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Topic Report No. 2
Topic: Internet for R&D

Task 5.1

Fachhochschule Solothurn Nordwestschweiz
Technik-Wirtschaft-Soziales

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Preface

This report is a deliverable of the SIBIS project (*Statistical Indicators Benchmarking the Information Society*), funded by the European Commission under the "Information Society Technology" Programme (1998-2002). The overall goal of SIBIS is to develop and pilot indicators for monitoring progress towards the Information Society, taking account of the "e-Europe action lines". SIBIS focuses on nine topics of interest, i.e. Telecommunications and Access, Internet for R&D, Security and Trust, Education, Work and Skills, Social Inclusion, e-Commerce, e-Government and e-Health.

Within the SIBIS project two surveys (a General Population Survey and a Decision Makers Survey – businesses) were conducted between March and May 2002 covering the nine eEurope topics. This report describes the outcomes with respect to the topic of Internet for R&D. The report on the Internet for R&D is delivered according to the time schedule developed for the entire SIBIS project. However, due to its specific nature and deviation from the other topic areas, this topic is not yet based on sufficiently broad empirical foundations. The project surveys of decision makers and the general population did not take the issues in this topic area into account. As a result, the currently available data only cover a small fraction of the indicator system, which is nevertheless presented in its entirety. An additional survey instrument is currently being developed which will collect data better suited to extending the benchmarking exercise.

The main audience should be policy makers, statistical offices at all levels (national, e.g. CBS, Statistisches Bundesamt, Statistics Finland etc., and supranational, e.g. Eurostat, OECD), industry leaders and researchers in the domain and those involved and interested in benchmarking the domain throughout Europe and the world.

The first three chapters of the report give the reader an overview of the main outcomes (*Executive Summary*), the context (*Introduction*) and the indicators developed (*Identification of the Indicator Framework*). Chapter 3 focuses on the analysis of the indicators for which data is available at present. The final chapters (*Further developments, Conclusions*) summarise the outcomes of the study as well as areas where future research might be necessary. The annexes consist of tables and graphs, providing the reader with access to the data referred to in the report.

For each of the nine topics a separate SIBIS report (WP2) was issued in 2001. The WP2 report was aimed at setting the scene on the topic, defining the gaps in the statistical coverage and suggesting innovative indicators to be developed through the subsequent survey. The current report, although an independent document, is an interim report. The final version will be issued in April 2003.

SIBIS is led by Empirica (Bonn, Germany), and includes the following project partners: RAND Europe (Leiden, The Netherlands), Technopolis Ltd. (Brighton, UK), Databank Consulting (Milan, Italy), Danish Technological Institute (Taastrup, Denmark), Work Research Centre Ltd. (Dublin, Ireland), University of Applied Sciences Solothurn Northwestern Switzerland (Olten, Switzerland).

The University of Applied Sciences Solothurn Northwestern Switzerland (Fachhochschule Solothurn Nordwestschweiz, FHSO) is a state-owned institution of higher education in the fields of Technology, Economics and Social Work. Besides its teaching activities it carries out applied R&D and consultancy for numerous clients at national and international level (see http://www.fhso.ch/_e/index_e.html). This report has been peer reviewed, however the authors are solely responsible for its contents.

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Abbreviations

.	No data available
A	Austria
B	Belgium
CATI	Cooperative Agreements and Technology Indicators
cf.	Compare
CH	Confoederatio Helvetica (Switzerland)
CMC	Computer-Mediated Communication
CSI	Computer Staff Intensity
D	Deutschland (Germany)
DK	Denmark
DMS	Decision Maker Survey
E	España (Spain)
EC	European Commission
EL	Greece
ELS	Electronic Library Services
ERA	European Research Area
EU	European Union
F	France
FHSO	Fachhochschule Solothurn Nordwestschweiz (University of Applied Sciences Solothurn Northwestern Switzerland)
FIN	Finland
FTP	File Transfer Protocol
GDP	Gross Domestic Product
HTTP	Hyper Text Transfer Protocol
I	Italy
ICT or IT	Information and Communication Technology
IRL	Ireland
IST	Information Society Technologies
L	Luxembourg
LAN	Local Area Network
MAN	Metropolitan Area Network
Med.	Median
MERIT	Maastricht Economic Research Institute on Innovation and Technology
MSTI	Main Science and Technology Indicators
NL	The Netherlands
NRN	National Research Network
OECD	Organisation for Economic Cooperation and Development
P	Portugal
PPP	Purchasing Power Parity
R&D	Research and Development
RN	Research Network
S	Sweden
SCI	Science Citation Index
SSCI	Social Science Citation Index
SIBIS	Statistical Indicators for Benchmarking the Information Society
SMTP	Simple Mail Transfer Protocol
TCR	Total Congestion Ratio
TERENA	Trans-European Research and Education Networking Association
UK	United Kingdom
USA	United States of America
WWW	World Wide Web

Executive Summary

The SIBIS topic "Internet for R&D" sets out to benchmark the use of Internet technologies in European research systems. The research systems in principle include academic and private sector research and development (R&D) establishments across all disciplines and industries and throughout all EU member states (plus selected additional countries such as Switzerland and the U.S.). However, the limited scope of the project requires some focusing and delimitation. In the present report we give a brief summary of the indicator system needed to perform such benchmarking together with the intermediate results of this benchmarking exercise which are based on the currently available data.[1]

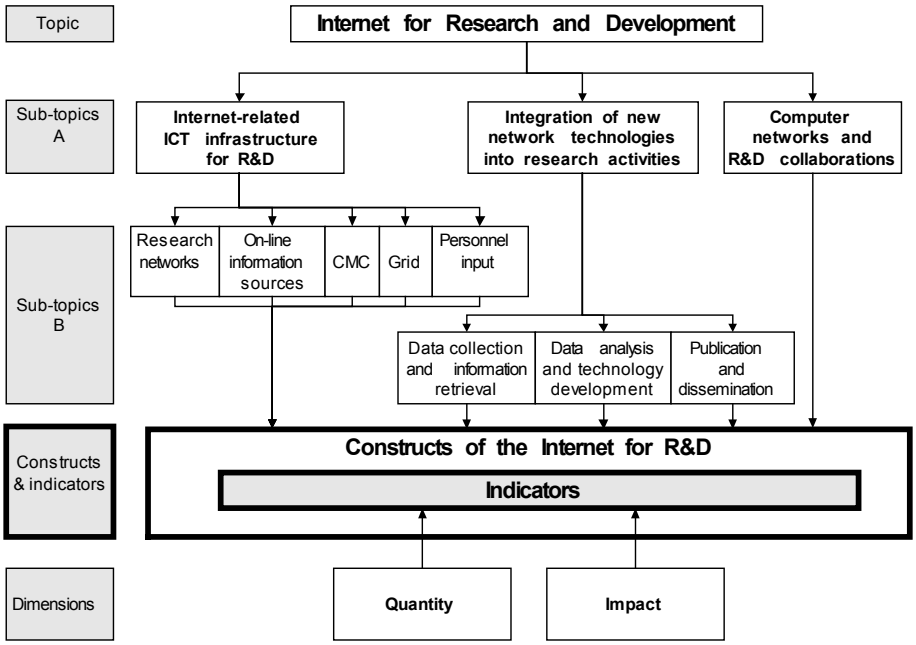
The Internet is a global network of computers which supports the transmission of digitised items of information using various information-sharing techniques (such as the Hyper Text Transfer Protocol (HTTP) or the Simple Mail Transfer Protocol (SMTP) of e-mail). E-mail and the World Wide Web were invented by and for science. Researchers in some disciplines may still be considered as avant-garde ICT users in a work environment. Hence, exploring Internet use in R&D should give clues about future ICT requirements and trends in other areas of society. Internet technologies also constitute an important group of inputs to R&D activities and hence they affect the degree to which R&D can function as a source of inventions and technical progress.

Various constructs fill the technology space and the human-computer interaction space established by the interaction of the Internet and R&D: Expenditure on ICT infrastructure, research networks, electronic library services, researchers' Web presentations, e-mail, computer skills of R&D personnel, specialised computer staff, digital library and peer site use, software use, information retrieval, e-publishing, quality control and R&D collaborations. These constructs also form the indicator system which is necessary for benchmarking the usage as well as the effects of the Internet in R&D. To ensure that both were considered appropriately in the indicator system, we differentiated between the two dimensions "quantity" and "impact". The former encompasses indicators related to the supply and use of Internet technologies and the latter refers to the effects of producing and using Internet technologies in R&D. Three different perspectives have been employed to provide more structure (cf. the figure):

- Internet-related ICT infrastructure for R&D: The infrastructure perspective considers Internet technologies as part of the research infrastructure and consequently investigates the extent to which they are used and what impact they have on R&D.
- Integration of new network technologies into research activities: This perspective of the Internet could be labelled people-oriented, as it assesses how the Net has changed and more often than not enriched the activities of researchers (e.g. the retrieval of research-related information or the dissemination of results).
- Computer networks and R&D collaborations: By reducing communication costs significantly, the Internet has created a strong incentive to replace other inputs with communication. Hence, collaborative research has grown and new and closer forms of collaboration have evolved. This group or project perspective complements the technology-oriented and the people-oriented perspectives.

[1] The topic and the indicator system have been described in much more detail in two previous intermediate reports which were delivered to the Commission in January 2002 (and which can be obtained from the SIBIS website (http://www.sibis-eu.org/sibis/ research/reports.htm) or from the authors upon request). More elaborate benchmarking will be performed in the final report with additional data collected in a survey among researchers on their Internet use. The exact definition of the indicators and detailed information on methodological issues and data availability do not form part of this report; instead these are dealt with in a SIBIS deliverable specifically designed for this purpose: the Indicator Handbook (to be delivered to the Commission in June 2003).

Figure: The indicator system on "the Internet for R&D"



Source: FHSO compilation.

There is virtually no data available on the use of technology in general, and ICT and the Internet in particular, in R&D. With the currently available data only two constructs, research networks and specialised computer staff, could be compared among (selected) European countries. The US could not be included as this country was not included in the data sources.

In terms of *research networks* (RNs) we identified the Netherlands, Switzerland and Sweden as countries having networks which are developed better than in an average EU member country. Finland and Ireland also performed rather well for the three RN-related indicators of the indicator system, whereas Spain is clearly placed last in the ranking. The other countries are located towards the middle.

Concerning the availability and usage of *specialised computer staff for R&D* it must first be stated that the empirical results contradicted the expectation that establishments which carry out a lot of R&D would also have a high computer staff intensity. On the contrary, the larger the R&D personnel ratio, the smaller the share of computer staff among the R&D personnel. This finding cannot be explained satisfactorily with the data obtained in this analysis and should be investigated further in the future. Regarding the indicator values, Finnish and French establishments make the lowest use of specialised computer staff for R&D (in relation to their R&D efforts). Greece and Spain have values above the seven-country average.

The main task of future SIBIS work on this topic will concentrate on broadening the benchmarking with additional data from a survey among scholars from selected research disciplines and countries on the use of Internet technologies. Nevertheless, for two reasons the indicator system and the available data cannot yet be regarded as comprehensive. Firstly, the novelty of Internet technologies and applications means that some concepts are not yet suitable for measurement (such as the so-called "Grids"). Secondly, only very few secondary data sources could be used and the resources of the SIBIS project for its own empirical work are limited. Further research should deal with developing categories and concepts to ensure that specific problems can be measured: in particular ICT expenditure differentiated according to its purposes, the quality of research networks at sub-national levels and more elaborate concepts of R&D collaborations (including information on their technology-dependence).

1 Introduction

1.1 Problem description

Buzzwords such as “Information Society”, “Digital Economy” or “Cyberspace” highlight the trend of increasing integration of information and communication technologies (ICTs) into the lives of people all around the world. Though this trend has been described in thousands of articles, we still lack detailed knowledge regarding its features and effects in many areas. This explains why MIT researchers recently suggested a research program that should deal with the role of organisations in the development of the digital economy, with the social transformations within and across internetworking organisations and with the use and effects of Internet technologies.[2] We are not yet able to fully understand or even observe the consequences of the information revolution as too many areas are affected by the new technologies, many technological and social developments are too new and the pace of change is too rapid. The fundamental problem is that we often lack valid concepts which show us where we should look and what we should measure in order to assess the size and effects of ICT developments, not to mention the empirical data itself. This applies to all of the different subsystems of society and the economy and hence, with regard to the SIBIS project, analysing nine of these subsystems can only be a modest contribution to what should become a broader effort in various fields of science. The present document will analyse the extent to which Internet technologies are used in one societal subsystem, research and development (R&D), in different countries.

The relationship between the R&D system and the Internet must be considered as particularly important: R&D is an important source of inventions, technical knowledge and skills and is therefore a major motor of economic growth. Taking an economic production function approach we can model the output of an R&D system as a function of its various inputs: researchers and supportive staff, instruments, library collections, computers and other capital goods, services from various service providers (such as computing services) and many other material and immaterial inputs which are impossible to assess in their entirety. However, there can be no doubt that Internet technologies constitute one important group of inputs which are used themselves or which provide access to other digitised research inputs such as databases and libraries. In order to evaluate the extent to which the different inputs contribute to a large and high-quality research output, statistical data for indicators on both sides of the production function are essential.

The OECD, together with the national statistical institutes and R&D institutions, has developed various manuals[3] and data collections. The Main Science and Technology Indicators Database (MSTI) covers the outputs (patents) as well as inputs (personnel, expenditure) of R&D activities. Other partly proprietary databases cover specific elements of R&D and include the bibliographical databases of the Institute for Scientific Information or the Cooperative Agreements and Technology Indicators (CATI) database developed at the Maastricht Economic Research Institute on Innovation and Technology (MERIT). However, as yet there is no comprehensive database covering the technological inputs for R&D activities. The various SIBIS reports on the Internet for R&D set out to develop indicators which are appropriate for measuring the extent to which the Internet has been integrated into R&D and the effects of this. The lack of proper indicators in this regard has been frequently lamented in the literature:

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2 Orlikowski, W. J.; Iacono, C. S. (2000): The truth is not out there: an enacted view of the “Digital Economy”, in: Brynjolfsson, E. and Kahin, B. (eds): Understanding the digital economy. Data, tools, and research. Cambridge and London, pp. 352-380.

3 OECD (1994): The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys of Research and Experimental Development - Frascati Manual 1993. 5th Edition. Paris. - OECD (1997): Proposed Guidelines for Collecting and Interpreting Technological Innovation Data: Oslo Manual. 2nd Edition. Paris.

> *"There is a pressing need to increase efforts and resources to undertake in-depth empirical studies on the innovative uses of Internet in science and to carry out European-wide surveys on this issue. Such studies are the only way to generate a sufficient amount of data and information necessary to evaluate the impact of new, high capacity electronic communication facilities upon the organization, distribution and conduct of collaboration on fundamental research problems."*[4]

At the same time the new possibilities and potential of computer networks have become increasingly important in concepts of science and technology policies. The European Commission has promoted a new research policy in its publications on the European Research Area (ERA).[5] The common thread of many goals and measures described in these documents is the creation of multi-layered networks within the R&D system as well as across its boundaries, including other socio-economic areas and political institutions. These networks among researchers, research institutes, protagonists of specific research topics, stakeholders of R&D in different organisations etc. must be developed in parallel with modern, high-capacity communication networks. The European Commission acknowledges this fact and consequently promotes the enhancement of Research and Education Networks for data transmission and the development of novel collaboration-oriented computer systems ("Grids") within its *e*Europe initiative. The ERA communications cover the usage side of ICTs and encourage the development and implementation of further computer-based tools for science, the training of researchers on the possibilities of ICTs and the use of computer networks to connect the best researchers in Europe to form "virtual centres of excellence". Over the last three years many European countries have developed new concepts of research policy and some, particularly Finland and the U.K.,[6] expect ICTs to contribute to the development of science. This orientation of research policy towards ICTs makes it even more necessary to develop indicators and collect data that are capable of quantifying the relationship between ICTs and R&D.

There is therefore a pressing need to develop indicators on the use of Internet technologies in science and to relate these to research output in order to better assess the determinants of successful R&D systems and thereby help steer science and technology policy. Before the indicator system can be discussed in more detail, it is necessary to delineate its scope and define some of the major categories.

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4 From the summary of a European Science Foundation conference, Foray, D. (1999): Building the Virtual 'House of Salomon': Digital collaboration technologies, the organisation of scientific work and the economics of knowledge access. Report of the ESF-IIASA-NSF Workshop - 3 to 5 December 1999 - at the International Institute for Applied System Analysis, Laxenburg, Austria, p. 9. (http://www.esf.org/policy/pdf/iiasa.pdf)

5 Cf. especially: EC (2000): Towards a European research area. Communication from the Commission COM 2000 (6). Brussels, 18 January 2000. (http://europa.eu.int/comm/research/ area/com2000-6-en.pdf). – EC (2000): Making a reality of the European research area: guidelines for EU research activities (2002-2006). Communication from the European Commission COM(2000) 612 final. Brussels, 4 October 2000. (Http://europa.eu.int/ comm/research/area/com2000-612-en.pdf).

6 The Finnish Government elaborated "A National Strategy for 2000-2004. Education, training and research in the Information Society" which deals with ICT and the information society as research topics and also covers the multiple opportunities of employing ICT for scientific research. The government also tries to realise its vision of Finland as a leading interactive knowledge society in the year 2004 by means of many different programmes, actions and instruments. The British Government communicated its science and innovation policy in a White Paper on "Excellence and Opportunity: a science and innovation policy for the 21st century" together with an implementation plan. The documents laid down many commitments which aim at improving the usage and the effects of ICT in R&D and they also determine concrete responsibilities and activities to monitor and evaluate the progress achieved.

1.2 Topic area definition

1.2.1 Framework and boundaries

The OECD defines R&D as creative work which is undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications.[7] This definition of R&D makes use of two elements: The first is on an input level, stating that R&D requires creative and systematic work. The second is on an output level, as R&D should create new knowledge or, in other words, find solutions for problems that cannot be answered with the available knowledge and techniques.

The second part of the definition which focuses on the goal of R&D is of special importance for understanding its uniqueness. Creative and systematic work can be carried out for similar but nevertheless different goals: e.g. an artist's creative work is (usually) justified by itself, whereas the creative work of a scientist always should pursue the goal of increasing knowledge. This does not mean that a researcher's work and its results must be immediately applicable and useful to society. They can also deal with fundamental problems which for the time being "only" increase the understanding of nature, society or a technical field.[8]

The current analysis is limited to R&D and omits the neighbouring and related, but nevertheless different, activities of innovation and education. Though some innovations have their roots in R&D results, they are not the same: the latter can be scientific publications and presentations or inventions which may or may not be used outside of science. Innovations, on the other hand, are new products, processes or forms of organisation which have been introduced into the market.[9] For this market introduction, additional activities are typically indispensable, such as market research on available products, competition, possible returns, optimal sales strategies and other activities that are not associated with R&D.[10] R&D is also not the same as education, though scientists often fulfil both functions. While R&D aims at extending the boundaries of knowledge, education primarily has the objective of teaching the important things within these boundaries. Thus, education is the foundation of self-reproduction of science and doubtless the borders between research and education are anything but clear; for example the insights gained in the process of teaching often constitute inputs into research and vice versa. Nevertheless, in this part of the study it is assumed that research and education can be divided analytically. A separate SIBIS research topic will deal with education issues.

