific fields.

Exhibit 50 FP 6 lead scientists identified documents* on the WOS online – by country (2000-2006)

Country	Number of Projects	Number of publications	Number of citations	Number of publications / project	Number of citation / project
Germany	361	10 186	194 747	28,2	539,5
UK	273	9 289	214 603	34,0	786,1
Italy	199	5 400	93 275	27,1	468,7
France	211	5 229	116 388	24,8	551,6
Netherlands	142	3 716	75 901	26,2	534,5
Spain	102	3 133	46 083	30,7	451,8
Belgium	81	2 498	49 391	30,8	609,8
Denmark	48	2 195	48 730	45,7	1015,2
Sweden	67	2 135	48 595	31,9	725,3
Switzerland	68	1 686	36 548	24,8	537,5
Finland	34	1 225	32 176	36,0	946,4
Greece	68	895	8 501	13,2	125,0
Austria	52	704	17 705	13,5	340,5
Portugal	30	673	6 774	22,4	225,8
Ireland	21	535	7 915	25,5	376,9
Poland	16	347	2 164	21,7	135,3
Norway	31	334	4 542	10,8	146,5
Slovenia	8	330	2 037	41,3	254,6
Czech Republic	6	150	2 004	25,0	334,0
Hungary	10	139	1 423	13,9	142,3
Slovakia	3	129	947	43,0	315,7
Romania	1	67	570	67,0	570,0
Bulgaria	3	32	179	10,7	59,7
Estonia	2	29	205	14,5	102,5
Iceland	4	15	89	3,8	22,3
Lithuania	1	14	26	14,0	26,0
Luxembourg	1	1	0	1,0	0,0
Total	**1 681**	**51 086**	**1 011 518**	**30,4**	**601,7**

Note: * data presented for the cleut/Id_publication_codewith collected information on documents and citations; ** possible double counting of documents by country.

Appendix J 2-year bibliometric indicators

Exhibit 51 Lead scientists 2–year relative citation rate (per thousand) for all scientific fields taken together, by priority and year of publication (2002-2006)*

Relative citation rate (=A / B)	**2002**	**2003**	**2004**	**2005**	**2006**	**2002-2006**
1 LIFE SCIENCE HEALTH	1.29	1.31	1.29	1.28	1.24	1.28
3 NMP	1.18	1.15	1.19	1.24	1.28	1.21
2 IST	1.24	1.23	1.25	1.16	1.14	1.20
POLICY SUPPORT	1.05	1.09	1.11	1.19	1.21	1.13
5 FOOD	1.19	1.16	1.17	1.14	1.16	1.17
6 GLOBAL	1.19	1.19	1.20	1.21	1.19	1.20
6 ENERGY	1.32	1.45	1.56	1.51	1.43	1.45
INCO	0.98	1.04	1.04	1.05	0.98	1.02
4 AERO SPACE	1.16	1.25	1.25	1.22	1.17	1.21
7 CITIZENS	1.00	1.06	0.99	1.04	0.96	1.01
EURATOM	1.09	0.97	1.07	1.17	1.32	1.12
6 TRANSPORT	1.25	1.17	1.02	0.97	0.94	1.07
6 OTHERS	*0.84*	*0.87*	*1.02*	*1.16*	*1.02*	*0.98*
SCIENCE SOCIETY	*2.16*	*1.99*	*1.77*	*0.52*	*0.60*	*1.41*
Total	**1.22**	**1.23**	**1.24**	**1.23**	**1.22**	**1.23**

Exhibit 52 Lead scientists two years relative impact index (per thousand) for all scientific fields taken together, by priority and year of publication (2002-2006)*

Two-years relative impact index (A)	**2002**	**2003**	**2004**	**2005**	**2006**	**2002-2006**
1 LIFE SCIENCE HEALTH	2.81	2.79	2.75	2.69	2.67	2.74
3 NMP	1.11	1.13	1.21	1.33	1.36	1.23
2 IST	0.97	0.99	0.95	0.88	0.84	0.92
POLICY SUPPORT	1.62	1.68	1.62	1.73	1.69	1.67
5 FOOD	1.36	1.36	1.40	1.38	1.43	1.39
6 GLOBAL	1.08	1.12	1.21	1.33	1.38	1.22
6 ENERGY	1.18	1.27	1.43	1.39	1.30	1.31
INCO	0.92	1.04	1.00	1.06	0.96	1.00
4 AERO SPACE	0.85	0.90	0.97	0.92	0.84	0.90
7 CITIZENS	1.23	1.27	1.22	1.34	1.33	1.28
EURATOM	0.91	0.79	0.82	0.93	1.21	0.93
6 TRANSPORT	0.77	0.69	0.76	0.72	0.67	0.72
6 OTHERS	*1.19*	*1.09*	*1.27*	*1.36*	*1.25*	*1.23*
SCIENCE SOCIETY	*1.30*	*1.15*	*0.74*	*0.81*	*0.75*	*0.95*
Total	**1.68**	**1.67**	**1.67**	**1.67**	**1.65**	**1.67**

Exhibit 53 Lead scientists two years relative impact index (per thousand) for all scientific fields taken together, by priority and year of publication (2002-2006)*

Two-years expected impact index (B)	**2002**	**2003**	**2004**	**2005**	**2006**	**2002-2006**
1 LIFES CIENCE HEALTH	2.18	2.14	2.12	2.11	2.15	2.14
3 NMP	0.94	0.98	1.02	1.07	1.06	1.02
2 IST	0.79	0.80	0.76	0.76	0.73	0.77
POLICY SUPPORT	1.54	1.54	1.46	1.45	1.40	1.48
5 FOOD	1.14	1.17	1.20	1.21	1.23	1.19
6 GLOBAL	0.90	0.94	1.00	1.10	1.16	1.02
6 ENERGY	0.89	0.88	0.91	0.92	0.91	0.90
INCO	0.94	0.99	0.96	1.01	0.97	0.98
4 AERO SPACE	0.73	0.72	0.77	0.75	0.71	0.74
7 CITIZENS	1.23	1.21	1.23	1.29	1.39	1.27
EURATOM	0.83	0.81	0.77	0.80	0.91	0.82
6 TRANSPORT	0.61	0.59	0.75	0.74	0.71	0.68
6 OTHERS	*1.42*	*1.26*	*1.24*	*1.18*	*1.23*	*1.26*
SCIENCE SOCIETY	*0.60*	*0.58*	*0.42*	*1.56*	*1.26*	*0.88*
Total	**1.37**	**1.36**	**1.35**	**1.36**	**1.35**	**1.36**

Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

Exhibit 54 2–year relative impact index by country, years 2002 and 2006

	Number of publication		**Two-years relative impact index - World**	
	2002	**2006**	**2002**	**2006**
DEU	611.3	794.6	1.6	**1.7**
UK	595.7	672.7	2.0	**2.0**
ITA	288.3	370.3	1.4	**1.5**
FRA	316.6	336.9	2.1	**1.8**
NLD	205.9	246.6	1.9	**1.7**
ESP	210.9	225.6	1.0	0.9
BEL	141.2	202.4	1.6	**1.5**
CHE	90.0	154.4	1.8	**2.1**
DNK	115.4	149.7	1.9	**2.1**
SWE	123.1	144.4	1.9	**1.9**
GRC	56.6	90.9	0.7	0.6
FIN	57.1	82.7	2.2	**1.5**
ISR	64.8	68.8	1.8	**1.9**
PRT	*46.5*	64.6	1.1	0.6
AUT	*36.5*	55.6	2.6	**2.2**
IRL	*34.0*	*48.4*	*1.1*	***1.9***

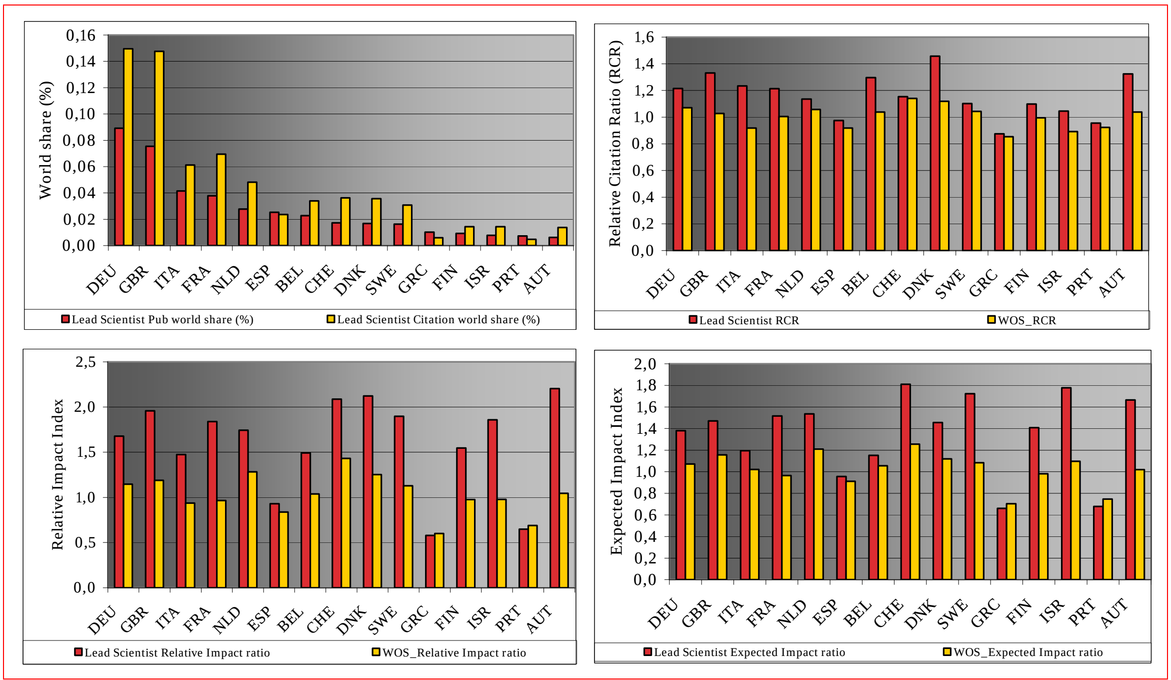
Exhibit 55 2–year relative impact index by country and priority*, years 2002 and 2006