The present topic area does not focus on informatics research or Internet research. In principle, it investigates the utilisation of the Internet and its effects on research in the social sciences and humanities as well as in the natural sciences and engineering. It is

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7 OECD (1994), op. cit., p. 29. Though this definition seems to be relatively straightforward, it still leads to a large list of "borderline activities" which cannot generally be included among or excluded from R&D. Some of the easier activities are dealt with by the OECD itself (ibid.): The OECD includes among R&D the administration of R&D projects, personal education only when specifically for R&D purposes, the development of prototypes and pilot plants. It excludes all work that is limited to using the existing stock of knowledge, especially consulting and advisory work, professional practice, the writing of policy-related studies, routine software development, design and drawing for production processes, trial production and routine tests. It also excludes the presentation of results at scientific conferences, and patent and license work.

8 This form of research is usually called 'basic research'. The OECD defines it as follows: "Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view." 'Applied research', in contrast, is directed primarily towards a specific practical aim or objective, cf. OECD (1994), op. cit., p. 68-69.

9 OECD (1997), op. cit., p. 31.

10 Research is not limited to the public sector but is carried out to a large extent in the private sector. This research must also be included. The difference stressed here is one between research and other activities.

clearly impossible to cover the entire world of science within one project and, consequently, it might be necessary to use single areas of research as examples. But it should nevertheless be possible to generalise the findings to some extent and use them as pilot results for future studies.

Until now the terms "the Internet" or "Internet technologies" have been used imprecisely and without any clear definition. However it is also necessary to explicate our understanding of this technology. The Internet is basically considered as a "global network connecting millions of computers".[11] It consists of technical infrastructure, particularly computers ("servers") and data storage devices and connections (narrowband and broadband) between these servers. This infrastructure is used with various information-sharing techniques to transmit, retrieve and display digitised items of information (the measurement and coding is usually performed using additional technologies). The most common techniques are currently the Hyper Text Transfer Protocol (HTTP) of the World Wide Web (WWW), the Simple Mail Transfer Protocol (SMTP) of e-mail and the File Transfer Protocol (FTP).[12]

We include in the topic area both the research-related technical infrastructure of the Internet and its applications. We also include the 'humanware' or computer skills available to R&D projects which may be inherent in the researchers themselves, in the technical staff they employ or in services they buy. This results in a conflict between the desire to be as focused as possible on Internet-related issues and the use of a broad approach to include all the important factors that determine how the effects of the technology materialise. This conflict cannot be resolved in advance and the question as to whether an indicator should form part of the indicator system will be decided on a case-by-case basis.

1.2.2 Stakeholders

Who cares about the potential of the Internet for R&D and who is affected by its use? It is possible to distinguish between three different groups which are involved in research activities:

- *R&D personnel:* researchers, technicians, research managers and other staff directly supporting R&D
- *Ancillary organisations:* research-related services, research associations, administrations and foundations
- *General public:* principals and customers of research activities, beneficiaries and claimants

The Internet technologies have changed the daily research activities of researchers and their assistants and support staff in all institutions which carry out R&D (see next section for examples). The Internet has also resulted in important new sources of information and methods for their retrieval which are important for research management. However, the human-technology interaction is certainly not one-way, as researchers influence the potential of Internet technologies, e.g. through the development of new technologies or through making new sources and instruments accessible to network-based applications.

The Internet has also modified the activities of R&D ancillary services. Bibliographic services and publishers, patent services, foundations and other funding organisations and many other services relevant to R&D provide access to information via the Internet. National Research Networks and local campus networks use the Internet for data transfer. In general these ancillary services had to, and still have to, modify their service

[11] http://www.webopedia.com/TERM/I/Internet.html

[12] Cf. on all these terms: http://www.webopedia.com.

portfolio to account for the new requirements of researchers triggered and facilitated by the Internet.

Society as a whole can be identified as the most general unit which is affected by the use and effects of Internet technologies in R&D. Certain groups within society, such as its political representatives, administrations, or customers of specific research results, are usually more affected than society as a whole as they want to use research results or modify societal regulations accordingly. One such group which should take special interest in the results of this part of the SIBIS project are R&D policy makers and administrations, as the decision to support and promote the use of Internet technologies should be based on a close analysis of their effects.

1.3 Overview of the report

We will begin in section 2 with an (abridged) overview of the relevant literature on Internet technologies in R&D which was carried out to identify the most important issues and provide a general structure of the indicator system. The entire literature review was a result of the SIBIS work package 2 (Topic research and indicator analysis) and delivered to the EC in January 2002.[13] We will briefly present our indicator system in section 2 but we do not elaborate on any details of the indicators, such as exact definitions, methodological issues, data availability etc. These issues are part of the main body of another deliverable of the SIBIS project, the indicator handbook, which will be made available in print and electronic form in June 2003. In section 3 we perform benchmarking of national research systems using the selected indicators. Due to large gaps in the available data, this benchmarking must be restricted to a limited set of issues and countries. Nevertheless, it gives a first indication of what the developed indicator system can accomplish. Section 4 highlights the current major deficits in the indicator system and the necessity of future investigations to overcome these. The last section contains a brief conclusion.

[13] This can be downloaded from the project website (http://www.sibis-eu.org/sibis/research/reports.htm) or obtained from the authors upon request.

2 Identification of the indicator framework

2.1 Overview

Overall, there can be no doubt that multiple feedback between the Internet and R&D is occurring: The WWW was developed to facilitate scientific collaboration and the Internet has made it easier to access information that would otherwise be difficult to obtain. E-mail has made asynchronous communication less formal and more frequent. R&D collaboration over large distances has been enhanced, as it has become easier to communicate and transmit large volumes of information in various formats.

We employ essentially three different perspectives for studying the relationship between the Net and R&D: the diffusion of Internet-related ICT infrastructure for R&D, the integration of the new network technologies into distinct research activities, and the impact of computer networks and R&D collaborations. The analysis of the topic and the indicator system were structured accordingly. The indicator system covers constructs in all three sub-topics (cf. figure 1). In a top-down approach the focus of the sub-topics was defined and discussed, and, where considered necessary, differentiated further into more detailed sub-topics and issues. Additionally we employed a second approach in order to be as comprehensive as possible. This approach serves to categorise the sub-indicators according to an indicator-related logic and not a topic-related logic. We differentiated among two dimensions (cf. figure 1):

1) Issues related to the supply and use of the constructs are taken into account by means of indicators in the dimension "*quantity*". This dimension encompasses indicators that measure for example how many "titles" are provided in digital collections, how many computer personnel are employed, or how many e-mails are sent or received during a certain period of time.

2) The "*impact*" dimension measures the effects of using Internet technologies in R&D. Impact can be multifaceted according to the spectator's viewpoint: for example, a research manager may be interested in the budgetary effects of the purchase and use of a specific computer programme, while a researcher is more interested, for instance, in its effects on the availability of research inputs or the amount of output produced. As a principle we will take the researcher's view.

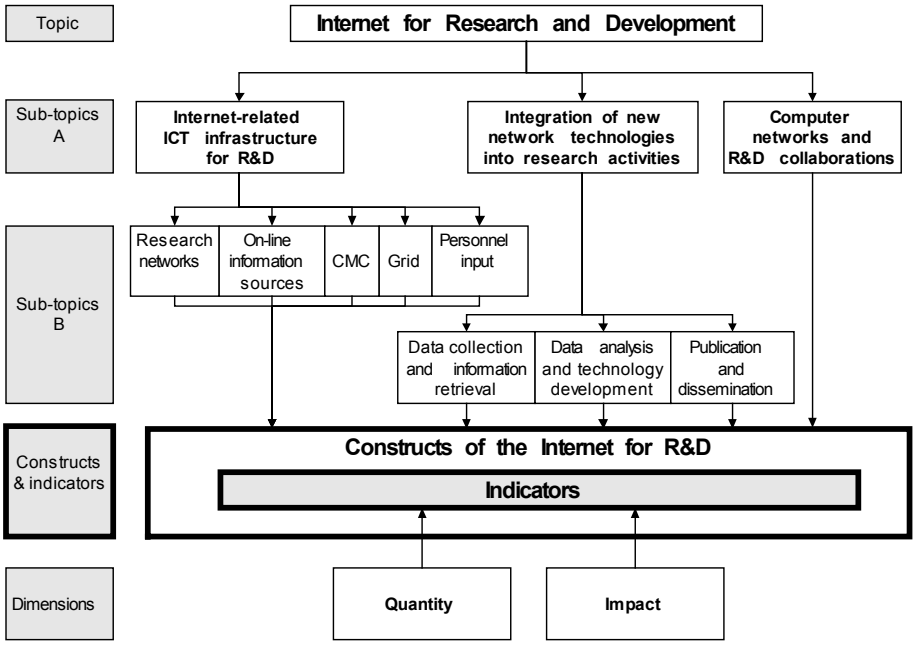
The distinction between the quantity and impact dimensions is of course purely analytical. There is a close relationship between both dimensions, as quantitative issues reveal a lot about cost-benefit ratios: levels of use would be low, if little benefit was accompanied by large costs.

In principle, such an indicator system could be infinitely large and the useful indicators should be differentiated from the less useful and useless in order to make the system feasible. In addition to measurement-related criteria such as validity, reliability, direction, sensitivity to differences and accessibility,[14] the range of applicability is an important criterion for selecting an indicator. As the aim of the SIBIS project is to produce indicators which are suitable for describing the situation in entire national research systems across the EU, the US and Switzerland we must abstract as much as possible from the specifics of an individual academic discipline. Indicators which only contain information on one or a few research disciplines are not particularly helpful. For example most of the Internet-based data collection tools are rather mono-disciplinary, as different research disciplines make use of different data. On the other hand, e-mail and other forms of computer-mediated communication are multi-disciplinary. We will concentrate on multi-disciplinary indicators, even if this leads to gaps in the coverage of the indicator system. However, it seems preferable to have some gaps rather than to construct an indicator system that is not really representative of the national R&D

[14] Cf. Weiss, C. H. (1998): Evaluation. 2nd edition, Upper Saddle River, pp. 144-150.

systems, though this does not imply that the indicator system ignores differences among the academic disciplines. Instead we will try to make these visible by assessing comparable indicators.

Figure 1: The indicator system on "the Internet for R&D"



Source: FHSO compilation.

After discussing the different possibilities for measuring the amount of Internet use and the impact on R&D and deleting indicators which would not meet the required criteria, a list of indicators was assembled.[15] This list is shown in table 1. The largest number of indicators, fifteen in all, assess the Internet-related ICT infrastructure for research activities. The first two relate to R&D expenditure on ICT and are not available in existing statistics and cannot be collected within of any of the SIBIS surveys. Nevertheless they are included in the indicator system as they are the only indicators which could provide an overall picture of the ICT-intensity of R&D. Three indicators can be calculated on the basis of existing data and eight will be assessed within the SIBIS surveys. The other two sub-topics are covered with less indicators and with data which should be collected in a topic-specific SIBIS survey, as no other suitable (or potentially suitable) sources exist.

Compound indicators are calculated with the values of different individual indicators in order to reduce information and facilitate comparison and benchmarking exercises. However, the boundaries between "simple" and compound indicators are fluent and often the "simple" indicators require some calculation and data transformation. Compound indicators based on two or more indicators of the present indicator system have not yet been developed. This is due to the fact that the topic indicators are to a large extent original developments for which no prior experience or data exist. However, the final version of this report will also contain compound indicators.

[15] Documented in the topic report of SIBIS work package 2 (cf. http://www.sibis-eu.org/sibis/research/reports.htm).

Table 1: Indicators on the Internet for R&D

Construct	Indicator Name	Existing indicators	New SIBIS indicators selected for the surveys
Infrastructure			
Expenditure on ICT infrastructure	1. R&D expenditure on ICT (total)		
	2. R&D expenditure on different types of ICT		
Research Networks (RN)	3. Core usable backbone capacity on a national RN	X	
	4. Congestion on the RN	X	
	5. Budget size of a national RN	X	
Electronic library services	6. Number of titles in digital collections		
	7. Staff providing electronic library services		
Researchers' Web presentations	8. Information displayed on a researcher's Web page		X
	9. Effects of researchers' Web page(s)		X
E-mail	10. E-mail communication for R&D		X
	11. Effects of e-mail use on R&D		X
Computer skills of R&D personnel	12. Computer skills of R&D personnel		X
	13. Effects of computer skills on R&D		X
Specialised computer staff	14. Computer staff intensity		X
	15. Unfilled vacancies for computer staff providing services to R&D		X
Research activities			
Digital library and peer site use	16. Frequency of information retrieval from Internet-based sources		X
	17. Documents/items from electronic sources		
Information search	18. Frequency of using Internet-based methods for information searches		X
	19. Effects of using Internet-based methods for information searches		X
E-publishing	20. Amount of work published in electronic media		X
	21. Impact of publications in electronic media (on size of readership, time to publication)		X
Quality control	22. Review activities for e-journals		X
R&D collaboration			
R&D collaboration	23. Frequency of using Internet-based tools for collaborative R&D		X
	24. Impact of computer networks on R&D collaborations		X

Source: FHSO compilation

The following sections 2.2 to 2.4 provide brief descriptions of the topic areas and focus on the indicators listed in the table whilst section 2.5 discusses their operationalisation and assessment.

2.2 Internet-related ICT infrastructure for R&D

A general assessment of the ICT infrastructure for research activities is only possible by means of a general unit of measurement. Monetary data are well suited to this purpose and hence the ICT expenditure on R&D can serve as a general indicator for assessing the "ICT-intensity" of an organisation's research activities (indicators 1 and 2).

Research networks, i.e. the physical and institutional networks for transmitting data between R&D locations, represent one of the major issues of Internet-related ICT infrastructure for R&D. They have been established on different geographical levels (local, national, supra-national). TERENA, the Trans-European Research and Education Networking Association, has recently initiated the development of indicators on national networks. In discussions with its members (the national research networks) it developed indicators on transmission capacities, budgets, staffing and traffic on the networks and these can be considered as a good basis for further considerations (indicators 3 to 5). TERENA has also undertaken various rounds of data collection and preliminary comparisons.

The market penetration of various further on-line information sources and computer-mediated communication tools differs markedly: A few, such as e-mail, have become omnipresent tools for researchers.[16] Some are mainly used in specific research disciplines such as numerical databases. Other applications are still in the market introduction phase, such as on-line conferencing tools. The latter also applies to 'grid computing', a new concept of making distributed data and other resources accessible to non-collocated researchers.[17] The possibility of evaluating these tools and concepts depends on their level of stability and diffusion: Looking at the relationship between new technology and its users (and other relevant social groups) we must expect frequent modifications of a new technology before 'closure' takes place.[18] Hence, in an early innovation phase, it is very difficult to collect valid and reliable quantitative data, establish benchmarks or undertake comparisons at national level. But even when use becomes widespread, certain data might loose their relevance: the simple distinctions between 'e-mail users' and 'non-e-mail users' or between 'on-line' and 'offline-only' journals are now almost irrelevant as e-mail use or the on-line availability of journals reaches a maximum. This has important methodical implications, inasmuch as the scale of an indicator must be considered closely. Binary scales might be rather short lived.

Some preliminary efforts at quantifying Internet applications in R&D have been undertaken and some studies have even attempted to assess the effects of Internet applications on research success.[19] More often than not they found positive effects.

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[16] Cf. Day, J.; Bartle, C. (1998): The Internet as an Electronic Information Service: Its Impact on Academic Staff in Higher Education. Proceedings IRISS '98 International Conference: 25-27 March 1998, Bristol, UK. (http://sosig.ac.uk/iriss/ papers/paper06.htm). - Walsh, J.P.; Maloney, N. G. (2001): Computer network use, collaboration structures and productivity, in: P. Hinds and S. Kiesler (ed.): Distributed work. Cambridge, Mass.

[17] Cf. Foster, I.: Internet Computing and the Emerging Grid, in: nature web matters, 7 December 2000. (http://www.nature.com/nature/webmatters/grid/grid.html). - Baker, M.; Buyya, R.; Laforenza, D. (2000): The Grid: international efforts in global computing. Presentation at the SSGRR International Conference on Advances in Infrastructure for Electronic Business, Science, and Education on the Internet, L'Aquila, Jul 31 - Aug 06 2000. (http://www.ssgrr.it/ en/ssgrr2000/papers/268.pdf). - Foster, I; Kesselman, C.; Tuecke, S. (2001): The Anatomy of the Grid. Enabling Scalable Virtual Organisations, to appear in: International journal of Supercomputer Applications. (also available at: http://www.globus.org/research/ papers/anatomy.pdf).

[18] Cf. Bijker, W.; Pinch, T. (1987): The social construction of facts and artefacts: or how the sociology of science and the sociology of technology might benefit each other, in: Bijker, W.; Hughes, T.P.; Pinch, T. (eds.): The social construction of technological systems. New directions in the sociology and history of technology. Cambridge, pp. 17-50.

[19] Cf. e.g. the following studies: Walsh, J.P.; Maloney, N. G. (2001): Computer network use, collaboration structures and productivity, in: P. Hinds and S. Kiesler (ed.): Distributed work. Cambridge, Mass. – Lawrence, S. (2001): Free online availability substantially increases a paper's impact, in: Nature, vol. 411, no. 6837, p. 521. (also available as 'Online or invisible?' at: http://www.neci.nec.com/~lawrence/

These studies and most of the data collected in relation to Internet infrastructure for research were carried out at the micro-level, i.e. the individual researcher, the individual research paper, the individual research organisation etc. as units of observation. Even with digital libraries, for which some of the most advanced indicator concepts were found,[20] only the micro-level perspective has been taken. Though this micro-level approach is very useful for comparing performance, attributing funds and even for setting policy goals, it has rarely led to indicators which are appropriate for the comparison of national research systems.

Based on these considerations we identified indicators for three stable constructs which are comparable at the national level:

- Electronic library services (indicators 6 and 7): The number of objects in digital collections and staff figures for electronic library services are indicators for measuring the amount of network-based information that is publicly accessible to researchers.
- Researchers' Web presentations (indicators 8 and 9): Both the amount of information displayed on researchers' Web presentations and the effects of Web page(s) on the researchers' time budgets, communicational activities, status, contacts and collaboration can provide meaningful information on the usage of the WWW for information dissemination.
- E-mail (indicators 10 and 11): As e-mail has developed into an important communication channel between researchers in all disciplines, it represents a good application for assessing the amount of computer-mediated communication (CMC) within a country's R&D system. Communication and information science have discussed the effects of CMC on R&D, particularly from the viewpoint of its impact on the information base, amount of collaboration, research productivity and quality of results. However, as e-mail use has been commonplace for quite some time, it has become difficult to assess its effects directly (e.g. by means of a survey question): The interviewees would have to think of a hypothetical situation or think back to the past in order to answer a question asking how the results of a research project would have differed if the researcher did not have access to e-mail.

In accordance with the broad understanding of infrastructure that we employ, the indicator system also contains indicators on human abilities and the availability of appropriately qualified support staff (indicators 12 to 15).

All in all, these 15 indicators form a basis for assessing the Internet infrastructure, its usage and the effects in different research communities. In addition to the rather static perspective of Internet infrastructure in R&D we also include a rather dynamic and actor-oriented perspective in the indicator system. The next section outlines its elements.

2.3 Integration of the new network technologies into research activities

papers.html). – Kaminer, N.; Braunstein, Y.M. (1998): Bibliometric analysis of the impact of Internet use on scholarly productivity, in: Journal of the American Society for Information Science, vol. 49, no. 8, pp. 720-730. – Cohen, J. (1996): Computer mediated communication and publication productivity among faculty, in: Internet Research: Electronic Networking Applications and Policy, vol. 6, no. 2/3, pp. 41-63. – Hesse, B.W. et al. (1993): Returns to science: Computer networks in oceanography, in: Communications of the ACM, vol. 36, no. 8, pp. 90-101.

[20] Cf. International Coalition of Library Consortia (1998): Guidelines for Statistical Measures of Usage of Web-based Indexed, Abstracted, and Full-Text Resources. (http://www.library.yale.edu/consortia/webstats.html). – Brophy, P. et al. (2000): EQUINOX - Library Performance Measurement and Quality Management System: Performance Indicators for Electronic Library Services. (http://equinox.dcu.ie/reports/pilist.html). – Shim, W. et al. (2000): ARL E-metrics project: developing statistics and performance measures to describe electronic information services and resources for ARL libraries. (http://www.arl.org/stats/newmeas/emetrics/phaseone.pdf).

A major change in scientific activity might result from new types of research questions that can be answered using Internet technologies. Research projects can also be structured differently when the researchers take the new features of electronic texts and entirely new computer-based forms of transmitting knowledge into account.[21] As soon as a research problem has been established, the Internet is mainly used by researchers for collecting data and retrieving scientific information from different virtual storage spaces and for presenting, disseminating and discussing research results. Internet-based data analysis has not yet become commonplace, but new developments and improvements in visualisation and simulation technologies, and especially the further development of grid computing, will increase the capacities (cf. footnote 17).

The literature that deals with the use of network infrastructure, on-line resources and Internet tools in R&D mainly discusses their advantages and disadvantages for different steps of the R&D process, e.g. the benefits and drawbacks of on-line questionnaires compared to regular methods;[22] or the possibilities of using server log files and Web content as data sources;[23] or the time and cost savings and distribution effects of e-publishing compared to print publishing.[24] With the exception of Web content analysis, a micro-level perspective has been employed and macro-level research questions have been disregarded.[25]

The indicator system includes two groups of indicators on the usage of Internet technologies for research activities:

- *Usage of digital libraries and peer sites and Internet-based methods for information searches* (indicators 16 to 19). In addition to looking at the electronic sources of information, it is also possible to investigate the usage of methods and tools for locating and gathering R&D-related information. Such methods are for example asking colleagues, searching in books and articles or using search engines and "favourites" with WWW browsers.
- *E-publishing and quality control* (indicators 20 to 22): A straightforward approach to assessing the significance of electronic publications from the perspective of the scientific author is to ask for the amount of work published in electronic media. Indicator 20 provides the frequency of publication of research results in different scientific media. However, scientists are not only involved as producers in the publishing process but also as reviewers, editors and advisers. The role of reviewer in particular has been hotly debated since the advent of the new, computer-based forms of publication. An alternative to assessing the scientists' affinity for, and experience with, electronic media could be to ask about their experiences with reviewing electronic publications (indicator 22).

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21 Cf. Nentwich, M. (2001): How online communication may affect academic knowledge production - Some preliminary hypotheses, in: Trans - Internet-Zeitschrift für Kulturwissenschaften, no. 10. (http://www.inst.at/trans/10Nr/nentwich10.htm) - In regard to ethnographic research: Dicks, B.; Mason, B. (1998): Hypermedia and Ethnography: Reflections on the Construction of a Research Approach, in: Sociological Research Online, vol. 3, no. 3. (http://www.socresonline.org.uk/ 3/3/3.html). – Kircz, J.G. (1998): Changing Presentations! Changing Science? Colloquium "L'écrit de la science/Writing Science" organised by the journal "Alliage" for The European Science & Technology Forum of the European Commission (DG XII), Nice 12-14 March 1998. (http://www.science.uva.nl/projects/commphys/papers/nicem.htm).

22 Cf. e.g. the bibliography at http://www.websm.org/lit_web.html

23 Cf. e.g. Almind, T.; Ingwersen, P. (1997): Informetric analyses on the World Wide Web: methodological approaches to 'webometrics', in: Journal of Documentation, vol. 53, no. 4, pp. 404-426. - Leydesdorff, L.; Curran, M.: (2000): Mapping university-industry-government relations on the Internet: the construction of indicators for a knowledge-based economy, in: Cybermetrics, vol. 4, no. 1, paper 2 (http://www.cindoc.csic.es/cybermetrics/articles/v4i1p2.html). - Burton, M. C.; Walther, J. B. (2001): The Value of Web Log Data in Use-Based Design and Testing, in: Journal of Computer-Mediated Communication, vol. 6, no. 3. (http://www.ascusc.org/jcmc/vol6/issue3/burton.html). - Kaminer, N.; Braunstein, Y.M. (1998), op. cit.

24 Cf. e.g. OECD (1998): The Global research village: How information and communication technologies affect the science system. Paris. (http://www.oecd.org/dsti/sti/s_t/scs/prod/global.pdf). - Butterworth, I. (1998): The impact of electronic publishing on the academic community an international workshop org. by the Academia Europaea and the Wenner-Gren Foundation. London [etc.]: Portland Press.

25 Such as: In which countries is advanced on-line research carried out? Where do the authors of e-journal articles come from?

2.4 Computer networks and R&D collaborations

A third approach for assessing the relationship between the Internet and R&D is the analysis of its relation to the organisation of R&D activities. Computer networks reduce the overall coordination costs and transaction risks.[26] This reinforces a seminal trend towards more R&D collaboration[27] which is caused by a variety of factors. Recent research from Smith and Katz using bibliometric data for the U.K. has shown that research collaboration decreases with distance. The median collaboration radius – the average radius around an institution within which 50% of its collaborators are located – is some 60 to 80 km.[28] On the other hand they have also shown that the distance between collaborators has tended to increase over the past 20 years. The latter tendency might be due to improved transportation, information transfer and communication.

The Internet has not only transformed existing collaborations, it has also made new types of R&D collaboration possible: those which depend on the electronic transmission of information. Instead of working together in one place or meeting frequently, such collaborations access geographically distant resources, exchange data and information, carry out their analytical work and document the results by means of the Internet. They not merely use the Internet – in fact they could not exist without it. Two different terms have been used for these new types of computer-based collaborations: 'collaboratories' and 'virtual teams'. Both are very similar and sometimes the terms are used synonymously, but in general the former is predominantly used in an academic environment and the latter in the private sector.

- The novelty of a *collaboratory* is that this kind of collaboration is only possible because of the capabilities of the new information and communication technologies and that it is organised to harness these as effectively as possible. Examples have been documented in many different research fields, such as biology, physics, medicine and communication science, and are usually related to fundamental research.[29] They jointly use large databases, scarce and expensive high-performance computing power or other instrumentation and they pool the experiences and expertise of scientists from different locations. In this way resources are optimised for the participants.
- The term *virtual team* has been used for arrangements where R&D work is not collocated but distributed over geographically distant sites. As in collaboratories, coordination and collaboration are largely computer- and network-based. E-mail, video conferencing and other tools for communicating, planning and scheduling, as well as document and application sharing, are used to overcome the problems that result from not working at the same location and sometimes not even at the same time. The creation of virtual teams is a response to globalisation, with business enterprises becoming increasingly globalised through mergers and acquisitions of

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[26] Cf. Clemons, E. K.; Row, M. C. (1992): Information Technology and Industrial Cooperation: The Changing Economics of Coordination and Ownership, in: Journal of Management Information Systems, vol. 9, no. 2, pp. 9-28.

[27] Cf. Walsh, J. P.; Bayma, T. (1996): The Virtual College: Computer-Mediated Communication and Scientific Work, in: The Information Society, vol. 12, pp. 343-350. - Smith, D.; Katz, S. (2000): Collaborative Approaches to Research. Fundamental Review of Research Policy and Funding. Final Report. The Higher Education Funding Council for England (HEFCE), pp. 27-28. - Lazinger, S.S.; Bar-Ilan, J.; Peritz, B.C. (1997): Internet use by faculty members in various disciplines: a comparative case study, in: Journal of the American Society for Information Science, vol. 48, no. 6, p. 513.

[28] Cf. Smith, D.; Katz, S. (2000), op. cit., p. 59.

[29] Cf. the extensive list in Finholt, T.A. (2001): Collaboratories, in: B. Cronin (Ed.): Annual Review of Information Science and Technology, vol. 36. (also available at: http://intel.si.umich.edu/crew/technical_reports_alphabetical.htm), and the examples in European Technology Assessment Network (ETAN) (1999): Transforming European science through information and communication technologies: challenges and opportunities of the digital age. Final version, pp. 40-42. - OECD (1998): The Global research village: How information and communication technologies affect the science system. Paris. (http://www.oecd.org/dsti/sti/s_t/scs/prod/global.pdf).

foreign firms or an extension of their sales areas to a global level. Also, the scarcity of highly qualified technical staff in many industrialised countries and the promise of round-the-clock development on different continents in different time zones can be considered as additional supporting factors to the establishment of virtual teams.[30] They tend to be found predominantly in applied research and development rather than in fundamental research. Many examples are documented from software development.[31]

Collaboratories and virtual teams have only been described in case studies thus far. The question of how to quantify their significance or their geographical spread still remains unsolved.

One possible approach to quantifying the extent to which private enterprises are involved in R&D collaborations and the role that computer networks play in these collaborations is to ask decision makers in the field of R&D (heads of R&D departments, in smaller firms the chief executives). This sort of question has been posed in innovation-related surveys and it has generally produced useful results.[32] We include two indicators which are suitable for both a decision maker survey and a survey in the public R&D sector, i.e. among universities and research institutes. The first, indicator 23, assesses to what extent specific Internet-based collaboration technologies are used. The second indicator, 24, measures whether the Internet has been essential for achieving certain purposes of R&D collaborations. The direct impact of computer networks on R&D collaborations is related to the amount and characteristics of communication, interaction and data and information transfer among the partners. An increase in overall communication may lead to improved co-ordination of R&D projects. ICT may also replace personal communication, e.g. if partners "meet" at a video conference, and thereby reduce travel expenses. The direct effects may additionally trigger a range of indirect effects: more or improved communication and information exchange can enhance the management of R&D projects, shorten the project duration, improve the quality of collaborative output and the productivity of R&D partnerships.

2.5 Operationalisation and data collection

The indicator system covers a broad range of issues relating to new Internet technologies, specific network-based tools for R&D, the integration of the Internet into research processes and the characteristics of R&D collaborations. It is not possible to collect all the data necessary for filling the indicator system within one single data collection process. Different data assessments and a methodological mix are necessary to comply with the broad claim established above.

However, some of the available methods of data collection were excluded for the purpose of this study. The level of methodological development of Web content analysis and log file analysis has not advanced sufficiently for them to be used effectively to answer the kind of macro-analytical questions we pose.[33] We also dispensed with bibliometrics, a common method for assessing the output data of research, as the empirical material available for bibliometrical analyses is not sufficiently detailed to account for Internet issues (e.g. whether the on-line or printed version of a journal was cited, whether and to what extent a research collaboration that produced a co-authored article used the Internet).

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30 Cf. Herbsleb, J. D. et al. (2000): Distance, Dependencies, and Delay in a Global Collaboration, in: Proceedings of CSCW 2000, Philadelphia, PA, Dec. 2-7, 2000 (http://www.bell-labs.com/org/11359/colab_prod/).

31 Cf. Herbsleb, J. D. et al. (2000), op. cit. - OECD (1998), op. cit.

32 Cf. Foyn, F. (2000): Community Innovation Survey 1997/98 - final results. Eurostat (Ed.): Statistics in Focus: Theme 9 Research and Development, no. 2/2000.

33 Cf. Björneborn, L.; Ingwersen, P. (2001): Perspective of webometrics, in: Scientometrics, vol. 50, pp. 65-82.

Traditional surveys and secondary use of data from ancillary R&D service organisations must be considered the most reliable and accessible methods for collecting empirical data relating to Internet use in R&D at the current point of time.

2.5.1 Surveys among researchers in academia and private firms

A further distinction is necessary when considering a survey of researchers, as research in a public/academic environment and in a private sector environment differ fundamentally: academic research is concerned with increasing the stock of public knowledge whereas private business research aims at increasing the yield that might be derived from the possession of private knowledge.[34] Also, the behaviour regarding the disclosure of knowledge is essentially different, i.e. more autonomous and less influenced by property rights is the norm in academia. This will bias indicators on the use of Internet technologies, for example the content of a researcher's Web presence. As we must expect structural differences in the answers from public and private researchers, it seems advisable to develop separate questionnaires for each sector. However, the operationalisation of the indicators and the question design should be similar, in order to ensure the possibility of detecting the differences between each sector by means of a comparison of the results.

Basic indicators which assess the extent to which the Internet has penetrated scientific work and how the latter has been affected by the new technology are accessible to such a survey. Indicators on the following constructs could be included:

- Communication for R&D purposes (including e-mail)
- Computer skills
- Information retrieval and computer networks (including digital library, peer site and software usage)
- Information dissemination and publishing activities and the Internet (including e-publishing, quality control and researchers' own Web presentations)
- R&D collaboration

A critical issue for both public and private R&D sector surveys is the composition of the samples. The sample structure in regard to research disciplines (academic sector) and industries (private sector) can be expected to exert a large influence on the results.[35] For example research disciplines differ in regard to how work is organised and how knowledge is produced, the function that social interactions fulfil and the extent to which they take place within the discipline and across disciplinary boundaries, what communication media are used and for what purpose.[36] The differences might even be considerable within individual research disciplines, between fields of research or between theorists and experimentalists. Becher developed the typology of busy and crowded "urban" and slow and quiet "rural" research areas[37] for these variations. It is therefore crucial to draw a representative sample for a survey of academic researchers,

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[34] Cf. Dasgupta, P.; David, P.A. (1994): Towards a new economics of science, in: Research Policy, vol. 23, pp. 487-521.

[35] Cf. Kling, R.; McKim, G. (2000): Not just a matter of time: Field differences and the Shaping of Electronic Media in Supporting Scientific Communication, in: Journal of the American Society for Information Science, vol. 51, no. 14, pp. 1306-1320. (also available at: http://xxx.lanl.gov/ftp/cs/papers/9909/9909008.pdf). – Walsh, J.P.; Roselle, A. (1999): Computer Networks and the Virtual College, in: STI Review No. 24: Special Issue on The Global Research Village. Paris, p. 51. – Walsh, J. P. et al. (2000): Connecting minds: CMC and scientific work, in: Journal of the American Society for Information Science, vol. 51, pp. 1295-1305. – McKain, K.W. (2000): Sharing digitized research-related information on the World Wide Web, in: Journal of the American Society for Information Science, vol. 51, pp. 1321-1327.

[36] This has been acknowledged for many years: cf. Crane, D. (1972): Invisible colleges. Diffusion of knowledge in scientific communities. Chicago and London. - On recent data cf.: National Science Board (2000): Science & engineering indicators 2000. Arlington, Va. (http://www.nsf.gov/sbe/srs/seind00/start.htm), tables 6-54 and 6-60.

[37] Becher, T. (1989/1996): Patterns of Communication, in: Nowotny, H.; Taschwer, K. (eds.): The sociology of sciences. Volume 1. Cheltenham and Brookfield, pp. 163-179.

and the same holds true for a survey of research in private firms in regard to the industry composition of the sample. An alternative to an overall representative survey might be a limited sample for certain research areas and disciplines or industries. This could serve to further explore the differences regarding Internet usage and the differing impact on selected disciplines and industries.

Of similar importance is the consideration of "local" characteristics. From the data on international R&D collaborations we know that small countries engage more in external collaboration than large countries. For example, in the years 1995 to 1997 almost 50% of the Swiss scientific and technical journal articles were internationally co-authored, whereas only 18% of the US-American articles had a foreign co-author.38 Similarly, the OECD-index for patents with foreign co-inventors in 1995-97 is 14.4 for Switzerland and 4.8 for the US.[39] It is not the objective of this project to explore the reasons for these differences between large and small countries.[40] But if we transfer this finding to the "local" level, we can infer that researchers from small organisations will collaborate more with researchers from other organisations than researchers from large organisations. We can construct a similar argument for the use of resources for scientific work, assuming that researchers from large organisations (with large libraries, laboratories etc.) obtain a larger percentage of their inputs locally and a smaller percentage from other sources. We should therefore expect that the size of an organisation affects the use of communication technologies. In principle, researchers (in public as well as private organisations) from smaller organisations should have a higher demand for Internet technologies to overcome the limits of "local" resources. This implies that the size of an organisation, or perhaps more appropriately the size of the regional research system, must also be taken into account when examining the differences in Internet usage. The regional research system, viz. its human and material resources, may compensate to some extent for a lack of "local" resources within an organisation. Consequently, the sampling procedure must account for differences in the size of research systems (i.e. certain precise research areas or industries and their broader regional environment) to avoid any bias in this respect. The most appropriate procedure seems to be a handpicked selection of certain research areas/industries at locations with large research systems compared to the same areas/industries at locations with small research systems.

a) Survey on Internet use in not-for-profit R&D

The survey on Internet use in the not-for-profit R&D sector pilots the majority of SIBIS indicators in this topic area in higher education (universities, polytechnics), private not-for-profit R&D institutions and government funded research institutes. Due to budgetary and time restrictions a representative survey across all research disciplines, research fields, types and sizes of R&D organisations, and regional research systems is not possible. Instead, specific research fields are selected which can be considered to span the variety of communication and collaboration behaviour and Internet use. The survey will be carried out in selected countries covering both large and small national R&D systems.

In principle, the indicator system does not prejudice the deployment of a traditional survey form (personal, phone, written) over a novel, Internet-based form (e-mail or on-line questionnaire). However, as one of the main targets is to assess the usage of various Internet tools, an on-line only survey might suffer from a sample selection bias.