		Number of publication		Two-years relative impact index - World	
Priorities with relevant data		**2002**	**2006**	**2002**	**2006**
1 LIFE SCIENCE HEALTH	DEU	201.4	241.0	2.4	**2.4**
	UK	174.3	192.7	3.4	**3.3**
	NLD	107.5	130.8	2.7	**2.2**
	FRA	124.7	127.8	3.2	**2.3**
	ITA	93.9	105.4	2.3	**2.4**
	SWE	52.6	63.7	2.0	**2.3**
	CHE	*42.1*	61.2	*2.0*	**2.8**
	BEL	50.3	52.7	3.2	**2.9**
	DNK	*43.8*	*46.6*	*3.0*	***4.2***
2 IST	DEU	131.7	164.9	1.1	0.9
	UK	52.4	84.2	1.6	**1.1**
	ESP	73.8	79.3	0.7	0.8
	ITA	53.3	76.4	0.7	0.7
	BEL	*23.7*	52.1	0.6	0.9
	FRA	*34.5*	*45.0*	*2.0*	***1.4***
3 NMP	DEU	111.2	179.5	1.1	**1.5**
	UK	95.7	107.9	1.5	**1.7**
	ITA	83.3	107.2	1.1	**1.5**
	FRA	67.4	75.9	0.9	**1.3**
	ESP	69.0	66.8	0.9	0.9
	FIN	*21.1*	*47.1*	*1.0*	*1.1*
POLICY SUPPORT	UK	55.7	72.9	1.5	**2.0**
	DEU	51.0	65.2	2.4	**2.3**
	ITA	*18.8*	*40.2*	*1.2*	*0.9*
5 FOOD	UK	86.6	81.1	1.3	**1.1**
	DEU	*37.5*	52.0	1.3	**1.7**
	FRA	*26.8*	*23.9*	*1.2*	***1.9***

Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]). Countries with at least 50 publications by priority, except those in blue colour.
*Data for other priorities are not relevant (N<20).

Appendix K Country profiles

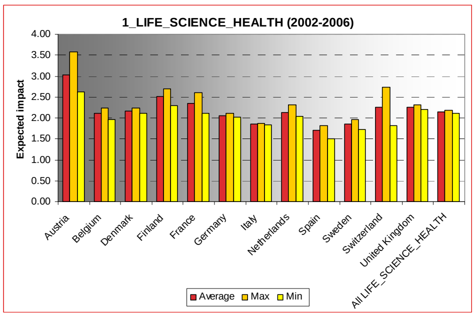
Exhibit 56 Main indicators all scientific fields and priorities taken together (2006)

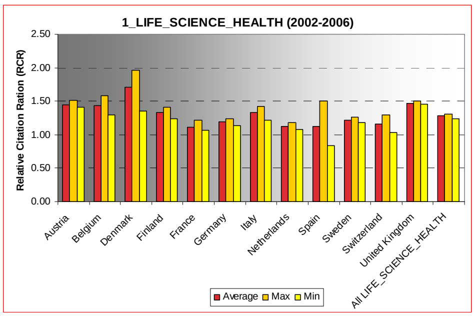


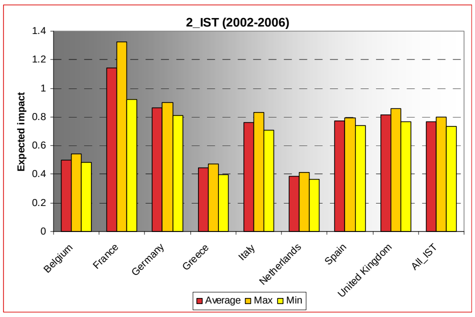
Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

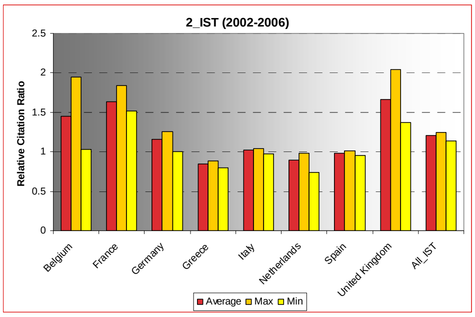
Appendix L Citation performance of FP6 lead scientists by priority and country

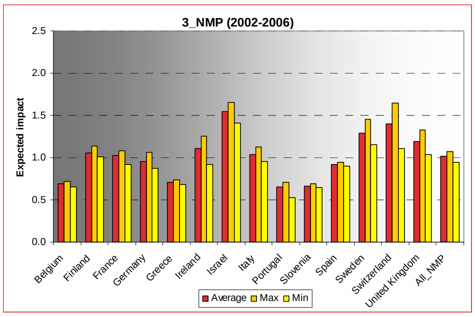
Exhibit 57 Expected impact and relative citation rate by priority - priorities 1-4