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38 National Science Board (2000), op. cit., p. A438-A449.

39 OECD (2001): Science, technology and industry scoreboard 2001. Towards a Knowledge-based Economy. Paris, pp. 112-113, 196.

40 Cf. on determinants of collaboration: Katz, J. S.; Martin, B. R. (1997): What is research collaboration?, in: Research Policy, vol. 26, pp. 1-18. - Luukkonen, T.; Persson, O.; Sivertsen, G. (1992): Understanding patterns of international scientific collaboration, in: Science, Technology, and Human Values, vol. 17, no. 1, pp. 101-126. – Especially on the situation in small research systems: Thorsteinsdóttir, O. H. (2000): External Research Collaboration in Two Small Science Systems, in: Scientometrics, vol. 49, pp. 145-160.

On the other hand, an on-line survey on this topic might trigger larger response rates. Hence, a combination of on-line and off-line methods seems to be a good solution.

The reporting units will be researchers at different hierarchical levels, e.g. heads of university institutes, professors, research fellows, Ph.D. students etc. to take status effects on media use into account. The survey will be carried out at the end of 2002 and its results will be integrated into deliverable 5.2, the final version of this deliverable.

b) Decision Maker Survey of SIBIS

In principle, a survey similar to the RCS could be conducted among researchers in private firms including some modifications of the questionnaire which take the characteristics of private R&D into account. Unfortunately, the SIBIS project does not have the financial resources to carry out a second survey oriented specifically towards the Internet in private R&D.

However, in order to tackle information society issues in the European economy the SIBIS project carried out a decision maker survey (DMS) of private business establishments in Germany, France, the UK, Italy, Spain, Finland and Greece. The sample of establishments taken is a disproportionately stratified sample reflecting labour force distribution across establishment size bands. Sample sizes range from 300 to 500 per country resulting in an overall sample of 3,100. The survey was conducted via computer aided telephone interviews.

The SIBIS topic research identified five domains which could be targeted within a general survey: e-commerce, telecommunication & access, security, e-government, Internet for R&D. In order to collect valid information for the different domains, a rather general reporting unit had to be used: “IT decision makers” includes the managing director, general manager or proprietor in smaller companies, and the heads of IT departments or senior professionals in the IT department in larger firms. Without doubt the general needs of the SIBIS project conflict to some extent with the specific needs of individual topics. For instance, the DMS would have to be targeted specifically at the management responsible for R&D, such as the heads of R&D units, to yield broad and meaningful results on this research topic.

Hence, only a restricted proportion of the indicators from this topic was found to be suitable for inclusion in the DMS. These are two indicators on the computer staff providing services to R&D (indicators 14 and 15). The operationalisation of the indicators within the DMS is shown in annex A.2 and the results are presented in section 3.

2.5.2 Secondary analysis of data from ancillary service organisations

Another group of indicators is based on data collection from ancillary service organisations. Important organisations in this field are the national research networks and the providers of electronic library services.

Specific indicators for research networks (indicators 3 to 5) can be taken from the Trans-European Research and Education Networking Association (TERENA) second survey of their member networks, which was carried out in January/February 2002. These indicators currently provide the best available insight into the strengths and weaknesses of the national research networks in Europe.

Unfortunately, a similar set of secondary data on electronic library services (ELS) for R&D does not exist. It is significantly more difficult to collect such data because a large number of institutions with differing data processing capacities and interests are involved. Though indicator formation has been advanced in order to facilitate a

performance assessment of ELS,[41] generally accepted indicators and routine data collection do not yet exist. In particular the formation of a standardised set of indicators and definitions which has been discussed widely and agreed upon by data users and providers is a necessary first step prior to any data collection. As appropriate treatment of this specific issue extends far beyond the scope of the present analysis, we dismissed a data collection on ELS within SIBIS.

[41] Proposals for indicators to measure the performance of ELS have been published by: International Coalition of Library Consortia (1998), op. cit. – Shim, W. et al. (2000), op. cit. – Brophy, P. et al. (2000), op. cit. – Other initiatives are undertaken within the D-Lib Forum Working Group on Digital Library Metrics (http://www.dlib.org/metrics/public/index.html) and supported by the Digital Library Federation (http://www.diglib.org/use.htm).

3 Analysis of currently available data

As indicated in the preface, the present section is still preliminary and will be expanded in the final version to integrate the results of survey among researchers on the use of Internet technologies. The current version only contains a small part of the information which will be available in the final version.

3.1 Internet-related ICT infrastructure for R&D

3.1.1 Research networks

This section on National Research Networks (NRNs) makes extensive use of the TERENA surveys of European research networks. All NRNs of the 15 EU member states and Switzerland (and further Eastern European and North African countries) are TERENA members and are included in this survey. Hence, the survey results for 2001 and 2002 (carried out at the beginning of the year) represent a suitable basis for national comparisons.[42]

a) Core usable backbone capacity on a national research network

The core capacity on an NRN is the maximum data transfer rate per second available within the network. While in 2001 the maximum core capacity available in a range of countries was 2.5 Gbit/s (= 2,500 Mbit/s), in 2002 two NRNs offered 10 Gbit/s (The Netherlands and Sweden) and the French RN offered 7.4 Gbit/s (cf. table 2). These three countries have increased the core transmission capacities considerably in 2001, and they can be considered as the current leaders. Greece, Spain and Portugal in both years had transmission capacities well below the EU median (middle value of the maximum transmission capacities of all countries in the sample).[43] Furthermore, none of the three has improved its capacity between the two phases of the TERENA survey. Some countries which had core transmission capacities well below the European average in 2001 made efforts to improve the service level: Austria, Ireland, Luxembourg and Switzerland managed to approach or even exceed the EU median. Another set of countries (Finland, Germany and the UK) had relatively high transmission capacities in 2001, but these stagnated in the following year. However, neither in these nor in the other countries should a constant core capacity be interpreted as overall stagnation. For example, the number of sites that are accessed with the maximum capacity might have increased.

[42] On the data sets cf. http://www.terena.nl/compendium/. The data are still preliminary and the current verification process by the NRNs might lead to corrections and changes which will be integrated into the final version of this report.

[43] However, the star-like topologies somehow limit the comparability with the other European networks. Madrid is the centre of the Spanish network. In Greece and Portugal the NRNs have two nuclei, Athens and Thessaloniki, and Lisbon and Porto.

Table 2: Core maximum capacity on the NRN by country in 2001 and 2002

	Core maximum capacity in Mb/s		Relation to the median[a]		Growth 2001-2002[b]
	2001	2002	2001	2002	
Austria	155	1,000	-	-	+
Belgium	622	1,000	=	-	+
Denmark	822	822	+	-	
Finland	2,500	2,500	+	+	
France	2,500	7,400	+	+	+
Germany	2,500	2,500	+	+	
Greece	155	155	-	-	
Ireland	155	1,000	-	-	+
Italy	.	2,500	.	+	.
Luxembourg	10	1,000	-	-	+
The Netherlands	2,500	10,000	+	+	+
Portugal	180	180	-	-	
Spain	155	155	-	-	
Sweden	622	10,000	=	+	+
Switzerland	310	2,000	-	+	+
U.K.	2,500	2,500	+	+	
Median	622	1,500	=	=	+

a "+" above the median, "=" at the median, "-"below the median.
b "+" Growth between 2001 and 2002.
Source: TERENA surveys 2001 and 2002 (http://www.terena.nl/compendium/).

b) Congestion on the research networks

Another indicator that provides information on the service level of computer networks within the entire national research system was assessed in the TERENA 2002 survey as *congestion*. The NRNs were asked to rank different computer networks according to the probability of experiencing congestion. They indicated that the campus networks and the access networks are probably the most congested, whereas the national backbones and the external connections hardly ever experience congestion (see annex table A-1). This ranking, however, only compares different elements of the computer networking infrastructure within a country.

For an international comparison the percentage levels of users that experience congestion is more appropriate. Terena asked the NRNs to carry out an estimation of the percentages of its client institutions that might be affected by congestion on the different national networks and the external connection. The data gathered with this method can only be considered as a crude approximation to actual congestion figures, and the following calculations are above all intended to give an impression what could be done with more reliable data. The estimated congestion percentages vary to a large extent (cf. table 3).[44] Of those countries who provided estimations, Spain is definitely the country with the most congestion, both for transmitting data at the national and international level. The Total Congestion Ratio (TCR), or percentage of client institutions that might experience congestion when transmitting data within the national network or to a foreign partner illustrate this.[45] Furthermore, relatively high congestion

[44] Not all NRNs were able to provide the required data. For some the missing data might also signify "0 percent of congestion". However to verify this, the NRNs would have to be contacted again which is beyond the scope of this analysis.

[45] National and international TCR are identical or only differ to a small extent as in most countries the external connections do not experience any congestion.

levels are estimated for the UK and Belgium. Greece, Ireland, Italy and Finland are close to the average. Lower levels are found in Denmark, Austria and Switzerland.

Table 3: Estimated percentage of client institutions affected by congestion in 2002 by country[a]

	Estimated percentage of client institutions which experience congestion					TCR[b]	
	Campus LAN	MAN or regional network	Access network	NRN backbone	External connections	National	Inter-national
Austria	10	.	20	0	0	28.0	28.0
Belgium	50	5	5	0	0	52.6	52.6
Denmark	0	0	0	0	0	0	0
Finland	30	5	10	0	0	37.5	37.5
Greece	5	0	25	20	10	43.0	48.7
Ireland	10	.	35	0	0	41.5	41.5
Italy	10	10	30	5	0	40.2	40.2
Spain	10	50	70	50	10	91.2	92.1
Switzerland	20	.	10	0	0	28.0	28.0
U.K.	50	5	10	0	1	57.0	57.5
Mode	10	5	10	0	0	.	.
Arith. mean	19.5	10.7	21.5	7.5	2.1	44.1	45.3

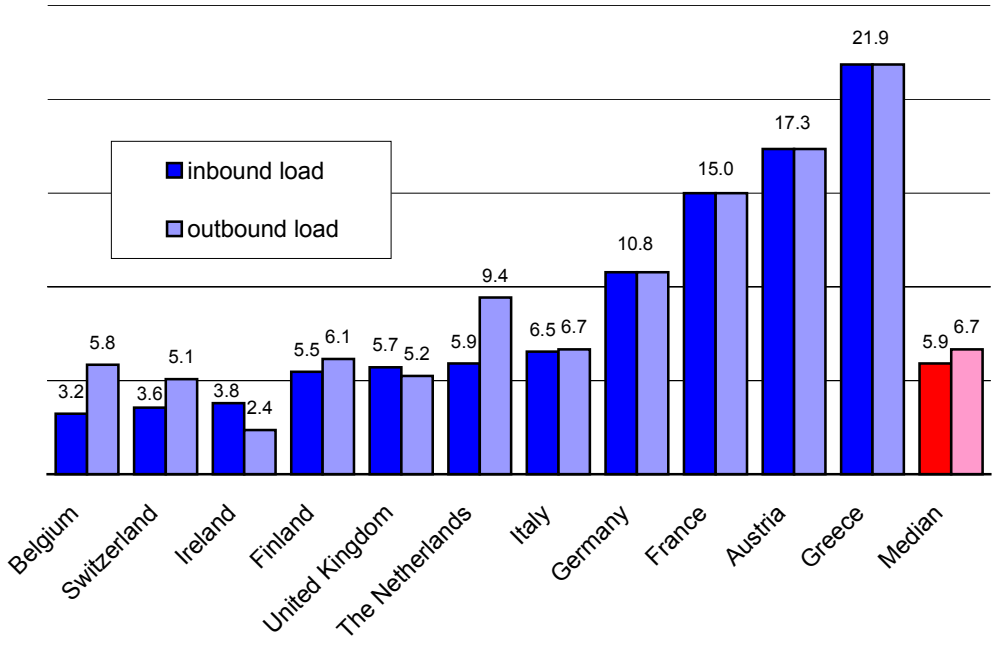
LAN: Local area network; MAN: Metropolitan area network; NRN: National research network
a No data provided for France, Germany, Luxembourg, the Netherlands, Portugal and Sweden.
b Total congestion ratio (TCR): Percentage of client institutions within a research system which might experience congestion on their network.
Source: TERENA survey 2002 (http://www.terena.nl/compendium/). – FHSO calculations.

A different methodology for estimating congestion on the NRN's external connections only has been proposed by Terena itself.[46] The inbound and outbound transmission capacities of the external connections are juxtaposed to the inbound and outbound traffic. The higher the average "load" (that is, the fraction of the potential and the actual volume of traffic) the higher is the risk to experience congestion during peak hours. Figure 2 contains a graphic representation of the in- and outbound loads for January 2002. It shows that only Ireland has both, low inbound and low outbound traffic loads on its external connections. A group of countries (Belgium, Switzerland, Finland, the U.K., the Netherlands, and Italy) has either in- or outbound traffic values close to the median value. If we assume peak traffic to be approximately three times as high as average traffic (Terena assumption), we still get traffic loads below thirty percent (of the capacity) for all countries. A third group of countries composed of Germany, France, Austria, and Greece has values above the median. However, only the peak traffic loads of Greece and possibly of Austria indicate a risk of congestion on the external connections.[47]

[46] The following data are unpublished figures from Terena that also is responsible for the methodology employed.

[47] At least for Greece this also confirms the judgement made by the Greek NRN in regard to the occurrence of congestion on its external connections (cf. table 3).

Figure 2: Inbound and outbound traffic loads of the NRN external connections (in Jan. 2002)[A]



a Cf. table A-2 for the data.
Source: TERENA calculations, unpublished data.

c) Budget size of a national research network

Another indicator useful for assessing the current and future service levels of NRNs is their budget size. TERENA collected data on budgets from the European NRNs (cf. annex table A-3). Though the NRNs were asked to include only the budget for activities related to networking activities (and exclude for instance domain name registration), it is still not certain that the data are entirely comparable, as even the scope of networking activities differs. For instance, some networks provide a lot of user support, and some carry out research, whereas others don't. However, this can only be taken into account, if the NRNs provide a detailed breakdown of their budget figures which is currently not the case. As the budgets for different years are also affected by fluctuations in investment outlays it seems advisable to calculate mean values over a longer period of time. This is also performed in table A-3 in the annex. Furthermore, the NRN budget data can be compared to realise two alternative objectives: on the one hand to compare the provision of data transmission capacities to the national research systems (which is our main objective) and on the other hand to compare the NRNs' cost-effectiveness. For the former objective the budget data should be normalised with variables that measure the size of the national research systems. For the latter, variables are needed which reflect the size of the network. Though the size of the research system and the size of the NRN are not independent of each other, there is a difference depending on the perspective taken.

We do not possess an optimal variable to measure the size of the national research systems, such as the number of researchers and students differentiated according to their data transmitting requirements. However, we can approximate this using different variables:

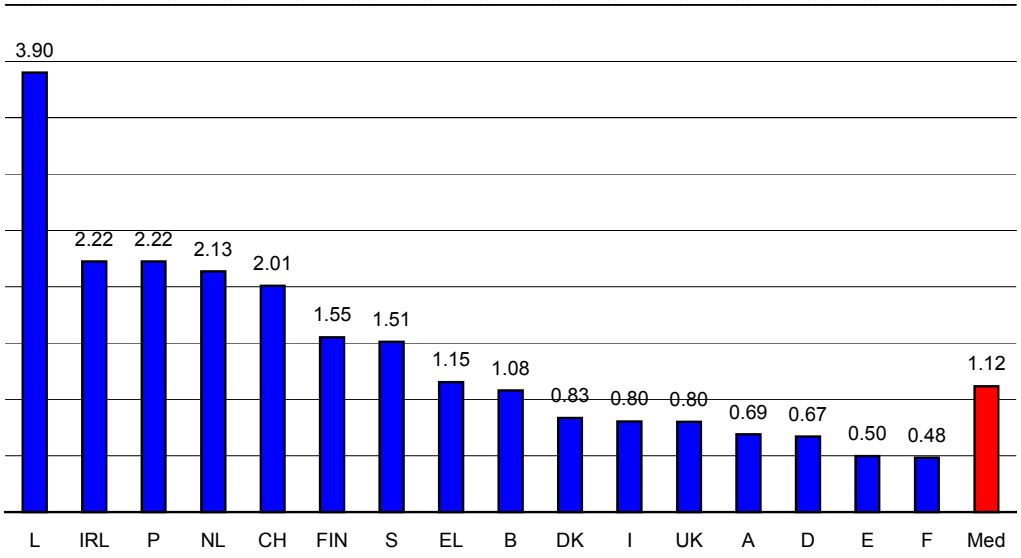
- The OECD publishes data on *researchers* and *R&D personnel* (both in full-time equivalents) in the MSTI database. Unfortunately, the data is not very up-to-date and it is not entirely clear for which countries it contains only researchers or all university graduates.

- The *number of students* is generally available from the national statistical institutes, however, this covers only a fraction of the client base.
- The volume of scientific output produced in a country as reflected in the *number of publications in scientific journals* included in the SCI and SSCI.
- The most general methods for approximating an NRN's potential client base are to use the *population* or the *GDP* of a country.

All of these variables have disadvantages: researchers, R&D personnel and students, each only covers part of the client base of an NRN and we do not know the data transmission requirements of the different groups and we therefore lack a way of connecting the variables. The national publication data of the citation indices SCI and SSCI are, of course, dependent on the size of national research systems, but they are also affected by their productivity. Moreover, a bias towards English publications and the inherent advantage of English-speaking researchers cannot be excluded. Population and GDP data are only very rough approximations of the size of the R&D system, if at all. However, the different data sets for standardising the NRN budgets correlate fairly well with each other and consequently the normalised budget indicators also correspond.

In annex table A-4 we show the budget figures of the NRN standardised in turn with each of the listed denominators. The figures 3 and 4 use the population and scientific publication data respectively.

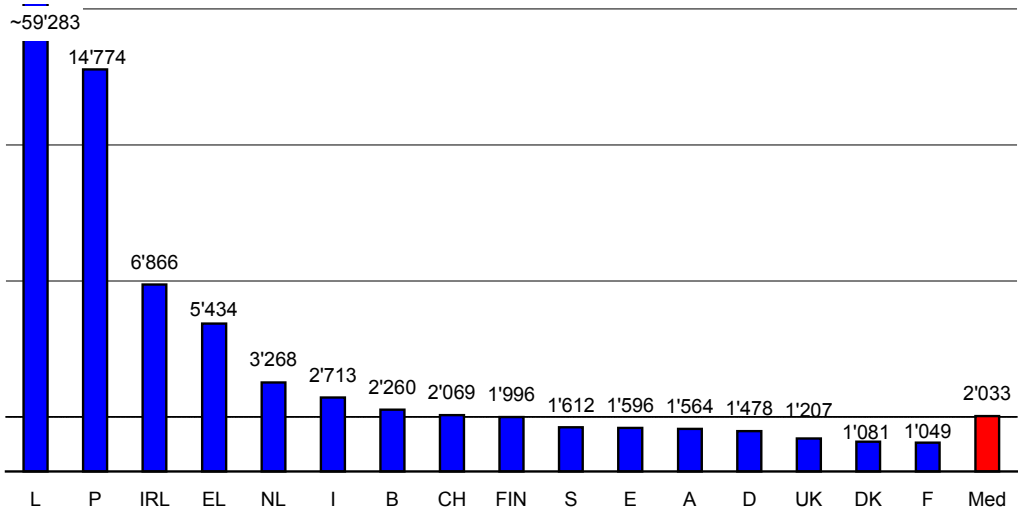
Figure 3: NRN budget in PPP per capita (average for budget years 2000-2002)[a]



a Cf. table A-4 for the data.

Source: TERENA surveys 2002 and 2001 (http://www.terena.nl/compendium/) – Eurostat (http://europa.eu.int/comm/eurostat). – FHSO calculations and drawing.

Figure 4: NRN budget in PPP per scientific publication (average for budget years 2000-2002)[a]



a Cf. table A-4 for the data.

Source: TERENA surveys 2002 and 2001 (http://www.terena.nl/compendium/) – National Science Board 2002, table 5-41. – FHSO calculations and drawing.

The first remarkable feature of the standardised budget data is that large countries (Germany, France, UK, Italy and Spain) have below-average budgets (per capita, per scientific paper). This could be partially due to the normalisation we chose. However, as we can see from the annex table A-4, they also have below-average data if we calculate NRN budgets per researcher, per R&D personnel, per student or per GDP. Another possible explanation could be economies of scale leading to lower average costs for larger NRNs:[48] Economies of scale are the result of lower average data transmission costs (e.g. twice the money buys four times the transmission rate) and the better bargaining position of an NRN with a large customer base. Whether this is the reason for the distinction between large, small and medium-sized countries' NRN budgets would need closer investigation, which is beyond the scope of this analysis. However, comparing the French and the German NRN, we see that the budget of the French NRN is roughly 30% lower than that of the German, for both normalisations used in figures 3 and 4.

A second feature of the budget figures is that they are largely consistent with a growth of core capacity on the NRN (compare table 2). Of the countries with the highest budgets per capita, Luxembourg, the Netherlands, Switzerland and Ireland increased the core capacity in 2001. This indicates that the budget figures reflect to some extent the investment efforts of the NRNs. Consequently, countries that did not increase their core capacities often had below average NRN budgets in the period 2000-2002 (Germany, Greece, Spain and the UK). Some countries, however, break this "rule": in particular France, with the lowest budget, nevertheless managed to increase its core capacity. The Portuguese NRN which had a budget above the European average undertook other investment projects (introduction of differentiated bandwidth, connection of schools).[49]

Taking the second perspective on NRN budgets, i.e. assessing and comparing the performance and cost-effectiveness of NRNs is not the objective of the present investigation. However, the TERENA survey collected data that might be used to normalise the NRN budgets for this purpose: the number of connected institutions, the usable backbone capacity on the network and the traffic that occurred on the network.

48 For this explanation we are grateful to B. van Pinxteren from Terena and U. Eppenberger from SWITCH.

49 Cf. Terena 2002a, op. cit., p. 12.

We include these data in the annex (table A-5) but will not deal with it further in the main body of the text.

d) Summary

Summarising the different indicators on research networks we can identify three countries which perform well on each: the Netherlands, Switzerland and Sweden all had above-average NRN budgets per capita and above-average transmission capacities. They have also managed to increase the transmission capacities in 2001/2002. The Swiss research network additionally estimates low congestion on the country's research networks (for the Netherlands and Sweden the data for this indicator is lacking) and gives low figures for the traffic load on external connections. Finland and Ireland also perform rather well in regard to the budget and the traffic load on their external connections. While Finland also has an above average transmission capacity on the NRN backbone, the Irish NRN has made great efforts to increase the core capacity.

Located in contrast to these NRNs is the Spanish network, with the lowest maximum transmission capacity, the highest congestion and very low budget figures. Two other Southern European countries, Portugal and Greece, also started out with low service levels. At least in Portugal the budget figures might be interpreted to indicate an increasing awareness of the necessity of high-quality NRN services.

The other countries are located somewhere in between, though obtaining a clear ranking is not possible with the data available. The large countries, Germany, U.K., France and Italy have high core capacities on their backbones. However, the budget figures are very low and further investigations are required in greater detail to determine whether economies of scale make up for the lower budgets. Austria, Denmark and Belgium might be satisfied with below average transmission capacities due to their smaller research systems (at least for Austria and Denmark the low congestion ratios also point in this direction). However, as the data transmission requirements of R&D increase these countries will have to continue to improve their networks and provide sufficient financial resources.

3.1.2 Personnel input

Information on the input of computer-related know-how into research activities is collected from two sources: the Decision Maker Survey (DMS) on specialised computer staff and the researcher survey on the computer skills of researchers. The results of the DMS are already available and presented in the following section.

a) Specialised computer staff

The SIBIS Decision Maker Survey includes one short module on the computer staff for R&D and the personnel of R&D-related IT services for establishments performing R&D (cf. annex 2). The survey provided initial data for two indicators, "Computer staff providing services to R&D" and "Unfilled vacancies for computer staff providing services to R&D".

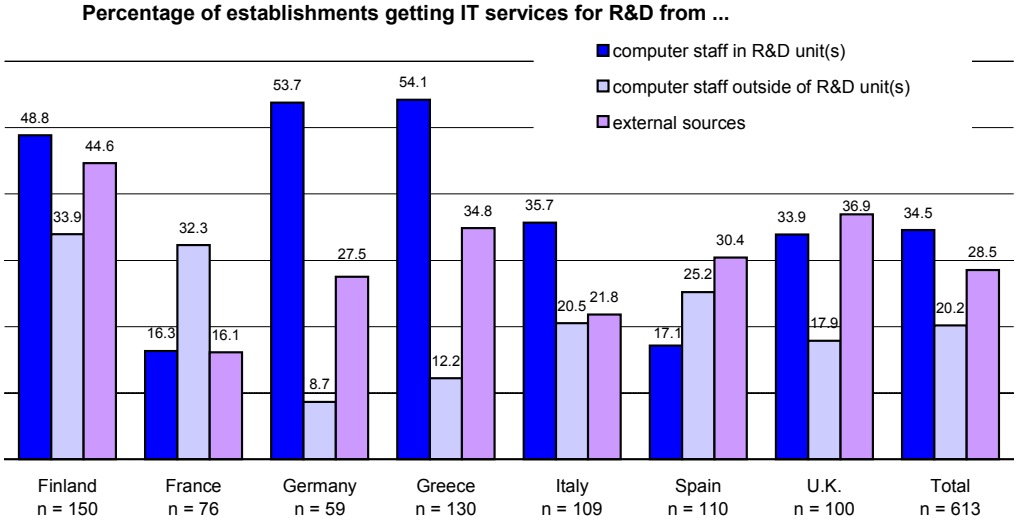
The reporting units in the DMS were IT decision makers, i.e. the managing director, general manager or proprietor in smaller companies, and the heads of IT departments or senior professionals in the IT departments of larger firms. Of course, it would have been more appropriate to ask R&D decision makers about R&D personnel and computer staff for R&D and we must assume that the data we obtained is of limited quality. Obviously false or implausible answers were deleted from the data set prior to analysis (45 cases). To get an impression of the quality of the remaining DMS sample for the R&D module we can compare the R&D intensity (total R&D personnel/total

employees) with data from the OECD/EC (cf. table A-7 in the annex). As the data are based on different definitions we should compare only the country rankings and the relations to the total.[50] These match fairly well. However, for Germany, U.K. and Italy the SIBIS DMS sample seems to contain lower R&D personnel figures whereas for Finland, France and Greece these are higher than usually obtained in the national surveys.

The questionnaire contained some filtering questions and general R&D-related questions. The answers to these are included in the annex, as they might be of interest to readers more generally inclined towards R&D (cf. table A-6), but they will not be dealt with in the main body of text.

Approximately 40% of the establishments carrying out R&D have at least one central R&D unit (table A-6). However, in France and Spain the organisational structure of the establishments is quite different, as only one in five establishments has an R&D unit. Approximately one third of the establishments also employs computer staff in these R&D unit(s), as a consequence of the organisational structure these percentages are significantly lower in France and Spain (cf. figure 5). Of the seven country total, establishments in Finland have the largest proportion of externally sourced IT services for R&D, in addition to computer staff within the R&D departments and IT personnel from other departments. In Germany, on the other hand, internal IT services for R&D are largely provided by computer staff within the R&D unit(s) and only marginally by computer staff from other units. As well as Finland, it is also customary in the U.K. to buy IT services for R&D from external providers, whereas in France this is rather unusual.

Figure 5: Percentage of establishments obtaining IT services for R&D according to location of computer staff and country



Weighting by establishments; due to different weighting factors the seven-country total is not equal to the sum of the individual countries.

Source: SIBIS 2002, DMS. – FHSO calculations.

The first of the SIBIS indicators on personnel input assesses the entire computer staff available for R&D activities, i.e. the computer staff within central R&D unit(s), outside of central R&D unit(s) and the (hypothetical) staff that would be necessary to substitute for R&D-related IT services which are bought from external service providers. To be comparable at the country level the data must be normalised. Different options for normalisation are available (cf. table 4). Taking simply the number of establishments

[50] The total of the SIBIS DMS is only for the seven countries of the sample. However, as the five largest EU countries are included, the EU average should be rather close to this.

that perform R&D takes the differing sizes of the country samples and the national research systems into account. However, the number of establishments is not a very good denominator, because differences in establishment size can still bias the indicator: for example the above average establishment size in Finland (cf. table 4, last column) is also reflected in the computer staff for R&D per firm performing R&D. This problem can be solved by calculating the proportion of computer staff for R&D to total R&D personnel or to total employees. As the objective of the indicator is to measure the computer staff available for R&D activities, the normalisation must consider the size of the R&D activities. This is possible by using the total R&D personnel as the denominator.[51] Clearly the indicator is only an approximation of the specialised computer staff for R&D and does not take into account differences in the quality levels of their services, e.g. based on the qualification of the computer staff or the quality of the available hardware and software. We will name this proportion of computer staff for R&D in relation to total R&D personnel "*computer staff intensity*" (CSI).

Table 4: Proportion of computer staff for R&D[a] using different denominators

	Computer staff for R&D in relation to …			Employees per establishment that performs R&D
	total R&D personnel	firms performing R&D	total employees in firms performing R&D	
Finland (n = 215)	19.5	22.1	2.9	754
France (n = 156)	11.0	6.4	1.8	352
Germany (n = 139)	33.4	17.1	4.1	414
Greece (n = 133)	42.3	3.0	2.5	123
Italy (n = 173)	25.3	6.0	1.2	512
Spain (n = 177)	46.6	10.8	3.0	358
U.K. (n = 159)	26.9	8.3	2.5	328
Total (n = 994)	26.1	10.5	2.7	395

a Staff within central R&D unit(s), outside of central R&D unit(s) and external, i.e. computer staff that would be necessary to substitute for IT services for R&D bought from external service providers.

Weighting by employment; due to different weighting factors the seven-country total is not equal to the sum of the individual countries.

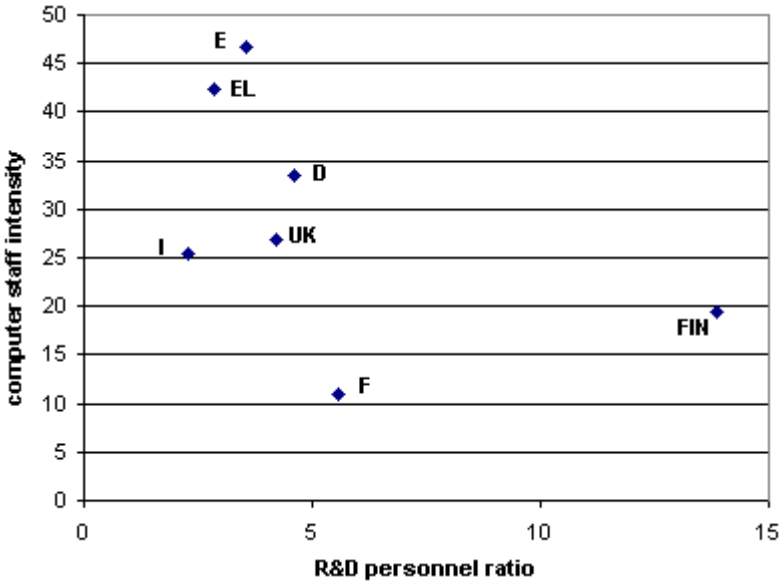
Source: SIBIS 2002, DMS. – FHSO calculations.

We obtain above average values for the computer staff intensity for Spain, Greece and Germany. Italy and the U.K. are around the seven-country average whereas the remaining two countries (Finland and France) are well below (cf. table 4). This runs somewhat counter to our expectations: we expected establishments in the countries with high R&D personnel proportions (cf. annex table A-7) to be in a position to equip their research activities with a large support staff. However, this is not the case and countries with rather low R&D personnel ratios such as Spain and Greece have the highest CSI values. The scatter plot of the computer staff intensity versus the R&D personnel ratio points into the same direction (cf. figure 6) and looking at the establishment data we get the same result.[52] Based on this finding we should interpret a low CSI value as a sign of strength and a high value as a sign of weakness of the research system.

[51] An example can make this clear: taking two establishments A and B with 100 employees and 10 computer staff for R&D each, establishment A with 10 R&D personnel can be expected to have a higher IT service level than establishment B with 20 R&D personnel: In establishment A each researcher has access to twice the computer staff than in establishment B. This would not be apparent if we instead took the entire establishment size, which was assumed to be the same for A and B.

[52] The correlation coefficient between the R&D personnel ratio and the CSI is very small (r = -0.115) but highly significant.

Figure 6: Computer staff intensity versus R&D personnel ratio



Weighting by employment.
Source: SIBIS 2002, DMS. – FHSO calculations.

A possible explanation could be that the countries with low computer staff intensities have large needs of filling open positions. This is, however, not the case, as we will show below (cf. footnote 53 and table A-8). A different explanation could be the above-mentioned deficiencies of the personnel data: they do not take the qualifications of computer staff or researchers into account. It can be assumed that a correlation exists between the penetration of computers within an R&D system and the computer skills and the ability to deal with problems in it. The indicators also do not provide any information on the available material infrastructure, hardware and software. Establishments in countries with less developed research systems might have to compensate for a lack of these by employing more support staff. However these explanations are not in line with the results for Germany which has both an above average CSI and a well-developed research system. Another explanation could be that the services provided by computer staff for R&D are subject to sharply diminishing returns: i.e. an establishment needs a certain number of computer staff to provide the basic range of computer services to its researchers and this amount does not depend so much on the size of its research activities (and personnel) but on other factors (such as the necessity to cover a broad range of different qualifications). An increase in staff levels and services does not provide much additional benefit to R&D activities. However, these explanations are all speculative and they cannot be tested with the available data. Consequently the indicator should be considered as preliminary and further analysis is needed to verify its value. This will be possible in part by using the data to be collected in the topic-specific survey on Internet use in R&D, as this survey will also collect data on the computer skills of researchers.

The second indicator on computer-related personnel input for R&D from the SIBIS DMS is oriented towards the unfilled vacancies for computer staff providing services to R&D. In the entire sample of establishments from the seven countries some 30% stated that their R&D projects were suffering due to a shortage of qualified computer staff, with the largest percentage in Italy (45%) and the lowest percentage in Germany (9%) (cf. table A-6). Being affected by a shortage of qualified computer staff should coincide with having a large number of vacancies. However, looking at the data on unfilled vacancies for computer staff required to provide IT services for R&D projects we cannot confirm this expectation (cf. table 5).[53] On average only 4.7 additional computer staff for R&D

[53] Different ways of normalising the unfilled vacancy figures are included in the annex table A-8. We decided that the present normalisation best matches the idea and objective of the indicator. However, in the light of the unexpected finding regarding the relation between the computer staff intensity and the

are needed per 100 already employed (within the establishment or from outside service providers), with the maximum values in Greece and Italy with some 14 and the minimum in Finland with less than 1. It is obvious that the lower this index of unfilled vacancies is, the higher the level of computer services to R&D, because a large index/number of unfilled vacancies indicates an unmet demand which might put strains on R&D.

Table 5: Unfilled vacancies for computer staff for R&D according to location of computer staff and country

	Unfilled vacancies for computer staff needed to provide IT services for R&D projects		
	per 100 total computer staff for R&D	per 100 *internal* computer staff for R&D	per 100 *external* computer staff for R&D[a]
Finland (n = 199)	0.6	0.7	3.4
France (n = 150)	8.1	10.3	37.7
Germany (n = 120)	1.5	2.1	5.6
Greece (n = 118)	14.5	18.6	65.8
Italy (n = 166)	13.8	18.7	52.2
Spain (n = 162)	10.5	16.5	28.9
U.K. (n = 151)	2.3	2.6	22.0
Total (n = 918)	4.7	6.2	19.5

a External: computer staff that would be necessary to substitute for IT services for R&D bought from external service providers.
Weighting by employment; due to different weighting factors the seven-country total is not equal to the sum of the individual countries.
Source: SIBIS 2002, DMS. – FHSO calculations.

If we differentiate the denominator and use only the internal or the external computer staff for R&D rather than the entire computer staff, we see that for some countries the relationship to the total does not change much: Finland has some 85% and Germany two thirds less unfilled vacancies than the entire seven-country sample, regardless of whether we take internal or external staff only as the denominator. However, for other countries the relationship changes markedly: for the UK the fraction of unfilled vacancies to *internal* computer staff is less than half that of the entire sample, whereas for *external* computer staff it is larger than the seven-country total. We can conclude that in some countries, in the sample Finland and Germany, there are fewer unfilled vacancies for computer staff for R&D because the establishments fulfil their needs by buying the required services from external providers. In other countries, both with a low number of unfilled vacancies (the UK) and a high number (Italy), the establishments might still reduce the number of unfilled vacancies for computer staff by buying the required services from external providers. To investigate why this is not done is beyond the scope of the present analysis. There might be various reasons, such as company policies to prevent breaches of security by avoiding external IT services in the sensitive field of R&D; another reason might be underdeveloped markets for these sorts of IT services, though this does not seem very likely for countries such as the UK and Italy.

b) Summary

The information on personnel input is limited to specialised computer staff for this version of the report. The interpretation of the computer staff intensity had to be modified due to the finding that countries (establishments) with large R&D personnel

R&D personnel ratio (cf. above) it is also interesting to see that the countries with high computer staff intensity (Spain and Greece) still have the largest requirements for additional computer staff for R&D projects (cf. table A-8).

ratios have low CSIs and vice versa. France and Finland have CSI values below the seven-country average, Italy, the U.K. and Germany are at the average, and Greece and Spain are well above it. The interviewed establishments in the latter two countries also indicated many unfilled vacancies for computer staff for R&D projects in comparison to the entire interview sample. This also employs to Italian and to a smaller extent to French establishments, whereas the British, German and Finnish establishments have relatively few unfilled vacancies.