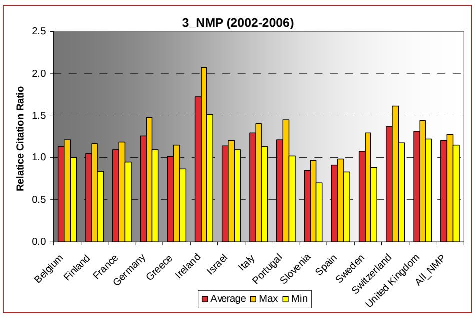


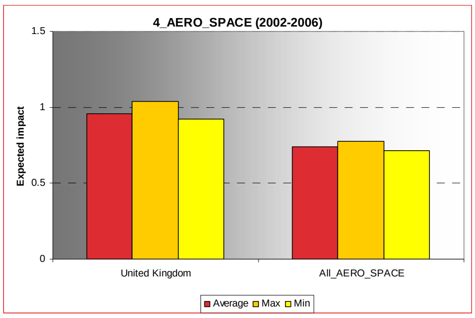


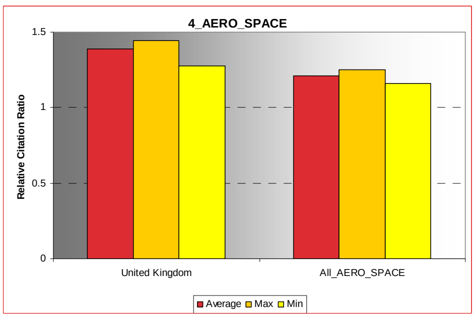






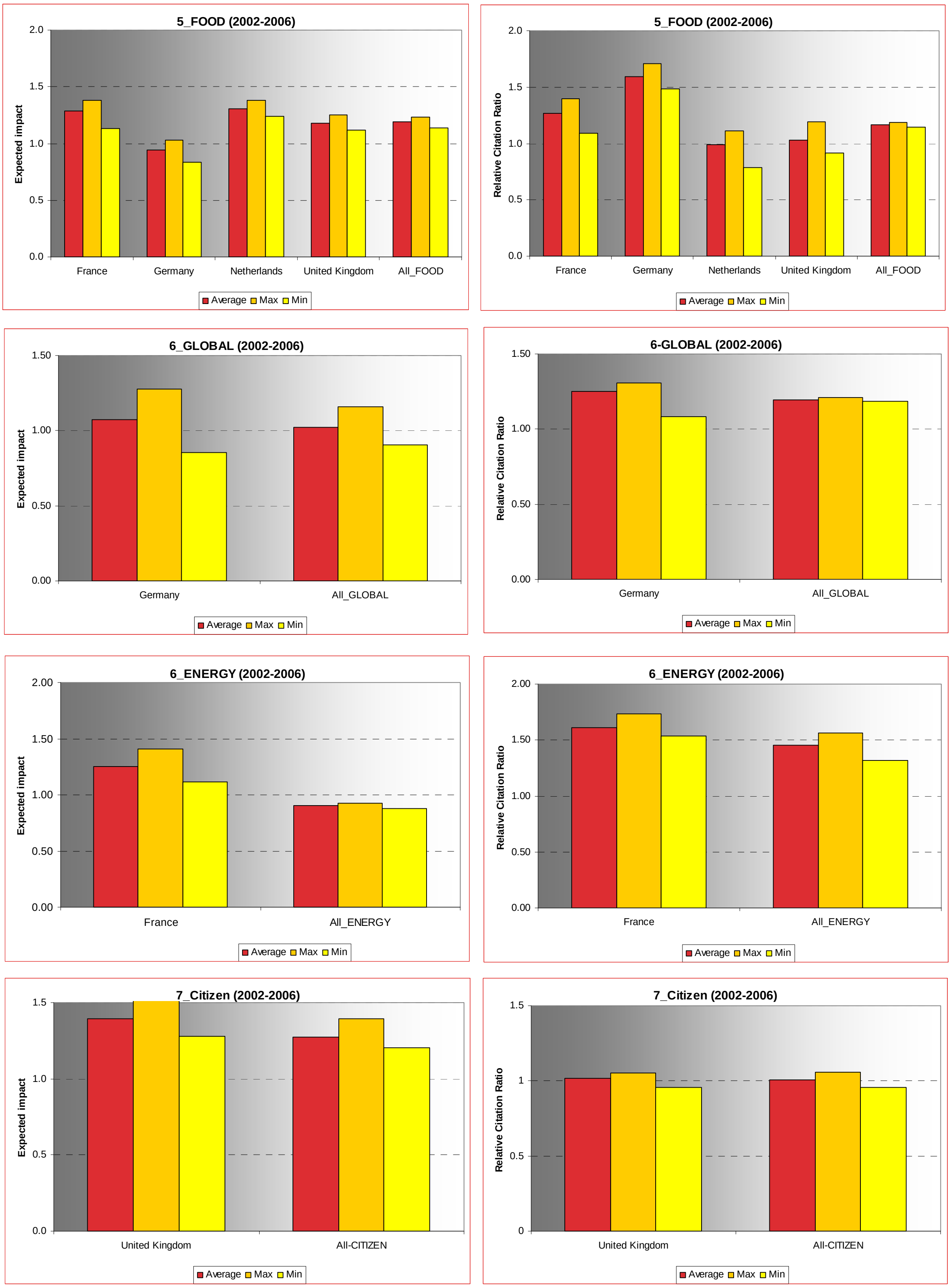






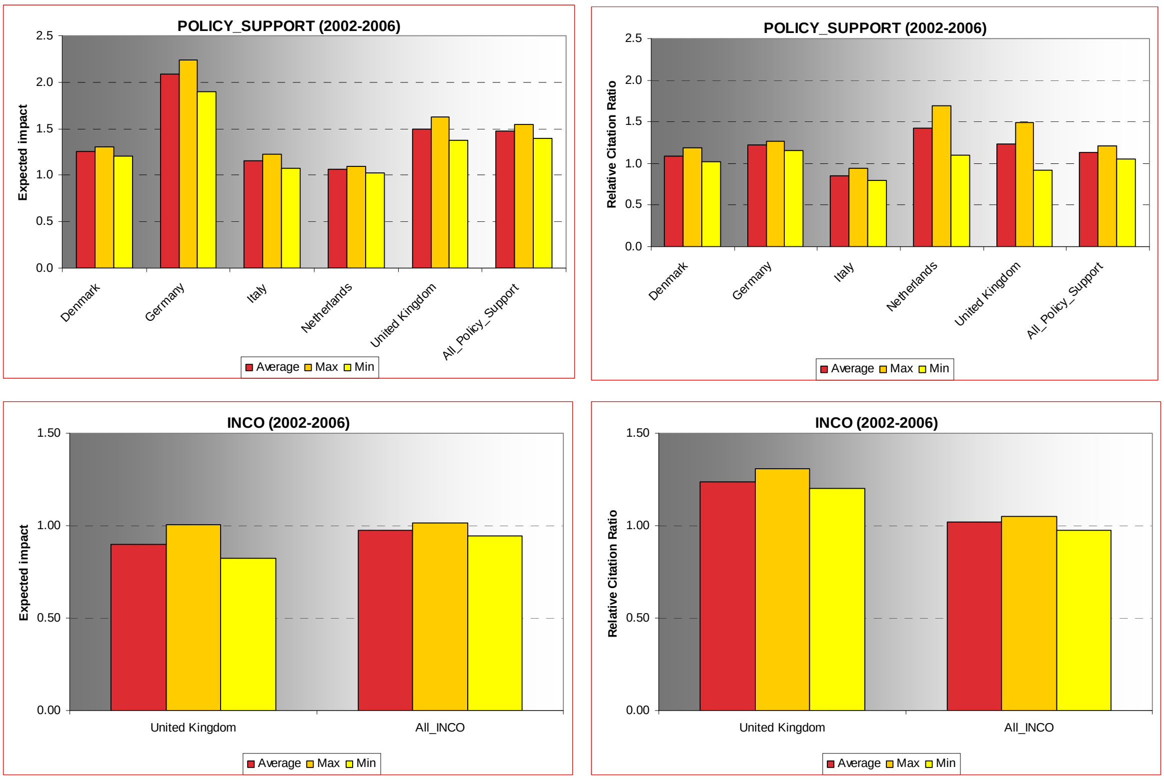
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

Exhibit 58 Expected impact and relative citation rate (2002-2006) by priority - priorities 5-7



Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

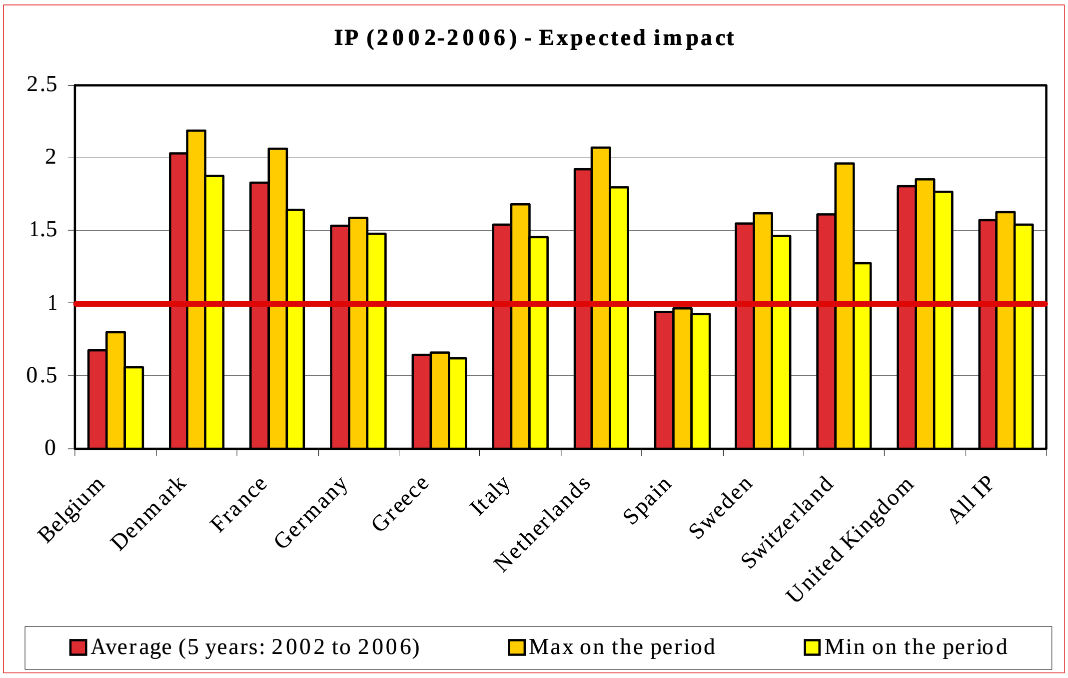
Exhibit 59 Expected impact and relative citation rate (2002-2006) by priority: policy support, INCO

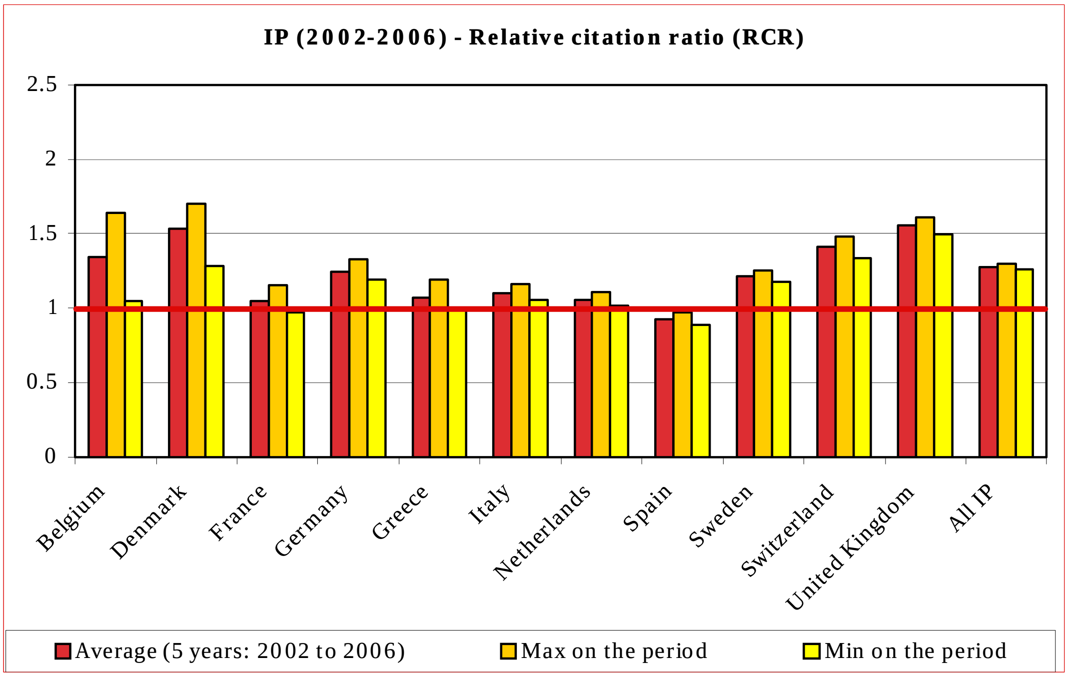


Source: Technopolis Group – OST.
Note: Data in fraction counting mode and for average years (2006=mean [2004, 2005, 2006]).

Appendix M Citation performance of FP6 lead scientists by instruments and country

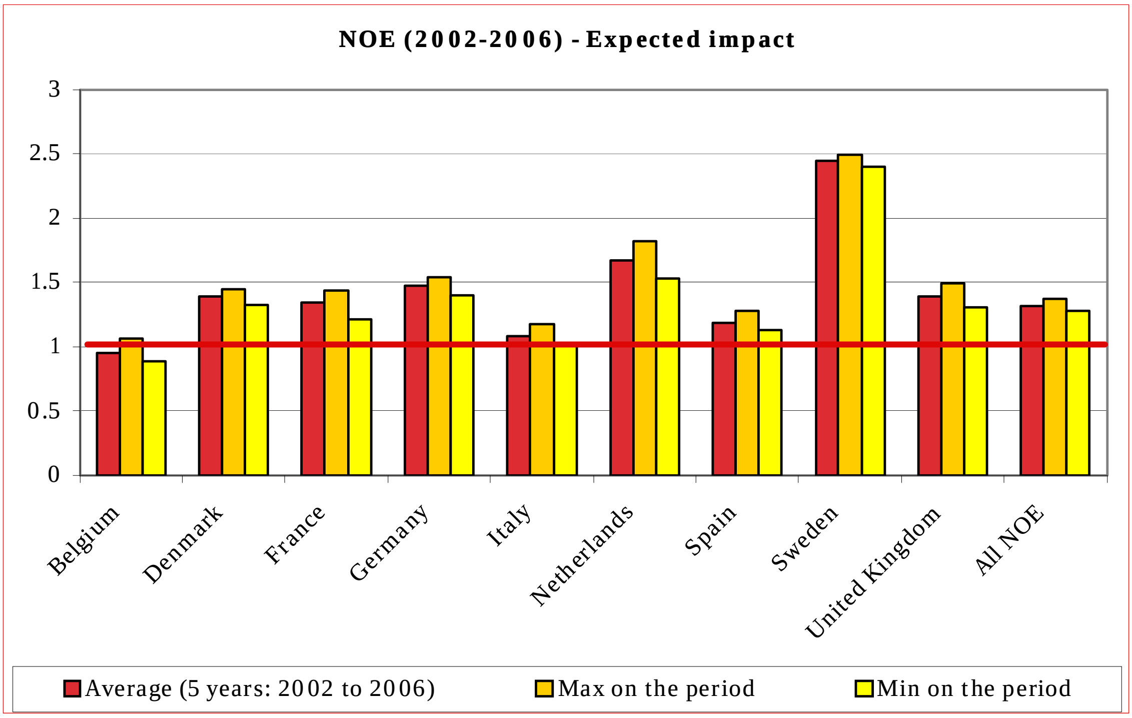
Exhibit 60 Expected impact and relative citation rate of lead scientists involved in IP projects, by country (2002 to 2006)

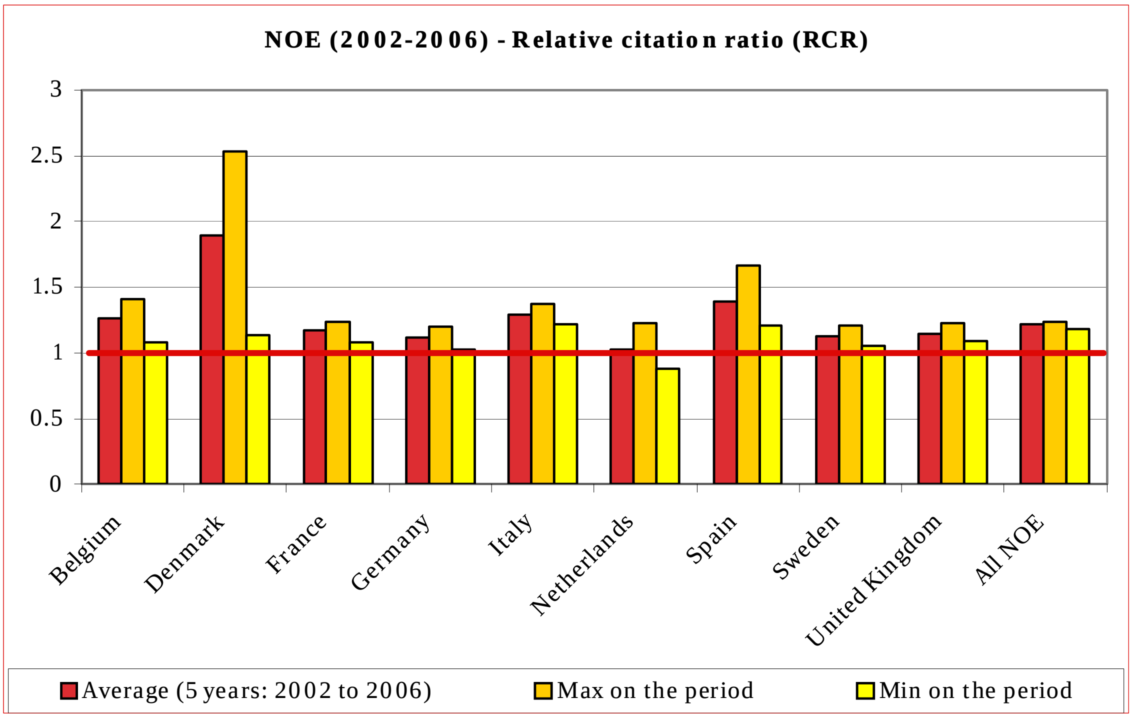




Source: Technopolis Group – OST.
Note: When the RCR indicator is higher than 1 lead scientists enjoys a higher citation performance (visibility) than the average of all articles published in the journals in which their articles appear.

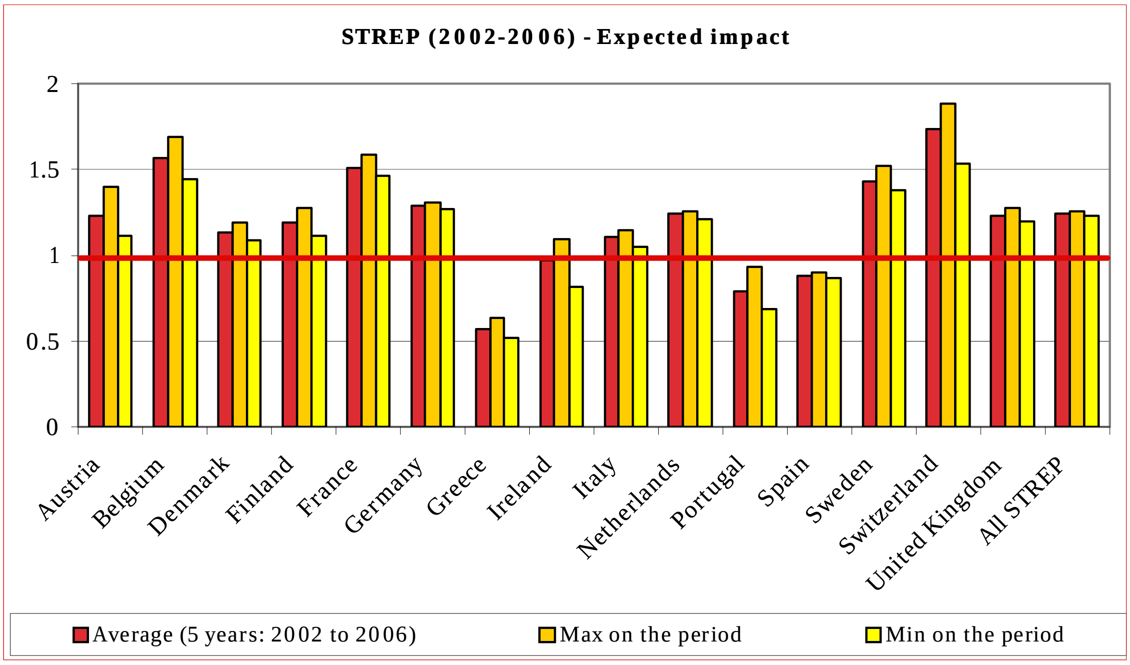
Exhibit 61 Expected impact and relative citation rate of lead scientists involved in NOE projects, by country (2002 to 2006)