4 Further developments

The indicator system can only be considered as a first approximation for benchmarking the usage and effects of Internet technologies in R&D. It still contains many weaknesses and gaps which are due to two different reasons:

First, the coverage of the topic with measurement concepts and indicators is still incomplete. This is essentially due to the novelty of Internet technologies and applications and the lack of established procedures which could be measured and analysed. As the technology matures this problem should become less important.

Second, the available data for filling the indicator system is very limited. Very few secondary data sources are available and there have been only few empirical research projects that developed indicators and collected data. The empirical work of the SIBIS project is limited, as the Internet for R&D is only one of nine different topics and the data requirements of all topics should be considered on an equal footing.

Consequently the indicator system and the benchmarking carried out in this report cannot be considered comprehensive. Further scientific analyses and data assessments are required especially in regard to the following issues.

1) The R&D-related ICT expenditure was listed as a topic-spanning indicator for the ICT-intensity of the research activities of an organisation. The scope of the present analysis did not allow any data collection in relation to this issue. This might be performed as part of an exploratory analysis which aims to structure and assess the purposes of ICT expenditure in general and the different types of expenditure (for new computers and peripherals, software licences, network fees etc.) in particular.

2) Until now, indicators and data on research networks have concentrated on the national networks and contained little information on local and international connections.[54] The TERENA questionnaire is still in an experimental and learning phase and some questions must be improved to ensure optimal results. Furthermore, although some questions on the quality of campus networks and metropolitan networks have been included in this questionnaire (cf. indicator 4 and page 27) the answers should be considered as rather speculative and not really based on a sound collection of empirical data. An in depth assessment of the service levels of the sub-national providers of research networks (e.g. in universities) has yet to be carried out. We also lack well-founded knowledge of the data transmission requirements of the different users (researchers and students from different disciplines) of a research network. The assessment of both the capacities of sub-national RNs and the user requirements could form part of a research project specifically focused on RNs and their services.

3) Some other elements of the Internet-related infrastructure for R&D were included in the indicator system but not in the pilot data collection and testing. This applies to electronic library services for which indicator concepts have been developed in order to benchmark the services (cf. footnote 20). As part of SIBIS work package 2 we discussed which parts of these concepts could be transferred to the national level in order to benchmark countries. The collection of data meeting both the requirements of research libraries and scientific statistics, however, must be based on the co-operation of research libraries and other providers of electronic library services to researchers (such as publishers of electronic journals). This is beyond the scope of SIBIS.

4) “Grid computing” was mentioned as a new concept of distributed research based on the capacities of ICT infrastructures and tools. As its highly dynamic nature still extends to the basic constructs (e.g. what are grid services and applications?) any

[54] A point of departure could be to compare the access differences to the GÉANT network (cf. http://www.dante.net/ geant/index.html). However, the network topology must be taken into account properly to make a comparison meaningful.

operationalisation would be rather unstable and the data collection would only produce meaningful data for a very short period of time. Hence, the diffusion of Grid technologies across national R&D systems was not considered to be appropriate for valid and reliable measurement at the current point in time. With the further development of Grids in the U.S. and Europe this should change and Grids might become an additional element of the ICT infrastructure for research in the near future. Grid technologies should also increase the possibility of carrying out on-line data analysis without having to transfer any data, merely the results.

Grid technologies also incorporate various tools for computer-mediated conferences and meetings and they create new communication facilities for non-collocated research teams. It would be beneficial to study how a broader range of on-line communication tools affects the structure and outcome of R&D.

5) The indicator system contains two indicators on R&D collaborations which assess how the new Internet technologies are integrated into collaborations and the consequences of this. New forms of collaborations which have been labelled collaboratories and virtual teams are, however, only marginally taken into account as it has not yet been resolved how they should be distinguished from the more traditional collaboration forms. Thus another task of future investigations should be to establish the role of communication technologies in R&D collaborations and convert this into clear concepts which are accessible to measurement and benchmarking at the micro (establishment) and macro (country) level.

5 Conclusions

The current state of research is not yet sufficiently mature to allow conclusions to be drawn as to how the use of Internet technologies differs between European research systems and the effects of this. By definition, such conclusions must be based on a range of indicators and empirical data which are not yet available. As a result only one brief implication of the SIBIS work in this topic area is stated here: The work has successfully constructed an indicator system which reflects the different aspects of a communication technology (the Internet) in a societal subsystem (research and development). The indicator system uses accepted concepts and the operationalisation and testing of those parts which have been the focus of the latest work stages have provided intelligible and interpretable results: In each of the two constructs analysed empirically, research networks and specialised computer staff, some countries perform well for all indicators and some countries perform poorly. Most of the differences could be explained and reconciled with available secondary data and our expectations and knowledge of the national research systems. This might be considered as a low threshold for proclaiming success, however, we should be aware that only a few years ago virtually no European researcher had heard of research networks or was concerned with computer staff to support their research. We will not call a halt to our work at the current state of knowledge but will broaden our benchmarking and testing efforts to provide an overview of Internet technologies in European research systems. This will also give an insight into R&D statistics and will help to identify optimised methods for measuring ICT usage in R&D.

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7 ANNEX 1

7.1 Data Annex

Table A-1: Congestion ranking for 2002 by country[A]

	Congestion ranking of the networks within a country				
	Campus LAN	**MAN or regional network**	**Access network**	**NRN backbone**	**External connections**
Austria	2	-	1	3	3
Belgium	1	-	-	-	-
Denmark	-	-	-	-	-
Finland	1	3	2	5	4
France	3	2	1	4	4
Germany	-	-	-	-	-
Greece	1	1	1	4	4
Ireland	2	-	1	3	4
Italy	2	2	1	4	5
Luxembourg	-	-	-	-	-
The Netherlands	1	2	2	2	2
Portugal	1	3	2	5	3
Spain	5	2	1	2	4
Sweden	1	3	2	5	4
Switzerland	2	-	1	4	3
U.K.	1	3	2	5	4
Mode	1	3	1	5	4

LAN: Local area network; MAN: Metropolitan area network; NRN: National research network
a Some of the ranks were modified compared to the source (and the values given by the NRNs) in order to meet standard ranking conventions. E.g. when three networks were given the same rank 1, the fourth rank was changed to 4 (even if it was 2, 3 or 5 in the source).
Source: TERENA survey 2002 (http://www.terena.nl/compendium/).

Table A-2: Inbound and outbound traffic loads[a] of the NRN external connections (in Jan. 2002)[b]

	Inbound traffic load[a]	Outbound traffic load[a]
Austria	17.3	17.3
Belgium	3.2	5.8
Finland	5.5	6.1
France	15.0	15.0
Germany	10.8	10.8
Greece	21.9	21.9
Ireland	3.8	2.4
Italy	6.5	6.7
The Netherlands	5.9	9.4
Switzerland	3.6	5.1
United Kingdom	5.7	5.2
Median	5.9	6.7

a Inbound (outbound) traffic load is the incoming (outgoing) traffic on the external connection(s) in relation to its (their) transmission capacities.
b No data for Luxembourg, Spain, Portugal, Sweden and Denmark.
Source: TERENA calculations, unpublished data.

Table A-3: NRN budgets by country

	NRN budget				
	2000 (million €)[a]	**2001 (million €)**	**2002 (million €)**	**Average of the years 2000-2002 (million €)**	**Average of the years 2000-2002 (million PPP)[b]**
Austria	6	5.2	.	5.6	5.6
Belgium	8.5	11.5	12.5	10.8	11.1
Denmark	6.3	4.9	5.1	5.4	4.5
Finland	6.3	8.3	7.6	7.4	8.0
France	30	30	30	30.0	28.7
Germany	75	50	50	58.3	55.1
Greece	7.7	10	12	9.9	12.2
Ireland	3	10.6	12.9	8.8	8.5
Italy	50	30	35	38.3	46.5
Luxembourg	1.6	1.8	2	1.8	1.7
The Netherlands	32	35	46	37.7	34.1
Portugal	13.2	22.5	16.5	17.4	22.3
Spain	10	20	20	16.7	19.6
Sweden	18	13	15	15.3	13.4
Switzerland	23.4	12.7	14.6	16.9	14.5
U.K.	30.7	67.8	68.6	55.7	47.9
Median	11.6	12.85	15	16	13.95

a In some countries the budget figures for the year 2000 might not be entirely comparable to the figures for the following years as in addition to the budget for the "core tasks" we also included some additional services such as domain name registration (e.g. in the case of Switzerland). However, taking only the 2001 and 2002 data does not change the general tendency for the "dubious" cases.
b Purchasing power parities (PPP) for gross fixed capital formation from Eurostat (Stapel 2002).
Source: TERENA surveys 2002 and 2001 (http://www.terena.nl/compendium/). – Stapel 2002. – FHSO calculations.

Table A-4: NRN budgets according to different definitions of the size of the research systems and country

	Average NRN budget for the years 2000-2002					
	per researcher (in PPP)[a]	per R&D personnel (in PPP)[a]	per student (in PPP)[c]	per scientific paper (in PPP)[b]	per capita (in PPP)[c]	per Mill. € of GDP
Austria	.	.	24.56	1'564	0.69	27.34
Belgium	471	283	31.44	2'260	1.08	43.62
Denmark	256	131	23.51	1'081	0.83	30.79
Finland	338	173	30.55	1'996	1.55	56.20
France	185	91	14.27	1'049	0.48	21.36
Germany	232	119	26.42	1'478	0.67	28.80
Greece	1,110	604	31.38	5'434	1.15	80.50
Ireland	1,085	706	56.25	6'866	2.22	85.37
Italy	612	328	25.89	2'713	0.80	32.89
Luxembourg	.	.	.	59'283	3.90	85.98
The Netherlands	873	399	72.59	3'268	2.13	93.91
Portugal	1,637	1,238	62.41	14'774	2.22	150.97
Spain	325	197	10.97	1'596	0.50	27.38
Sweden	364	205	40.07	1'612	1.51	62.17
Switzerland	669	288	120.56	2'069	2.01	65.10
U.K.	302	.	23.02	1'207	0.80	35.98
Median	418	283	30.55	2'033	1.12	49.91

a Data on researchers and R&D personnel are from 1997, except for CH: 1996; FIN, D, NL, E (researchers), UK: 1998, E (R&D personnel): 1999

b Publication counts are for 1999 for a set of journals classified and covered by the Institute of Scientific Information's Science and Social Science Citation Indexes. Article counts are based on fractional assignments; for example, an article with two authors from different countries is counted as one-half of an article for each country.

c Student figures are for 1999 and population figures for 2001.

Purchasing power parities (PPP) for gross fixed capital formation from Eurostat (Stapel 2002).

Source: TERENA surveys 2002 and 2001 (http://www.terena.nl/compendium/). – Stapel 2002. – Eurostat (http://europa.eu.int/comm/eurostat). – OECD MSTI 2000. – National Science Board 2002, table 5-41. – FHSO calculations.

Table A-5: NRN budgets according to different definitions of the size of the network and country[c]

	Average NRN budget for the years 2000-2002			
	per total institutions connected (in 1,000 PPP)	per universities and higher/further education institutes (in 1,000 PPP)	per physical network size (in PPP)[d]	per traffic in gigabyte in 2001 (in PPP)
Austria	77.78	233.33	2.80	5.22[b]
Belgium	85.12	257.34	158.08	6.92
Denmark	37.22	81.20	9.93	.
Finland	94.53	160.69	1.61	3.49
France	47.85	124.82	.	11.96
Germany	99.34[a]	648.65	.	3.61[b]
Greece	187.34	358.15	135.30	20.30
Ireland	212.34	314.58	57.14	45.91
Italy	155.07	581.51	142.92	43.08
Luxembourg	4.91	286.53	.	.
The Netherlands	170.59	454.91	0.49	5.64
Portugal	265.23	506.34	.	.
Spain	72.62	297.09	15.81	.
Sweden	167.80	335.61	.	.
Switzerland	160.75	.	23.08	15.99
U.K.	65.63	70.46	.	7.33
Median	96.93	297.09	19.45	7.33

a D: 4000 schools are not included.

b Total traffic estimated on the basis of the data for inbound and outbound traffic.

c Purchasing power parities (PPP) for gross fixed capital formation from Eurostat (Stapel 2002).

d Physical network size: core capacity in Mb/s * length in km.

Source: TERENA surveys 2002 and 2001 (http://www.terena.nl/compendium/). – Stapel 2002. – Eurostat (http://europa.eu.int/comm/eurostat). – FHSO calculations.

Table A-6: Establishments carrying out R&D according to characteristics of the organisation and country in 2002[a]

		Establishments carrying out R&D					
	Total[b]	**with at least one central R&D unit (in %)**	**with computer staff in the central R&D unit(s) (in %)**	**obtaining IT services for R&D from computer staff outside of the central R&D unit(s) (in %)**	**buying IT services for R&D from external service providers (in %)**	**R&D activities suffer from a shortage of qualified computer staff (in %)**	**Having unfilled vacancies for computer staff needed to provide IT services for R&D projects (in %)**
Finland	n = 150	51.7	48.8	33.9	44.6	18.5	10.4
France	n = 76	23.2	16.3	32.3	16.1	19.4	18.8
Germany	n = 59	58.1	53.7	8.7	27.5	9.3	6.8
Greece	n = 130	54.2	54.1	12.2	34.8	22.9	21.4
Italy	n = 109	43.9	35.7	20.5	21.8	45.4	37.4
Spain	n = 110	18.9	17.1	25.2	30.4	29.3	29.6
U.K.	n = 100	39.3	33.9	17.9	36.9	30.8	9.8
Total	n = 613	39.5	34.5	20.2	28.5	29.2	22.3

a Weighting by establishments; due to different weighting factors the seven-country total is not equal to the sum of the individual countries.
b Seven-country total is not equal to the sum of the country values due to different weighting factors.
Source: SIBIS 2002, DMS. – FHSO calculations.

Table A-7: R&D personnel in relation to workforce by country

	R&D personnel per 100 employees (SIBIS DMS data)[a]		Total researchers per 1,000 workforce (OECD data)[b]	
	In %	**Country rank**	**In %**	**Country rank**
Finland (n = 266)	14.2	1	9.9	1
France (n = 489)	7.3	2	6.1	2
Germany (n = 483)	5.0	3	6.0	3
Greece (n = 264)	4.2	5	2.6	7
Italy (n = 474)	2.5	7	3.3	6
Spain (n = 481)	4.0	6	3.7	5
U.K. (n = 469)	4.6	4	5.5	4
Total (n = 2,964)	5.0	-	5.2[c]	-

a Data for 2002, weighting by employment; due to different weighting factors the seven-country total is not equal to the sum of the individual countries.
b EL, I: 1997; F, UK, total: 1998; others: 1999
c EU average.
Source: SIBIS 2002, DMS. – OECD 2001. – FHSO calculations.

Table A-8: Unfilled vacancies for computer staff for R&D according to different denominators by country in 2002

	Unfilled vacancies for computer staff needed to provide IT services for R&D projects		
	per establishment performing R&D	**per 100 total R&D personnel**	**per 100 total computer staff for R&D**
Finland (n = 199)	0.2	0.4	1.2
France (n = 150)	0.6	1.6	9.7
Germany (n = 120)	0.3	1.1	2.7
Greece (n = 118)	0.6	7.3	13.0
Italy (n = 166)	0.9	6.5	13.1
Spain (n = 162)	1.1	8.2	6.2
U.K. (n = 151)	0.2	1.0	3.3
Total (n = 918)	0.6	2.2	5.7

Source: SIBIS 2002, DMS. – FHSO calculations.

7.2 DMS questionnaire module on the Internet for R&D

Module E: R&D		
E1a *ALL*	You said before that **xyz** ***[PROGR.: Insert answer to question A5]*** employees work for your organisation at this establishment. From this, how many work in research & development, i.e. R&D? Please add up possible part time R&D personnel to full-time personnel. INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate? INT.: IF NECESSARY, EXPLAIN*:* Among R&D we include all creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications.	[OPEN] I__I__I__I__I__I__I *6-digit num.* INT.: IF NONE, CODE "0". [DK]
E1b *IF E1a > 0 and E1a is NOT DK*	R&D can be centralised in R&D units, or it can be distributed over various units of an establishment. Do you have at least one central R&D unit at your establishment?	(1) yes (2) no (3) DK
E2 *IF E1b=1*	What is the size of the computer staff in your central R&D unit(s)? Please add up part time computer staff to full-time staff. INT.: IF NECESSARY, EXPLAIN: By computer staff we mean all staff that - manages the computers, networks and digital resources, or - manages the Internet access and presentation, or - carries out information searches and computations as their major work tasks, or - provides user training. INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit num.* INT.: IF NONE, CODE "0". [DK]
E3 *IF E1a > 0 and E1a is NOT DK*	Do you get IT services for R&D from internal computer staff that are not members of your central R&D unit(s)?	(1) yes (2) no (3) DK
E4 *IF E3=1*	What is the size of the internal computer staff outside of your R&D unit(s) who provide IT services for R&D projects? Please add up part time computer staff to full-time staff again. INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit num.* INT.: IF NONE, CODE "0". [DK]
E5 *IF E1a > 0 and E1a is NOT DK*	Do you buy IT services for R&D from external service providers?	(1) yes (2) no (3) DK
E6 *IF E5=1*	What is the number of additional computer staff in your establishment that would be necessary to substitute for the IT services for R&D projects which are currently obtained from external service providers? INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit num.* INT.: IF NONE, CODE "0". [DK]
E7 *IF E1a > 0 and E1a is NOT DK*	Do your R&D activities suffer from a low supply of qualified computer staff in your establishment?	(1) yes (2) no (3) DK
E8 *IF E7=1*	Please specify the number of open jobs for computer staff needed to provide IT services for R&D projects in your establishment? INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit num.* [INT.: IF NONE, CODE "0". [DK]

Source: SIBIS DMS questionnaire.

8 ANNEX 2 - Methodology of the survey

8.1 General Population Survey (GPS)

8.1.1 Outline of the study

The survey was conducted in April-May 2002 in all 15 EU Member States plus Switzerland and the USA, using computer-aided telephone interviews. The survey was co-ordinated and executed by INRA, Germany. The population for this study is all persons aged 15 and over living in private households in the respective countries and speaking the respective national language(s). Subject discussed included ownership and use of ICT equipment, use of the Internet and e-commerce activities, competence in the use of new media, questions on health and the Internet, the Internet and security concerns, e-government, telework, mobile work and other new ways of working, as well as further education and satisfaction with working conditions. 11,832 interviews were successfully completed. The average interview length per country varied between 10 and 20 minutes.