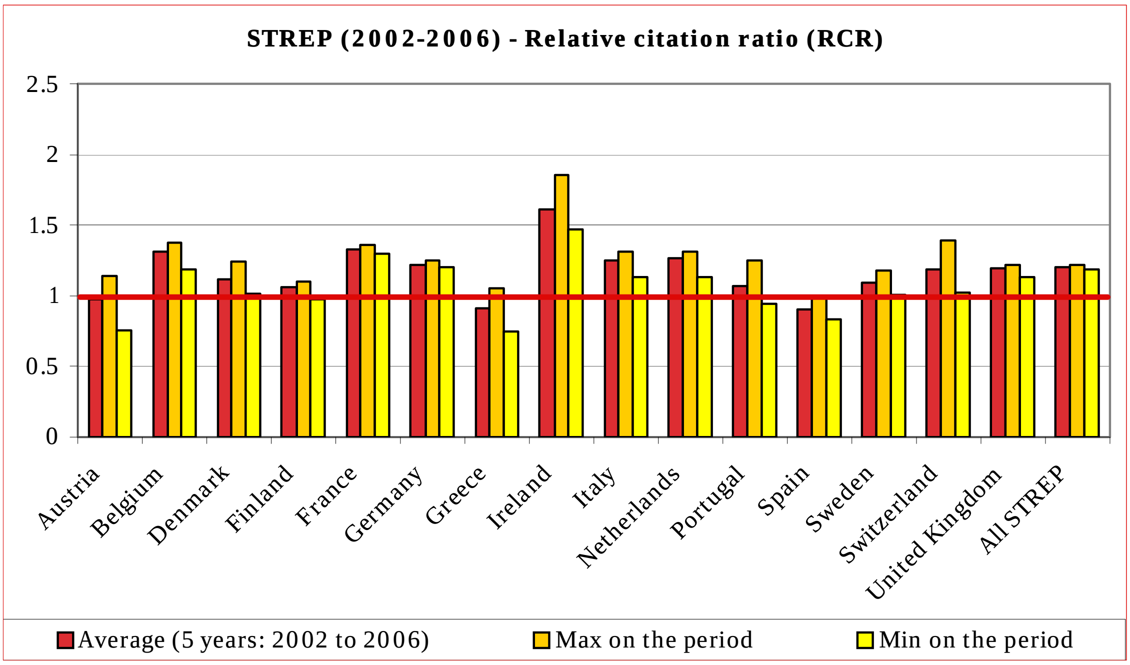




Source: Technopolis Group – OST.
Note: When the RCR indicator is higher than 1 lead scientists enjoys a higher citation performance (visibility) than the average of all articles published in the journals in which their articles appear.

Exhibit 62 Expected impact and relative citation rate of lead scientists involved in STREP projects, by country (2002 to 2006)





Source: Technopolis Group – OST.
Note: When the RCR indicator is higher than 1 lead scientists enjoys a higher citation performance (visibility) than the average of all articles published in the journals in which their articles appear.

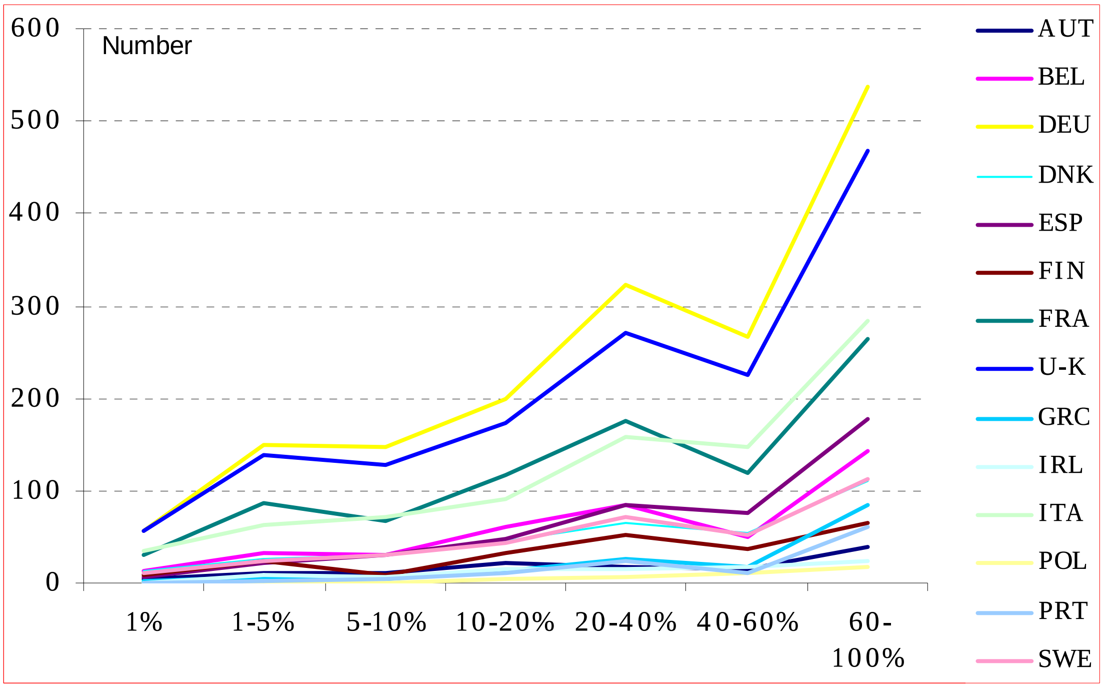
Appendix N Indicators of citation performance by class of citations

Exhibit 63 Number of publications of lead scientists by class of citation (2006)

Country	1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-100%	Total
AUT	5	11	10	21	18	16	39	120
BEL	13	33	31	60	85	50	142	414
DEU	56	150	147	199	322	267	537	1678
DNK	12	25	31	46	65	55	111	345
ESP	7	21	30	48	85	76	177	444
FIN	8	23	9	32	51	36	64	223
FRA	31	86	68	118	176	119	265	863
U-K	56	138	128	174	271	225	467	1459
GRC	3	7	4	12	25	17	84	152
IRL	1	8	6	16	16	18	23	88
ITA	34	62	71	91	159	147	284	848
POL	0	1	1	5	6	10	17	40
PRT	0	3	5	11	24	10	60	113
SWE	11	23	31	43	72	52	112	344

Source: Technopolis Group – OST.

Exhibit 64 Number of publications of lead scientists by class of citation (2006)



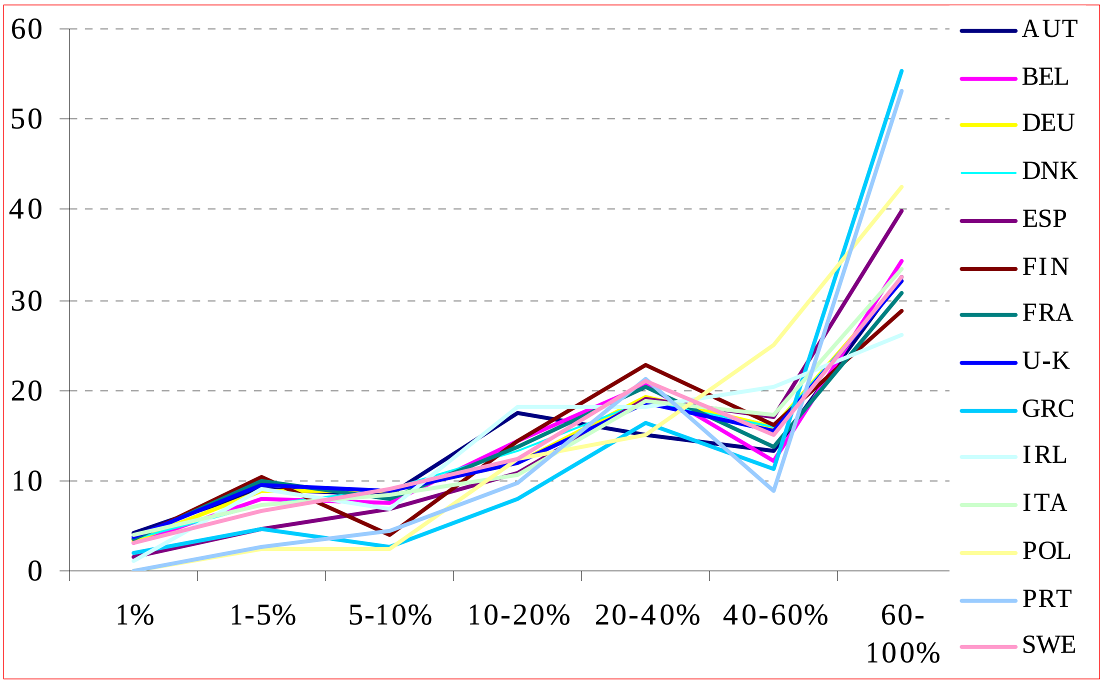
Source: Technopolis Group – OST.

Exhibit 65 Distribution of publications of the lead scientists by class of citation and by country (2006)

Country	1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-100%	Total
AUT	4.2	9.2	8.3	17.5	15.0	13.3	32.5	100.0
BEL	3.1	8.0	7.5	14.5	20.5	12.1	34.3	100.0
DEU	3.3	8.9	8.8	11.9	19.2	15.9	32.0	100.0
DNK	3.5	7.2	9.0	13.3	18.8	15.9	32.2	100.0
ESP	1.6	4.7	6.8	10.8	19.1	17.1	39.9	100.0
FIN	3.6	10.3	4.0	14.3	22.9	16.1	28.7	100.0
FRA	3.6	10.0	7.9	13.7	20.4	13.8	30.7	100.0
U-K	3.8	9.5	8.8	11.9	18.6	15.4	32.0	100.0
GRC	2.0	4.6	2.6	7.9	16.4	11.2	55.3	100.0
IRL	1.1	9.1	6.8	18.2	18.2	20.5	26.1	100.0
ITA	4.0	7.3	8.4	10.7	18.8	17.3	33.5	100.0
POL	0.0	2.5	2.5	12.5	15.0	25.0	42.5	100.0
PRT	0.0	2.7	4.4	9.7	21.2	8.8	53.1	100.0
SWE	3.2	6.7	9.0	12.5	20.9	15.1	32.6	100.0

Source: Technopolis Group – OST.

Exhibit 66 Distribution of publications of the lead scientists by class of citation and by country (2006)



Source: Technopolis Group – OST.

Exhibit 67 Activity index of the lead scientist publications by class of citation and by country (2006)

Country	1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-100%
AUT	**3.8**	**2.4**	**1.8**	**2.1**	*0.9*	*0.9*	*0.6*
BEL	**2.9**	**2.0**	**1.6**	**1.8**	**1.3**	*0.8*	*0.7*
DEU	**3.1**	**2.3**	**1.9**	**1.4**	**1.2**	**1.1**	*0.6*
DNK	**3.2**	**1.9**	**1.9**	**1.6**	**1.2**	**1.1**	*0.6*
ESP	**1.4**	**1.2**	**1.4**	**1.3**	**1.2**	**1.1**	*0.8*
FIN	**3.3**	**2.7**	*0.9*	**1.7**	**1.4**	**1.1**	*0.6*
FRA	**3.3**	**2.6**	**1.7**	**1.7**	**1.3**	*0.9*	*0.6*
U-K	**3.5**	**2.4**	**1.9**	**1.4**	**1.2**	**1.0**	*0.6*
GRC	**1.8**	**1.2**	*0.6*	*1.0*	**1.0**	*0.7*	**1.1**
IRL	**1.0**	**2.3**	**1.5**	**2.2**	**1.1**	**1.4**	*0.5*
ITA	**3.7**	**1.9**	**1.8**	**1.3**	**1.2**	**1.1**	*0.7*
NLD	**2.0**	**2.1**	**1.6**	**1.6**	**1.4**	*1.0*	*0.6*
POL	*0.0*	*0.6*	*0.5*	**1.5**	*0.9*	**1.7**	*0.8*
PRT	*0.0*	*0.7*	*0.9*	**1.2**	**1.3**	*0.6*	**1.0**
SWE	**2.9**	**1.7**	**1.9**	**1.5**	**1.3**	**1.0**	*0.6*

Source: Technopolis Group – OST.

Exhibit 68 Activity index by class of citation and by scientific field of science (2006)

	Class of citation	1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-100%	Total
Fundamental Biology	Leadscientists (a)	2.3%	7.3%	7.4%	12.0%	21.0%	16.1%	34.0%	100.0%
	Authors in WoS (b)	1.1%	3.9%	4.5%	8.1%	19.2%	15.3%	47.9%	100.0%
	Number of publications of leadscientists	54	170	171	279	488	374	790	2326
	Activity Index (a/b)	**2.2**	**1.9**	**1.6**	**1.5**	**1.1**	**1.0**	0.7	
Medical research	Leadscientists (a)	2.9%	9.0%	8.7%	12.3%	20.2%	15.3%	31.6%	100.0%
	Authors in WoS (b)	1.1%	3.9%	4.6%	8.5%	15.3%	16.1%	50.4%	100.0%
	Number of publications of leadscientists	74	234	226	319	523	395	819	2590
	Activity Index (a/b)	**2.7**	**2.3**	**1.9**	**1.4**	**1.3**	**0.9**	0.6	
Applied Biology - Ecology	Leadscientists (a)	2.8%	6.6%	6.1%	8.3%	19.7%	19.5%	37.1%	100.0%
	Authors in WoS (b)	0.9%	3.2%	3.9%	6.8%	14.4%	19.3%	51.5%	100.0%
	Number of publications of leadscientists	*13*	*31*	*29*	*39*	93	92	175	472
	Activity Index (a/b)	**3.1**	**2.0**	**1.6**	**1.2**	**1.4**	**1.0**	0.7	
Chemistry	Leadscientists (a)	2.6%	6.7%	6.5%	11.8%	18.3%	19.7%	34.4%	100.0%
	Authors in WoS (b)	0.9%	3.7%	4.1%	8.0%	14.2%	18.8%	50.3%	100.0%
	Number of publications of leadscientists	*38*	96	94	169	263	284	494	1438
	Activity Index (a/b)	**2.8**	**1.8**	**1.6**	**1.5**	**1.3**	**1.1**	0.7	
Physics	Leadscientists (a)	3.0%	8.0%	7.9%	12.1%	20.3%	20.5%	28.3%	100.0%
	Authors in WoS (b)	1.0%	3.8%	4.1%	8.1%	16.6%	20.9%	45.4%	100.0%
	Number of publications of leadscientists	*40*	106	105	161	270	272	376	1330
	Activity Index (a/b)	**3.1**	**2.1**	**1.9**	**1.5**	**1.2**	**1.0**	0.6	
Earth and space sciences	Leadscientists (a)	3.0%	5.5%	8.3%	11.5%	18.0%	20.6%	33.2%	100.0%
	Authors in WoS (b)	1.0%	3.6%	4.8%	8.6%	13.8%	22.1%	46.2%	100.0%
	Number of publications of leadscientists	*17*	*31*	*47*	65	102	117	188	567
	Activity Index (a/b)	**3.1**	**1.5**	**1.7**	**1.3**	**1.3**	0.9	0.7	
Engineering and technology	Leadscientists (a)	2.1%	5.2%	6.1%	11.7%	14.0%	5.3%	55.6%	100.0%
	Authors in WoS (b)	0.9%	2.9%	4.2%	8.1%	14.0%	4.2%	65.7%	100.0%
	Number of publications of leadscientists	*24*	61	71	137	164	62	649	1168
	Activity Index (a/b)	**2.3**	**1.8**	**1.4**	**1.4**	**1.0**	**1.3**	0.8	
Mathematics	Leadscientists (a)	1.5%	10.3%	2.9%	11.8%	16.2%	16.2%	41.2%	100.0%
	Authors in WoS (b)	0.8%	3.0%	4.7%	4.0%	16.5%	5.8%	65.0%	100.0%
	Number of publications of leadscientists	*1*	*7*	*2*	*8*	*11*	*11*	*28*	68
	Activity Index (a/b)	**1.8**	**3.4**	**0.6**	**2.9**	**1.0**	**2.8**	0.6	
All fields gathered	Leadscientists (a)	2.8%	8.2%	7.9%	12.3%	19.6%	15.2%	34.1%	100.0%
	Authors in WoS (b)	1.0%	4.0%	5.0%	10.0%	20.0%	20.0%	40.0%	100.0%
	Number of publications of leadscientists	228	656	631	987	1572	1223	2737	8034
	Activity Index (a/b)	**2.8**	**2.0**	**1.6**	**1.2**	**1.0**	0.8	0.9	

Source: Technopolis Group – OST.
Note: data for which numbers of publications are lower than 50 are highlighted in blue.
Lead scientists (a): distribution of the lead scientists publications by class of citation
Authors in WoS (b): distribution of the 'authors in WoS' publications by class of citation
Activity indexes higher than 1 are highlighted in Bold character.

Exhibit 69 Activity index by class of citation and priorities (2006)