8.1.2 Methodology

Subject of study	Topics of this survey were statements on interviewees' ownership and use of ICT equipment, use of the Internet and e-commerce activities, competence in the use of new media, questions on health and the Internet, the Internet and security concerns, e-government, telework, mobile work forms, as well as further education and satisfaction with working conditions.
Study concept	The study was conceived and executed as a cross national study. The co-ordination was carried out by INRA Deutschland GmbH, Mölln, on behalf of the client. The study consisted of two parts, a trial in Germany with a subsequent main survey in all participating countries.
Overall responsibility and co-ordination	**INRA Deutschland GmbH, Mölln**

Countries and executing institutes

Belgium:	**INRA Belgium** Kroonlaan 159-165 Avenue de la Couronne 1050 Brussels
Denmark:	**Gallup A/S** Sundkrogsgade 10 2100 Copenhagen
Germany:	**INRA Germany GmbH** Papenkamp 2-6 23879 Mölln
Finland:	**Taloustutkimus Oy** Lemuntie 9 00510 Helsinki
France:	**BVA** B.P. 59 78222 Viroflay Cedex
Greece:	**MEMRB – K.E.M.E** 24 Ippodamou St. 11635 Athens
Great Britain:	**BMRB International** Saunders House, 53 The Mall, Ealing London W5 3TE
Ireland:	**Lansdowne Market Research Ltd.** 49 St. Stephens Green Dublin 2
Italy:	**INRA Demoskopea** Via Salaria, 290; Via Rubicone 41 00199 Roma
Luxembourg:	**ILReS. S.A.** 46, Rue du Cimetière 1338 Luxembourg / Bonnevoie
Netherlands:	**NIPO**

Grote Bickersstraat 74
1013 ks Amsterdam

Austria: **Spectra**
Brucknerstr. 3-4/5
4020 Linz

Portugal: **METRIS**
Av. Eng. Arantes e Oliviera, No. 3-2
1900 Lisboa

Sweden: **GfK Sverige AB**
Box 401
22100 Lund

Switzerland: **Link Institut**
Spannortstrasse 7/9
6000 Luzern

Spain: **INRA España S.A.**
Calle Alberto Aguilera 7-5º
28015 Madrid

USA: **I.C.R**
605 West Street
Media, Pennsylvania 19063-2620

Survey methodology

The study was carried out as a telephone survey (Computer Assisted Telephone Interview – C.A.T.I) in all countries.

Population

The population for this study is all persons aged 15 and over living in private households in the respective countries and speaking the respective national language(s).

Switzerland: Here the survey was carried out in both the German and French speaking parts of Switzerland.

USA: The population includes English speaking people in the 48 continental federal states of the USA (excluding Alaska and Hawaii).

Finland: Finnish speaking population.

Random sampling and selection process

Belgium: 3-stage selection process based on the INFO BEL telephone directory. Addresses in 10-fold translation, random sampling of households, selection of the target person via a birthday key.

Denmark: Geographically stratified sample based on telephone directories. Telephone numbers are generated so as to also include unlisted numbers. The selection of the target person results from a birthday key.

Germany: Within the ADM telephone sampling system a representative, multistage random sample is drawn for each survey area. The selection data is based on the batch of all registered fixed network telephone numbers. Master numbers are formed by detaching the two final digits. Through the generation of new final digits from 00 to 99 number blocks are produced which contain listed as well as non listed numbers. As far as possible, business numbers were removed from this sampling frame. All telephone numbers were given an area code number, either the original or according to the known distribution in the number block. In this way numbers can be sorted regionally, thus increasing the precision of the sample. By means of the relation between sample size and distribution of households per regional cell an allocation table is produced which determines the number of samples to be drawn for each cell. Assuming a random starting point, all areas are processed with a fixed step width through set stages until the number to be selected from which areas for each cell has been determined. Subsequently the numbers are drawn randomly in a second selection stage. The selection of the target person results from a birthday key.

Finland: Geographically and socio-demographically stratified random sample based on information from official statistics. The selection of target households takes place at random. The selection of target persons results from a birthday key.

France: Geographically and socio-demographically stratified random sample of 8000 starter addresses based on France Telecom

directories. The selection of target persons results from a birthday key.

Greece: Multistage stratified random sampling. The geographical stratification takes place on the basis of NUTS 1, NUTS 2 and location size. The size of each unit is determined on the basis of official statistics. The selection of the target person results from a birthday key.

Great Britain: The sample is based on a draw data-file. Through the generation of new final digits a sample frame is established which contains listed and unlisted as well as so far non-existent numbers. The selection of target households takes place at random. The selection of the target person is via quota.

Ireland: Geographically sorted random sample based on the "Eircom" telephone directory. Additional telephone numbers are also generated in order to include unlisted numbers. The selection of the target person results from a birthday key.

Italy: Geographically and socio-demographically stratified random sample. 705 sample points result from the stratification. Additional telephone numbers are generated in order to also include unlisted numbers. The selection of the household results from Random Digit Dialling and the selection of the target person results from a birthday key.

Luxembourg: The sample is based on a draw data-file. Through the generation of new final digits from 00 to 99 a sample frame is established which contains listed and unlisted as well as so far non-existent numbers. The selection of target households takes place at random. The selection of the target person results from a birthday key.

Netherlands: Geographically stratified random sample. The geographical sorting is based on post code areas. Target person selection takes place through an algorithm which selects the interviewee on the basis of age and gender of people living in the household.

Austria: Geographically stratified random sample. The selection of the target household takes place through RDD (Random Digit Dialling). The selection of the target person results from a birthday key.

Portugal: Geographically and socio-demographically stratified random sample. 200 sample points result from the stratification. The selection of households takes place via Random Digit Dialling, the selection of target persons via a birthday key.

Sweden: Geographically and socio-demographically stratified random sample. 200 sample points result from the stratification. The selection of households takes place via Random Digit Dialling, the selection of target persons via a birthday key.

Switzerland: Geographically stratified random sample based on post codes. Each post code represents a sample cell. The selection of households takes place via Random Digit Dialling and the selection of the target person via an algorithm which selects the interviewee at random on the basis of a list of household members.

Spain: Geographically stratified random sample based on NUTS2 areas. 148 randomly selected sample points result from the sorting. Within these sample points addresses of target households are randomly drawn. Selection of target persons results from a birthday key. After about two thirds of the fieldwork the screening was targeted towards male members of the household due to a disproportionate number of female interviewees.

USA: Geographically stratified random sample based on the MSG-Genesys sampling process. The selection of households takes

place via Random Digit Dialling and the selection of the target persons via a birthday key. After the 758th interview the screening was targeted towards male members of the household due to a disproportionate number of female interviewees.

Survey period

The interviews were carried out in the following period:
04.03.-18.05.2002

Interviews undertaken

Total: 11,832

Average interview length

Belgium	16.0 min	Luxembourg	16.2 min
Denmark	18.1 min	Netherlands	18.4 min
Germany	17.5 min	Austria	15.8 min
Finland	17.3 min	Portugal	12.1 min
France	12.0 min	Sweden20.2 min	
Greece	10.2 min	Switzerland	19.0 min
Great Britain	18.0 min	Spain	12.5 min
Ireland	17.7 min	USA	18.3 min
Italy	14.0 min		

Interviewers used

Total: 632

Additional comments to the data set

Belgium: In order to improve the sample, an additional 85 interviews were carried out in some cells.
Finland: In order to improve the sample, an additional 169 interviews were carried out in some cells.
Netherlands: In order to improve the sample, an additional 30 interviews were carried out in some cells.
Switzerland: In Switzerland respondents were not asked to deduct tax from income (Z19), as that is not the norm there.

Data supply

One labelled SPSS data set of the main survey of all interviews.

Field report and outcomes

		B	DK	D	FIN	F	EL	UK	IRL	I	L	NL	AT	P	S	CH	E	USA
Method		C.A.T.I.																
1	gross sample (utilised addresses)	4506	3154	9999	2621	7300	5022	11392	3890	12006	8764	3640	4669	1403	5177	2327	6494	18162
1.1.	non-contacts – thereof:	311	242	1701	40	3401	2346	139	1111	4436	5023	803	193	91	455	638	1239	4192
1.1.1	unobtainable	0	235	1202	0	2342	2077	123	654	4436	3748	522	124	43	113	638	644	3656
1.1.2	engaged	3	7	436	0	57	206	1	316	0	705	164	8	32	55	0	5	536
1.1.3	answer phone, fax, modem	308	0	63	40	1002	63	15	141	0	570	117	61	16	287	0	590	0
1.1.4	other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.2	sample neutral non-response – thereof:	1874	1917	4492	984	511	1022	5088	1051	2659	1316	805	2322	410	2808	322	1095	8789
1.2.1	invalid telephone numbers	955	1516	3760	97	60	529	4308	498	1657	790	652	858	334	2297	230	398	5725
1.2.2	not in the population	472	202	41	782	374	176	119	405	364	0	153	1248	47	16	0	164	478
1.2.3	business numbers	300	82	285	12	27	220	437	0	340	455	0	75	15	193	0	434	1331
1.2.4	other	147	117	406	93	50	97	224	148	298	71	0	141	14	302	92	99	1255
2	net sample – thereof:	2321	995	3806	1597	3388	1654	6165	1728	4911	2425	2032	2154	902	1914	1367	4160	5181
2.1	refusal	1470	468	2451	912	2231	747	5012	1134	3592	1000	1248	1609	364	1246	529	2255	3198
2.2	termination	114	0	87	0	30	0	80	11	201	0	0	1	6	19	0	115	143
2.3	target person contacted but interview impossible – thereof:	152	26	267	16	127	402	73	83	118	925	254	44	32	146	316	775	836
2.3.1	possible appointment outside field time	0	23	14	1	23	9	26	14	106	763	208	7	6	30	80	321	156
2.3.2	appointments to continue interview outside field time	152	0	200	0	104	295	47	65	12	17	11	34	18	24	194	179	669
2.3.3	other	0	3	53	15	0	98	0	4	0	145	35	3	8	92	42	275	11
2.4	complete interviews	585	501	1001	669	1000	505	1000	500	1000	500	530	500	500	503	522	1015	1004
3	exhaustion rate (%) (2.4/(2.1+2.2+2.4))	27.0%	51.7%	28.3%	42.3%	30.7%	40.3%	16.4%	30.4%	20.9%	33.3%	29.8%	23.7%	57.5%	28.5%	49.7%	30.0%	23.1%

8.1.3 Weighting

1. Transformation from household sample to person sample:

As only one person per household is interviewed, the described sample procedure provides a household sample, i.e. each household of the base population has the same likelihood of being in the sample but not each person. With the weighting stage of the transformation the equal likelihood of households is replaced mathematically by the equal likelihood of the individuals. To this end, each data set is multiplied by the amount of people in the household aged 15 or over. This number is subsequently divided by the average household size in order to obtain the actual case number.

2. Adjustment of unweighted sample structure to the official statistic:

Because random samples are not evenly distributed across all population strata, the distribution of unweighted samples regularly and systematically deviate from the population distribution from official statistics. Through the mathematical weighting the sample distribution is adjusted to the official statistics. The national weighting factor (P10) which results from the iterative weighting was included in the data material. To this end the following criteria are used in the respective countries.

Austria: age, gender, region; **Belgium**: age, gender, region, locality size; **Denmark**: age, gender, region; **Germany**: age, gender, region, locality size; **Greece**: age, gender, locality size; **Finland**: age, gender, region; **France**: age, gender, region, locality size; **Ireland**: age, gender, region; **Italy**: age, gender, region, locality size; **Luxembourg**: age, gender, region, locality size; **Netherlands**: age, gender, region; **Portugal**: age, gender, region, locality size; **Sweden**: age, gender, region; **Switzerland**: age, gender, region; **Spain**: age, gender, region, locality size; **UK**: age, gender, region; **USA**: age, gender, region, locality size.

3. Adjustment of weighted sample structure to the EU15-member states population:

This weighting factor was necessary to calculate total figures according to the whole population of the European Union member states. Furthermore it is useful to compare the EU with the US. Population sizes of each member state are weighted to reduce the distortion based on the sample sizes in each country. The different country-specific weighting factors are the following:

Austria	0.44	Italy	1.63
Belgium	0.48	Luxembourg	0.02
Denmark	0.29	Netherlands	0.80
Germany	2.29	Portugal	0.55
Greece	0.59	Spain	1.09
Finland	0.21	Sweden	0.48
France	1.56	United Kingdom	1.57
Ireland	0.20	*Switzerland, USA*	*none*

8.1.4 Sample characteristics and effect of weighting

	Total				EU15			
	un-weighted	weighted	% un-weighted	% weighted	un-weighted	weighted	% un-weighted	% weighted
Total sample	11832	11832	100.0	100.0	11832	10306	100.0	100.0
Country								
Austria	500	500	4.2	4.2	-	-	-	-
Belgium	585	585	4.9	4.9	-	-	-	-
Denmark	501	501	4.2	4.2	-	-	-	-
Finland	669	669	5.7	5.7	-	-	-	-
France	1000	1000	8.5	8.5	-	-	-	-
Germany	1001	1001	8.5	8.5	-	-	-	-
Greece	505	505	4.3	4.3	-	-	-	-
Ireland	500	500	4.2	4.2	-	-	-	-
Italy	1000	1000	8.5	8.5	-	-	-	-

Luxembourg	500	500	4.2	4.2	-	-	-	-
Netherlands	530	530	4.5	4.5	-	-	-	-
Portugal	500	500	4.2	4.2	-	-	-	-
Spain	1015	1015	8.6	8.6	-	-	-	-
Sweden	500	500	4.2	4.2	-	-	-	-
Switzerland	522	522	4.4	4.4	-	-	-	-
UK	1000	1000	8.5	8.5	-	-	-	-
USA	1004	1004	8.5	8.5	-	-	-	-
EU15	-	-	-	-	*10306*	*10306*	*87.1*	*100.0*
Age groups								
up to 24	1964	2019	16.6	17.1	1731	1651	16.8	16.0
25 to 49	5511	5309	46.6	44.9	4817	4593	46.7	44.6
50 to 64	2515	2495	21.3	21.1	2191	2209	21.3	21.4
65 and more	1833	2000	15.5	16.9	1558	1839	15.1	17.8
don't know	9	9	0.1	0.1	9	14	0.1	0.1
Terminal education age								
up to 13	695	717	5.9	6.1	693	728	6.7	7.1
14	715	742	6.0	6.3	701	881	6.8	8.5
15 to16	1794	1750	15.2	14.8	1641	1820	15.9	17.7
17 to 20	3587	3515	30.3	29.7	2997	2937	29.1	28.5
21 and more	3266	3275	27.6	27.7	2743	2495	26.5	24.2
still studying	1687	1751	14.3	14.8	1463	1372	14.2	13.3
don't know	88	81	0.7	0.7	77	73	0.7	0.7
Household type								
one person household	2006	1611	17.0	13.6	1682	1408	16.3	13.7
household with kids aged under 6	1723	1754	14.6	14.8	1451	1440	14.1	14.0
household with kids aged 6+	2970	3152	25.1	26.6	2653	2655	25.7	25.8
two person household without kids	5063	5240	42.8	44.3	4467	4768	43.3	46.3
no answer on household size	70	75	0.6	0.6	53	35	0.5	0.3
Household income (according to national household income quartiles by Eurobarometer)								
First quartile (lowest income)	1774	1580	15.0	13.4	1548	1299	15.0	12.6
Second quartile	2132	2084	18.0	17.6	1878	1764	18.2	17.1
Third quartile	2536	2521	21.4	21.3	2214	2087	21.5	20.3
Fourth quartile (highest income)	2968	3102	25.1	26.2	2502	2725	24.3	26.4
don't know	1214	1295	10.3	10.9	993	995	9.6	9.7
refusal	1208	1249	10.2	10.6	1171	1436	11.4	13.9
Employment status								
paid employment	4966	4853	42.0	41.0	4291	4133	41.6	40.1
self-employed	935	941	7.9	8.0	809	799	7.8	7.8
unemployed/ temporarily not working	701	683	5.9	5.8	621	631	6.0	6.1
in education	1687	1751	14.3	14.8	1463	1372	14.2	13.3
retired or other not working	3441	3510	29.1	29.7	3034	3292	29.4	31.9
don't know	102	94	0.9	0.8	88	80	0.9	0.8
Social grade (ESOMAR classification)								
unskilled manual workers and other less well educated workers/ employees	1332	1318	11.3	11.1	1238	1323	12.0	12.8
skilled workers and non-manual employees	1525	1445	12.9	12.2	1316	1287	12.8	12.5
well educated non-manual and skilled workers	1434	1402	12.1	11.8	1254	1121	12.2	10.9
managers and professionals	1577	1586	13.3	13.4	1265	1167	12.3	11.3
not specified	5964	6081	50.4	51.4	5233	5408	50.8	52.5

8.2 Decision Maker Survey (DMS)

8.2.1 Outline of the study

The survey was conducted in March-May 2002 in seven EU Member States using computer-aided telephone interviews. The survey was co-ordinated and executed by INRA, Germany. The population for this study is defined as all establishments belonging to four aggregated industry sectors in the seven Member States. The interview was conducted with IT responsible persons in companies across all sectors of the economy. Subjects discussed included ownership and use of ICT equipment, use of the Internet and e-commerce and e-business activities, e-business security, e-government, web-site accessibility and ICT in research and development. 3,139 interviews were successfully completed. The average interview length per country varied between 14 and 18 minutes.

8.2.2 Methodology

Subject of study

- Basic ICT: use of ICT and e-business technologies
- e-commerce
- e-business security
- e-government
- web-site accessibility
- research and development
- establishment demography

Study concept

The study was conceived and executed as a cross national study. The co-ordination was carried out by INRA Deutschland GmbH. The study consisted of 2 parts, a trial in Germany with a subsequent main survey in all participating countries.

Overall responsibility and co-ordination

INRA Deutschland GmbH, Mölln

Countries and executing institutes

Germany:	**INRA Germany GmbH** Papenkamp 2-6 23879 Mölln
Finland:	**Taloustutkimus Oy** Lemuntie 9 00510 Helsinki
France:	**BVA** 101 avenue du General Leclerc 78222 Viroflay Cedex
Greece:	**MEMRB – K.E.M.E** 24 Ippodamou St. 11635 Athens
Great Britain:	**Continental Research** 132-140 Goswell Road EC1V 7DY London
Italy:	**INRA Demoskopea** Via Rubicone 41 00199 Roma
Spain:	**INRA España S.A.** Calle Alberto Aguilera 7-5º 28015 Madrid

Survey methodology

The study was carried out as a telephone survey (Computer Assisted Telephone Interview – C.A.T.I) in all countries.