	Class of citation	1%	1-5%	5-10%	10-20%	20-40%	40-60%	60-100%	Total
1_LIFE_SCIENCE_HEALTH									
Fundamental Biology	Leadscientists (a)	*2.9%*	8.4%	7.7%	13.6%	22.9%	15.7%	28.7%	100.0%
	Authors in WoS (b)	*1.1%*	3.9%	4.5%	8.1%	19.2%	15.3%	47.9%	100.0%
	Number of publications of leadscientists	*40*	116	106	188	315	217	396	1378
	Activity Index (a/b)	***2.7***	**2.1**	**1.7**	**1.7**	**1.2**	**1.0**	0.6	
Medical research	Leadscientists (a)	3.5%	10.2%	9.3%	13.6%	21.3%	14.9%	27.3%	100.0%
	Authors in WoS (b)	1.1%	3.9%	4.6%	8.5%	15.3%	16.1%	50.4%	100.0%
	Number of publications of leadscientists	55	162	147	215	338	236	433	1586
	Activity Index (a/b)	**3.2**	**2.6**	**2.0**	**1.6**	**1.4**	0.9	0.5	
2_IST									
Engineering and technology	Leadscientists (a)	*2.0%*	*4.9%*	*4.5%*	10.9%	11.6%	0.5%	65.5%	100.0%
	Authors in WoS (b)	*0.9%*	*2.9%*	*4.2%*	8.1%	14.0%	4.2%	65.7%	100.0%
	Number of publications of leadscientists	*11*	*27*	*25*	60	64	3	360	550
	Activity Index (a/b)	**2.2**	**1.7**	**1.1**	**1.3**	0.8	0.1	1.0	
3_NMP									
Chemistry	Leadscientists (a)	*3.3%*	7.4%	6.1%	13.4%	17.0%	19.7%	33.1%	100.0%
	Authors in WoS (b)	*0.9%*	3.7%	4.1%	8.0%	14.2%	18.8%	50.3%	100.0%
	Number of publications of leadscientists	*28*	63	52	115	146	169	284	857
	Activity Index (a/b)	***3.4***	**2.0**	**1.5**	**1.7**	**1.2**	**1.1**	0.7	
Physics	Leadscientists (a)	*3.7%*	8.1%	9.4%	14.0%	17.6%	22.1%	25.2%	100.0%
	Authors in WoS (b)	*1.0%*	3.8%	4.1%	8.1%	16.6%	20.9%	45.4%	100.0%
	Number of publications of leadscientists	*23*	51	59	88	111	139	159	630
	Activity Index (a/b)	***3.7***	**2.1**	**2.3**	**1.7**	**1.1**	**1.1**	0.6	
POLICY_SUPPORT									
Fundamental Biology	Leadscientists (a)	*2.9%*	*8.4%*	*7.7%*	*13.6%*	22.9%	15.7%	28.7%	100.0%
	Authors in WoS (b)	*1.1%*	*3.9%*	*4.5%*	*8.1%*	19.2%	15.3%	47.9%	100.0%
	Number of publications of leadscientists	*8*	*21*	*16*	*27*	50	48	102	272
	Activity Index (a/b)	***2.7***	***2.1***	***1.7***	***1.7***	**1.2**	**1.0**	0.6	
Medical research	Leadscientists (a)	*2.9%*	*8.4%*	*7.7%*	*13.6%*	*22.9%*	*15.7%*	28.7%	100.0%
	Authors in WoS (b)	*1.1%*	*3.9%*	*4.5%*	*8.1%*	*19.2%*	*15.3%*	47.9%	100.0%
	Number of publications of leadscientists	*8*	*12*	*19*	*33*	*39*	*38*	94	243
	Activity Index (a/b)	***2.7***	***2.1***	***1.7***	***1.7***	***1.2***	***1.0***	0.6	
5_FOOD									
Fundamental Biology	Leadscientists (a)	*0.8%*	*4.7%*	*6.2%*	*13.6%*	*16.3%*	*15.1%*	43.4%	100.0%
	Authors in WoS (b)	*1.1%*	*3.9%*	*4.5%*	*8.1%*	*19.2%*	*15.3%*	47.9%	100.0%
	Number of publications of leadscientists	*2*	*12*	*16*	*35*	*42*	*39*	112	258
	Activity Index (a/b)	*0.7*	***1.2***	***1.4***	***1.7***	*0.8*	***1.0***	0.9	
Medical research	Leadscientists (a)	*1.6%*	*6.6%*	*7.8%*	*10.9%*	26.1%	9.7%	37.4%	100.0%
	Authors in WoS (b)	*1.1%*	*3.9%*	*4.6%*	*8.5%*	15.3%	16.1%	50.4%	100.0%
	Number of publications of leadscientists	*4*	*17*	*20*	*28*	67	25	96	257
	Activity Index (a/b)	***1.5***	***1.7***	***1.7***	***1.3***	**1.7**	0.6	0.7	

Note: For each class by broad field: at least 25 publications by priority and 80 publications by broad scientific field
Lead scientists (a): distribution of lead scientists publications by class of citation
Authors in WoS (b): distribution of the 'authors in WoS' publications by class of citation
Data for which numbers of publications are lower than 50 are highlighted in blue.
Activity indexes higher than 1 are highlighted in Bold character.

Appendix O Distribution of lead scientists in the top class of citation, by country and by field of science

Exhibit 70 Percentage of lead scientists with at lest one publication in the top 1% - by country and by field of science

%	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Iceland	Ireland	Italy	Luxembourg	Netherlands	Norway	Portugal	Spain	Sweden	Switzerland	UK	Total
Agricultural Sciences					6	13	14		33	8		13		20	6	25		21	12
Biology & Biochemistry	31	33	23	17	12	11	15			10		7	33	14		10	19	12	12
Chemistry			13	27	11	13			38	9		4			8	9	8	12	11
Clinical Medicine	25	67	20	42	20	10	8			12		23	17		6	22	15	29	18
Computer Science						2	6			3				10	10	11	8		3
Economics & Business																		8	3
Engineering	6	25	9	13	8	10	6		13	7		3		9	13	10	10	12	9
Environment/Ecology	20				5					8			17		6		11	4	4
Geosciences					18	4	25			13							33	14	9
Immunology				33	4					7		7				8		2	3
Materials Science						12	11		20	3				20	12	9	14	12	8
Mathematics					13													8	4
Microbiology		33				7				5		4						9	4
Molecular Biology & Genetics	25		15	14	4	7										15		20	8
Neuroscience & Behavior				20	4	4				6							11	6	4
Pharmacology & Toxicology				17	9	2				10				25				6	5
Physics	25	40	12	50	25	23	10		38	16					21	13	24	30	22
Plant & Animal Science	14				14	8				11		4			17	14		7	8
Psychiatry/Psychology				33						13		8						14	7
Social Sciences, general			13		14	19				13		16	33		33	17		8	13
Space Science				100		11											100	16	9
Multidisciplinary	17		23	25	26	35	50			20		33			30	31	31	45	32

Source: Web of Science online – estimation Technopolis Group.
This table reads as follows:
Example: 31% of Austrian lead scientists publishing in the biology and biochemistry have published at least one publication that falls in the top 1% world most cited publications in this field

Appendix P Structure of collaborations

Exhibit 71 Comparison of structure of collaboration lead scientists / authors in the Web of Science

	Lead scientists				Authors in Web of Science				
Country	Co pubs (a)	Mono address labs pubs (b)	Total pubs (a+b)	Total pubs (a+b)	Co pubs (c)	Mono address labs pubs (d)	Total number of pubs (c+d)	Total number of pubs (c+d)	Delta lead scientist / authors in WoS in terms of pubs in co pubs
AUT	79%	21%	100%	119.7	74%	26%	100%	8 772.0	**6%**
BEL	78%	22%	100%	409.7	75%	25%	100%	12 544.3	**5%**
BGR	*93%*	*7%*	*100%*	*4.7*	*75%*	*25%*	*100%*	*1 680.0*	*24%*
CZE	*81%*	*19%*	*100%*	*31.3*	*74%*	*26%*	*100%*	*5 847.7*	*9%*
DEU	76%	24%	100%	1659.3	67%	33%	100%	72 850.3	**13%**
DNK	84%	16%	100%	334.3	76%	24%	100%	8 820.0	**10%**
ESP	79%	21%	100%	449.3	67%	33%	100%	30 468.3	**18%**
EST	*78%*	*22%*	*100%*	*3.0*	*71%*	*29%*	*100%*	*728.3*	*10%*
FIN	82%	18%	100%	203.7	77%	23%	100%	8 095.7	**5%**
FRA	84%	16%	100%	831.3	74%	26%	100%	52 729.7	**14%**
GRC	63%	37%	100%	152.0	66%	34%	100%	7 866.7	**-5%**
HUN	*74%*	*26%*	*100%*	*23.0*	*76%*	*24%*	*100%*	*4 798.3*	*-3%*
IRL	70%	30%	100%	85.3	69%	31%	100%	3 942.7	**1%**
ITA	83%	17%	100%	878.3	75%	25%	100%	40 957.3	**11%**
LTU	*33%*	*67%*	*100%*	*2.0*	*62%*	*38%*	*100%*	*934.3*	*-46%*
LUX	*100%*	*0%*	*100%*	*0.3*	*84%*	*16%*	*100%*	*173.7*	*18%*
NLD	84%	16%	100%	572.0	77%	23%	100%	22 385.7	**10%**
POL	86%	14%	100%	42.7	62%	38%	100%	14 052.0	**40%**
PRT	73%	27%	100%	117.0	77%	23%	100%	5 537.7	**-5%**
ROM	*94%*	*6%*	*100%*	*11.3*	*73%*	*27%*	*100%*	*2 488.0*	*29%*
SVK	*82%*	*18%*	*100%*	*20.0*	*73%*	*27%*	*100%*	*2 057.0*	*12%*
SVN	*79%*	*21%*	*100%*	*43.7*	*66%*	*34%*	*100%*	*1 941.3*	*18%*
SWE	83%	17%	100%	324.7	75%	25%	100%	16 313.0	**11%**
U-K	76%	24%	100%	1439.0	65%	35%	100%	73 436.0	**18%**

Source: Technopolis Group – OST.

Appendix Q Model of collaboration

Exhibit 72 Partnerships in the Web of Science (2006): ranking based on number of copublications of the authors in WoS

	Country lead scientists															
	AUT	BEL	CZE	DEU	DNK	ESP	FIN	FRA	GRC	IRL	ITA	NLD	POL	PRT	SWE	U-K
Country WoS																
AUS																**9**
AUT	**1**			10												
BEL		1						9	10			7				
BRA														8		
CAN		10				9		8		9	9	10				7
RUS			8	8			9				10		7			
CHE	7	9		6		8		7	9		7	9	10	10		
CHN																10
CZE			1													
DEU	**2**	6	2	1	4	5	5	3	4	4	4	3	3	6	4	3
DNK					1										6	
ESP	8	8		9	10	1		6	7	8	6	8	9	3		8
FIN							1								8	
FRA	6	3	4	4	6	4	6	1	5	5	3	5	4	5	5	4
GRC									1							
HRV																
IRL										1						
ITA	5	7	6	5	8	6	7	5	6	6	1	6	6	7	7	5
JPN													8			
NLD	9	5	10	7	7	7	8	10	8	7	8	1		9	9	6
NOR					9		10								10	
POL	10		9										1			
PRT						10								1		
SVK			7													
SVN																
SWE					5		3			10					1	
U-K	4	4	5	3	3	3	4	4	3	2	5	4	5	2	3	1
USA	3	2	3	2	2	2	2	2	2	3	2	2	2	4	2	2

Source: Technopolis Group – OST.
Note: Presence counting mode.
Exemple of reading: Austrian and German authors are respectively the first and 2nd partners of Austrian Lead Scienstists.

Exhibit 73 Partnerships in the Web of Science (2006) - Distribution of the number of copublications

	Country															
	AUT	BEL	CZE	DEU	DNK	ESP	FIN	FRA	GRC	IRL	ITA	NLD	POL	PRT	SWE	U-K
Country WoS																
AUS																**2.7**
AUT	**32.9**			2.4												
BEL		34.0						2.9	2.1			5.2				
BRA														3.9		
CAN		3.0				1.9		2.9		3.0	2.0	2.9				2.8
RUS			4.5	3.3			3.8				2.0		3.6			
CHE	5.4	3.8		3.8		1.9		3.3	2.1		3.0	3.1	2.1	2.9		
CHN																2.1
CZE			39.2													
DEU	**19.6**	9.0	12.0	35.3	9.7	6.0	8.2	7.2	6.3	7.4	6.9	10.9	9.1	7.3	8.6	6.3
DNK					35.5										4.8	
ESP	3.5	4.3		2.5	3.8	39.7		3.8	2.9	3.5	4.1	3.7	2.4	9.9		2.8
FIN							48.2								4.2	
FRA	5.8	12.1	8.0	5.2	5.6	6.6	4.6	42.4	5.0	5.7	6.9	6.4	6.0	8.2	5.2	4.8
GRC									41.1							
HRV																
IRL										30.1						
ITA	6.0	5.8	5.1	3.9	4.8	5.5	4.2	5.4	4.6	4.2	52.4	5.2	3.6	4.8	4.2	3.8
JPN													2.5			
NLD	3.4	9.2	3.1	3.4	5.0	2.7	3.9	2.7	2.5	3.8	2.9	42.3		3.5	3.6	3.1
NOR					4.6		3.1								3.6	
POL	2.6		4.4										31.2			
PRT						1.8								43.1		
SVK			4.6													
SVN																
SWE					8.9		8.5			2.5					38.7	
U-K	6.5	9.4	6.8	6.3	10.7	6.7	8.3	6.7	8.4	18.3	6.9	10.3	4.5	10.5	8.7	34.1
USA	12.3	12.3	10.1	12.9	14.3	9.8	12.2	11.2	11.2	12.8	12.4	13.9	10.1	9.8	13.6	12.6

Source: Technopolis Group – OST.
Note: Presence counting mode.
Exemple of reading: 32.9% of Austrian copublications has at least two adresses labs in Austria. 19.6% of Austrian copublications has at least one address labs in Germany.

Exhibit 74 Partnerships of FP 6 lead scientists (2006): ranking based on number of copublications of FP 6 lead scientists

	Country lead scientists															
	AUT	BEL	CZE	DEU	DNK	ESP	FIN	FRA	GRC	IRL	ITA	NLD	POL	PRT	SWE	U-K
Country WoS																
AUS																
AUT	**1**												**5**			
BEL		1				8				9		7	9			
BRA														7		
CAN	**4**			9		7	8	9	8		8					6
RUS				6			9	10			9					9
CHE	5	8		10	9		10		10			10	5	10		
CHN		10						8		6						10
CZE			1													
DEU	2	5		1	4	3	3	4	2	3	3	3	2	5	4	3
DNK			8		1				7			9			9	
ESP		9	4	7	5	1	7	7		7	7	8		4		7
FIN							1								9	
FRA	6	3		4	6	6		1	6	5	5	6		9	7	5
GRC			4						1							
HRV			8													
IRL										1						
ITA	10	7	8	5	8	5	5	5	5		1	5	5		5	4
JPN	9					10	6			10			9		8	
NLD	8	4		8	10	9		6			6	1	4	6	6	8
NOR											10			8		
POL													1			
PRT														1		
SVK			4						8							
SVN			4													
SWE					6					7			5		1	
U-K	6	6	3	3	3	4	4	3	4	2	4	4		3	3	1
USA	3	2	2	2	2	2	2	2	3	4	2	2	3	2	2	2

Source: Technopolis Group – OST.
Note: Presence counting mode.
Exemple of reading: Austrian and Polish authors are respectively the first and 5th partners of Austrian Lead Scienstists. Authors with address labs in Canada are the 4th partner of authors with adress labs in Austria.

Exhibit 75 Partnerships of lead scientists (2006*): distribution of the FP6 lead scientists co publications

	Country lead scientists															
	AUT	**BEL**	**CZE**	**DEU**	**DNK**	**ESP**	**FIN**	**FRA**	**GRC**	**IRL**	**ITA**	**NLD**	**POL**	**PRT**	**SWE**	**U-K**
Country WoS																
AUS																
AUT	29.2												3.1			
BEL		41.8				4.8				2.7		4.2	2.3			
BRA														4.0		
CAN	11.4			7.5		4.9	11.5	11.5	2.2		8.8					10.8
RUS				9.3			10.3	11.2			8.7					8.8
CHE	7.5	3.9		6.0	4.6		10.1		1.5			3.2	3.1	2.0		
CHN		3.5						11.9		4.3						6.9
CZE			46.8													
DEU	22.6	6.8		51.3	10.9	11.4	15.7	18.8	10.3	6.3	14.5	11.0	14.8	4.8	7.0	15.5
DNK			7.4		53.4				2.4			3.3			3.3	
ESP		3.6	8.5	8.1	6.2	56.8	11.6	11.9		3.9	10.5	3.6		8.3		10.4
FIN							63.2								3.3	
FRA	7.2	8.8		10.4	6.1	8.2		57.6	2.9	5.5	13.4	5.0		2.3	4.0	11.1
GRC			8.5						48.0							
HRV			7.4													
IRL										36.3						
ITA	4.5	4.9	7.4	9.4	6.0	8.4	12.6	13.6	4.6		63.4	5.5	3.1		5.4	12.2
JPN	5.6					4.2	11.9			2.3			2.3		3.9	
NLD	6.1	7.6		7.8	4.3	4.6		12.1			11.2	58.6	10.9	4.3	4.2	9.8
NOR											7.7			2.6		
POL													74.2			
PRT														47.6		
SVK			8.5						2.2							
SVN			8.5													
SWE					6.1					3.9			3.1		58.2	
U-K	7.2	6.2	10.6	12.7	11.0	8.7	15.4	19.0	5.9	17.2	13.5	10.9		8.8	7.5	52.7
USA	17.3	12.4	13.8	18.4	14.5	13.6	20.8	22.0	9.0	5.9	17.6	14.0	11.7	9.1	15.6	22.3

Source: Technopolis Group – OST.
Note: Presence counting mode.
*Average 2004, 2005, 2006.
Reading in column - Exemple : column 1: 11.4% of the Austrian publications in copublications in the Web of sciences are with authors with adress labs in Canada.

Exhibit 76 Differences in partnership rankings between networks of lead scientists and networks of authors publishing in the Web of science (2006*)

	Country lead scientists															
	AUT	BEL	CZE	DEU	DNK	ESP	FIN	FRA	GRC	IRL	ITA	NLD	POL	PRT	SWE	U-K
Country WoS																
AUS																-9
AUT	0			-10									5			
BEL		0				8		-9	-10	9		0	9			
BRA														-1		
CAN	4	-10		9		-2	8	1	8	-9	-1	-10				-1
RUS			-8	-2			0	10			-1		-7			9
CHE	-2	-1		4	9	-8	10	-7	1		-7	1	-5	0		
CHN		10						8		6						0
CZE			0													
DEU	0	-1	-2	0	0	-2	-2	1	-2	-1	-1	0	-1	-1	0	0
DNK			8		0				7			9			3	
ESP	-8	1	4	-2	-5	0	7	1	-7	-1	1	0	-9	1		-1
FIN							0								1	
FRA	0	0	-4	0	0	2	-6	0	1	0	2	1	-4	4	2	1
GRC			4						0							
HRV			8													
IRL										0						
ITA	5	0	2	0	0	-1	-2	0	-1	-6	0	-1	-1	-7	-2	-1
JPN	9					10	6			10			1		8	
NLD	-1	-1	-10	1	3	2	-8	-4	-8	-7	-2	0	4	-3	-3	2
NOR					-9		-10				10			8	-10	
POL	-10		-9										0			
PRT						-10								0		
SVK			-3						8							
SVN			4													
SWE					1		-3			-3			5		0	
U-K	2	2	-2	0	0	1	0	-1	1	0	-1	0	-5	1	0	0
USA	0	0	-1	0	0	0	0	0	1	1	0	0	1	-2	0	0

Source: Technopolis Group – OST.
Note: Presence counting mode.
Example: Canada is 4 places higher in the ranking of Austrian lead scientists first country partners in comparison with the ranking of Austria first country partners in the Web of Science.

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