Population

The population for this study are establishments (in each respective country) in the four sectors:

- Manufacturing, Construction, Primary Sector
- Distribution, Catering, Transport & Communication
- Financial & Business Services
- Public administration, education, health, other personal and social services

Target person at the establishment was the person who is responsible for or significantly involved in decisions in the area of IT/

DP. In larger establishments/ organisations the head or another executive of the IT/ DP department. In smaller establishments/ organisations also the owner/ proprietor or managing director/ board member.

Random sampling and selection process

General: The sample was set up according to given industry and size class quota. Accordingly a stratified random sample was drawn from the universe, allowing for the relevant industries within the four aggregated sectors. Drawing the sample was organised locally by the national executing institutes.

Germany: The sample was drawn from the Heins und Partner Business Pool. Heins und Partner have created a high quality business pool based on the available address inventories consisting of about 3.4 m data sets that have undergone comprehensive validation. For every enterprise comprehensive additional information is available, including corporate structure and branch office structure (220,000 branch offices) and is continuously being updated. The sample was drawn from the establishment file, which results from the transformation of enterprises into establishments and appending branch offices to the headquarters.

Finland: The sample was taken from the so called "Blue Book - Salesleads database" which is edited by Helsinki Media Company Oy (Sanoma Magasines Finland). This data base contains of about 170,000 data sets and is being updated every two months.

France: The sample was drawn from the “INSEE Siren file” (the national office of statistics). INSEE, as a public organisation, is responsible for gathering all economic and social data in France. These data sets are being updated every two months.

Greece: The sample was drawn from the address inventory of ICAP (major establishment data base for Greece and member of the European Association of Directory and database Publishers). The data base is being updated every 18 months and also contains public sector addresses. Additionally, public sector addresses were taken from the national telephone inventory.

Great Britain: The sample was drawn from "BT’s Business Database". This is a representative data base of all establishments in the UK having a telephone number (including addresses by BT, Mercury, cable and about 92 further telecom carriers). The data base consists of about 1.6 m addresses and is being updated every two months.

Italy: The sample was drawn from Dun & Bradstreet's data base. This data base is considered to be the most reliable source for Italy.

Spain: The sample was drawn from Schober's data base. This data base is the most voluminous record as regards number of establishments for Spain.

Survey period

The interviews were carried out in the following period:
21.03.-15.05.2002

Interviews undertaken

Total: 3,139

Average interview length

Germany	16.0 min	Great Britain	16.2 min
Finland	16.4 min	Italy	18.2 min
France	14.1 min	Spain	16.4 min
Greece	15.1 min		

Interviewers used

Total: 212

Quality control

All interviewers were instructed about the questionnaire before the beginning of field work. Field work was permanently controlled by supervisors. Because of computer aided realisation of interviews systematic errors of data gathering can be excluded. Furthermore

the proper realisation of interviews was monitored according to institute standards. Following is the share of interviews monitored (by telephone):

Germany:	10%	Great Britain:	8%
Finland:	5%	Italy:	10%
France:	10%	Spain:	30%
Greece:	20%		

Additional comments to the data set

Question A8: Turnover indication in national currencies were translated in Euro except for UK.

Some indications seem to be very high, others very low. National institutes have re-examined and verified statements by calling the respondents again and reassured turnover answers were as stated.

Problems encountered

In all countries fulfilling the quota for the largest establishments was difficult (mainly 500+ / partly also 200-499 employees). In these establishments on the one hand the availability of target persons is significantly lower, on the other hand are these target persons "over-researched" (which in part results in a general interdiction to take part in surveys).

Due to this in France it was necessary to adapt the quota in order to achieve the number interviews aimed at (i.e. interviews - as far as possible - carried out in establishments of the next smaller size class).

Data supply

One labelled SPSS-data set of the main survey of all interviews.

Field report and outcomes

		D	FIN	F	EL	UK	I	E
1	Sample (gross), i.e. number dialled at least once	4917	1923	8061	1728	8726	10846	8489
1.1	Telephone number does not exist	787	47	598	43	416	1160	808
1.2	Not an establishment (i.e. private household, etc.)	46	15	0	2	0	0	235
1.3	Fax machine/ Modem	81	0	152	31	0	0	519
1.4	Quota completed, therefore address not used	0	849	1599	2	2659	848	1397
1.5	No target person in establishment	858	226	1261	35	1766	822	2043
1.6	Language problems	0	15	0	0	0	0	10
1.7	SUM (1.1+1.2+1.3+1.4+1.5+1.6)	1753	1152	3610	113	4841	2830	5012
2	Net sample (1 minus 1.7)	3164	771	4451	1615	3885	8016	3477
2.1	Nobody picks up phone (and max. contacts not yet exhausted)	325	2	326	229	32	804	18
2.2	Line busy, engaged	45	0	31	235	2	1852	9
2.3	Answering machine	111	4	82	15	0	0	482
2.4	Contact person refuses (i.e. refusal at reception, switchboard)	436	228	912	38	1354	1056	1022
2.5	Target person refuses	1044	204	1569	107	1672	1410	896
2.6	no appointment during fieldwork period possible	33	14	356	36	176	680	203
2.7	open appointment	604	4	642	644	52	1668	111
2.8	target person is ill/ cannot follow the interview	1	3	18	0	0	0	18
2.9	Interview abandoned	53	1	14	4	97	34	102
2.10	Interview error, cannot be used	0	5	0	6	0	0	109
2.11	SUM (2.1+2.2+2.3+2.4+2.5+2.6+2.7+2.8+2.9+2.10)	2652	465	3950	1314	3385	7504	2970
2.12	SUCCESSFUL INTERVIEWS	512	306	501	301	500	512	507
3	Completion Rate (2.12 / (2.11+2.12)), in %	16.18	39.69	11.25	18.63	12.87	6.38	14.58

Target and actual numbers of interviews

			F	D	I	E	UK		FIN	EL
Quota Group		required	- achieved -					required	- achieved -	
I Manufacturing, construction, primary sector	1 - 9	*30*	33	30	34	33	32	*18*	18	17
	10 - 49	*35*	36	36	37	35	35	*21*	21	22
	50 - 199	*35*	38	37	40	35	35	*21*	21	25
	200 - 499	*40*	44	41	43	41	40	*24*	28	22
	500+	*15*	9	14	13	15	15	*9*	9	6
	Sum	155	160	158	167	159	157	93	97	92
II Distribution, catering, transport and communication	1 - 9	*45*	50	47	45	46	45	*27*	28	27
	10 - 49	*40*	42	41	41	43	40	*24*	24	25
	50 - 199	*30*	28	31	26	30	30	*18*	18	18
	200 - 499	*15*	19	15	16	15	15	*9*	5	9
	500+	*10*	5	10	8	10	10	*6*	5	6
	Sum	140	144	144	136	144	140	84	80	85
III Financial and business services	1 - 9	*30*	32	30	34	30	30	*18*	16	17
	10 - 49	*20*	19	21	23	21	20	*12*	14	11
	50 - 199	*10*	13	10	17	10	10	*6*	6	8
	200 - 499	*10*	13	10	6	10	10	*6*	7	6
	500+	*10*	8	9	4	7	8	*6*	6	6
	Sum	80	85	80	84	78	78	48	49	48
IV Public administration, education, health, other personal and social services	1 - 9	*20*	20	24	19	20	20	*12*	13	13
	10 - 49	*25*	29	25	26	25	25	*15*	16	16
	50 - 199	*30*	22	30	34	30	30	*18*	18	18
	200 - 499	*35*	32	35	31	35	35	*21*	23	20
	500+	*15*	9	16	15	16	15	*9*	10	9
	Sum	125	112	130	125	126	125	75	80	76
	Total	*500*	501	512	512	507	500	*300*	306	301

8.2.3 Weighting

For the SIBIS DMS a sample stratified by sector/ size cells was used which ensured that in each sector, establishments from all size classes were sampled. In order to be able to raise figures to national level, some form of weighting is required which adequately reflects the structure and distribution of establishments (or related variables) in the universe of the respective country (and, by implication, EU15). All presentation of SIBIS results indicates clearly which of these weighting schemes was used.

Original weight

Within each country, the interviews were split according to a quota plan which guaranteed that the sample is not dominated by micro and small companies. The quotas roughly reflect the distribution of employment over sector and establishment size bands in the EU, and derive from research into establishment sampling frames undertaken for previous studies by Infratest and GfK in the course of ECaTT. They represent best estimates, but do not take account of country differences.

The quota scheme looks as follows:

empirica			SUGGESTED QUOTAS: Sectors (aggregated) X Size											
			1- 9		10 - 49		50 - 199		200 - 499		500+		Total	
			% of total	abs	% of total		% of total		% of total		% of total		% of total	
Quota I		Manufacturing, Construction, Primary Sector, includes:	6%	30	7%	35	7%	35	8%	40	3%	15	31%	155
	1	Mining, Energy												
	2	Manufacturing												
	3	Construction												
Quota II		Distribution, Catering, Transport & Communication includes:	9%	45	8%	40	6%	30	3%	15	2%	10	28%	140
	4	Distribution												
	5	Hotels, Restaurants												
	6	Transport, Communication												
Quota III		Financial & Business Services includes:	6%	30	4%	20	2%	10	2%	10	2%	10	16%	80
	7	Banking, Insurance												
	8	Business Services												
Quota IV		Public administration, education, health, other personal & social services includes:	4%	20	5%	25	6%	30	7%	35	3%	15	25%	125
	9	Public Administration												
	10	Education												
	11	Health and Social Work												
	12	Other personal or social services												
		Total	25%	125	24%	120	21%	105	20%	100	10%	50	100%	500

(The absolute numbers refer to countries with n=500)

Weighting was used in cases where the quotas could not be reached exactly in line with this quota plan (mostly due to the limited absolute number of establishments in the two biggest size classes). Note that because of the use of a single quota plan for all countries, country differences in the distribution of employment over establishment size bands which occur in reality are not reflected in the data. This is due the lack of available data on the distribution of employment across establishments size bands in almost all EU Member States, and constitutes a considerable problem. This weight is therefore not used for presenting SIBIS results.

Weighting by employment

The data available on the distribution of employment over establishment size bands is very limited for most EU Member States. SIBIS used data from a variety of sources, including

BT database (United Kingdom)

ISTAT Industry and Services Intermediate Census – latest available, 1996 (Italy)

National Statistical Service of Greece - latest available, 1995 (Greece)

SIREN (France)

Tilstokeskus Official Statistics (Finland)

Heins + Partner B-Pool (Germany)

Schober Business Pool (Spain)

and adjusted using data from the DG Enterprise/ Eurostat SME Database (latest available, 1997), to estimate the establishment/ employment structure for each country in the sample. The table below shows the resulting establishment size structure per country.

		Country							
		D	E	EL	F	FIN	I	UK	*EU7*
Establishment size band	1 to 9	23%	23%	59%	17%	13%	38%	14%	*23%*
	10 - 49	19%	28%	16%	22%	16%	22%	31%	*24%*
	50 - 199	21%	21%	8%	21%	19%	14%	26%	*20%*
	200 - 499	13%	9%	6%	14%	16%	7%	13%	*12%*
	500 and more	25%	18%	10%	25%	37%	19%	17%	*21%*

Total	Column %	100%	100%	100%	100%	100%	100%	100%	*100%*

Using this weight, the weighted sample for each country therefore reflects employee distribution between the five establishment size bands within that country. This means that a data reference of, for example, ”20% of all establishments in country A” should be understood to mean ”establishments accounting for 20% of all employees in country A”.

Weighting by employment for EU7 averages

Additionally another weighting factor was created to calculate average figures for all countries in the sample (which together represent roughly 82% percentage of total EU employment). Each country is represented in this weight according to its share in the total employment of the 7 EU countries in which the survey was conducted.

8.2.4 Sample characteristics and effect of weighting

	Total			
	unweighted	**weighted by employment***	**% unweighted**	**% weighted by employment***
Total sample	3139	3139	100.0	100.0
Country				
Finland	306	306	9.7	9.7
France	501	501	16.0	16.0
Germany	512	512	16.3	16.3
Greece	301	301	9.6	9.6
Italy	512	512	16.3	16.3
Spain	507	507	16.2	16.2
UK	500	500	15.9	15.9
	Total			
	unweighted	**weighted by employment (EU7)**	**% unweighted**	**% weighted by employment (EU7)**
Number of staff at site				
up to 9	803	713	25.6	22.7
10 to 49	769	746	24.5	23.8
50 to 199	668	648	21.3	20.6
200 to 499	626	364	19.9	11.6
500 and more	273	668	8.7	21.3
Industry Sector				
primary: manufacturing, energy, mining, construction	990	989	31.5	31.5
secondary: distribution, catering, communication and transport	873	878	27.8	28.0
third: financial and business services	502	501	16.0	15.9
fourth: public administration, health, education, other social/ personal	774	772	24.7	24.6
Type of organisation				
headquarter of international operating organisation	267	348	8.5	11.1
headquarter of organisation only operating in country	607	536	19.3	17.1
division/ branch of international operating organisation	256	290	8.2	9.2
division/ branch of organisation only operating in the respective country	309	312	9.8	9.9
other type	76	40	2.4	1.3
only one establishment	1617	1608	51.5	51.2
don’t know	7	6	0.2	0.2

8.3 Questionnaires

8.3.1 Questionnaire for the General Population Survey (GPS)

Structure of the questionnaire:

Module IN: Introduction and screening

Age
Educational attainment
Employment status
Occupation
Type of organisation
Main working place

Module A: Basic ICT equipment access and use

Use of computer
Use of e-mail
Internet access and use
Methods of Internet access
Effects of Internet use
Barriers to using the Internet
Access to mobile phone
Mobile data services
Effects of mobile phone use

Module B: E-commerce and other uses of the Internet

Online activities
Barriers to buying online

Module D: Skills

Internet user experience and know-how

Module L: e-Health

- Use of online health information
- Perception regarding the trust placed in online health information provider
- Rationale for health info search

Module J: Security

Security concerns
Reporting of security violations
Security-related awareness and behaviour

Module K: e-Government

Preference for e-Government services

e-Government experience
Barriers to e-Government

Module E: Telework

Home-based telework
Intensity of home-based teleworking
Duration of telework:
Financing of tele-workplace
Interest in telework:
Perceived feasibility
Effects of telework

Module F: Mobile work

Mobile work (Intensity):

- Mobile telework

Module G: Tele-cooperation/Tele-collaboration

Co-operation with external contacts using ICTs
e-Lancing

Module H: Outcomes of work

Work-family balance
Job quality
Job satisfaction

Module C: Educational attainment and lifelong learning

Company-provided training
Training provided by other organisations
Self-directed learning
Modes of training (use of eLearning)

Module Z: Standard demography

Household size
Disability
Income

No ***Branching***	Question	Answer categories
Module IN: Introduction and Screener questions		**GPS**
INTRO TEXT *ALL*	Hello my name is ... calling for ... We are presently conducting a scientific survey for the European Union in fifteen countries. I would like to talk to the person in your household, that is at least 15 years old, and whose birthday is up next. *[INTERVIEWER: IF NECESSARY]* To topic of this survey is the internet and the work life. *[INTERVIEWER: IF NECESSARY]* Your answers will be held strictly confidential and will be used only for scientific purposes. *[INTERVIEWER: IF NECESSARY]* Your participation is very important to us, because you have been selected through a statistical procedure that will result in a typical selection of people in [COUNTRY] *[PROMPT: The interview will last about 15 minutes]*	
IN1 *ALL*	Would you please tell me in which year you were born?	|_1_|_9_|__|__| [DK]
	PROGRAMMING: IF respondent born after 1986 END INTERVIEW!	
IN2 *ALL*	Have you finished your full-time education or are you still studying?	(1) finished education already (2) Is still studying (3) DK
IN3 *IF IN2=1*	At what age did you finish full-time education? *[PROMPT: HOW OLD WHERE YOU WHEN YOU STOPPED FULL-TIME EDUCATION]*	|__|__| years [DK]
Transition X1 *IF IN2=1*	I would like to ask you a few questions regarding your employment situation.	
IN4 *IF IN2=1*	At present are you in paid work either as an employee, civil servant or as self-employed?	(1) yes (2) no (3) DK
IN5a *IF IN4=1*	Do you have one job or more than one job at present?	(1) only one job (2) more than one job (3) DK
IN5b *IF IN5a=2,3*	How many hours per week do you normally work, including paid overtime and taking all your jobs together?	|__|__|__| [DK]
Transition X2 *IF IN5a=2*	For answering the following questions, please consider only your main job, i.e. the job you spend most of your working time on.	
IN6 *IF IN4=1*	And are you ... [in your main job] *[INTERVIEWER: Read out answer categories]*	(1) self-employed (2) in paid employment (including civil servants) (3) DK
IN7 *IF IN4=2,3*	And are you ... *[INTERVIEWER: Read out answer categories]*	(1) temporarily not working, e.g. because of unemployment, paternal leave or illness (2) retired (3) not working, because you are responsible for ordinary shopping and looking after the home. (4) DK

No ***Branching***	**Question**	**Answer categories**
IN8 *IF IN6=1*	What kind of work do you do? Are you a ... *[INTERVIEWER: Read out answer categories]*	(1) Professional (eg doctor, lawyer, accountant, architect) (2) Farmer, fisherman (3) Business proprietor, owner of company/shop, craftsmen, other self-employed person (4) DK
IN9 *IF IN8=3*	How many employees do you have?	|__|__|__|__|__|__|__| [DK]
IN10 *IF IN4=1*	[In your main job,] Are you working full-time or part-time?	(1) full-time (2) part-time (3) DK
IN11 *IF IN4=1*	How many hours per week do you normally work in your main job, *[PROGRAMMER: Skip the following if IN6=1]* including paid overtime?	|__|__|__| [DK] *[PROGRAMMER: INCLUDE CHECK WITH IN5B]*
IN12 *IF IN6=2,3*	Are you employed ... *[INTERVIEWER: Read out answer categories]*	(1) on an unlimited permanent contract (2) on a fixed term contract (3) on a temporary employment agency contract (4) on apprenticeship or other training scheme (5) other (6) DK
IN13 *IF IN7=2,3,4*	Would you like to be in paid work?	(1) yes (2) no (3) DK
IN14 *IF IN8=3 or IN6=2*	What kind of work do you do? Are you ... *[INTERVIEWER: Read out answer categories]*	(1) working mainly at a desk (2) not working at a desk, but travelling (salesmen, driver, ...), (3) not working at a desk, but in a service job (retail shop, restaurant, ...) (4) doing some other kind of work (5) DK
IN15 *IF IN6=2*	What position do you hold? *[INTERVIEWER: Read out answer categories]*	(1) Employed professional (employed lawyer, medical practitioner, accountant, architect etc.), (2) Management (3) Other non-manual employee (4) Manual worker (5) DK
IN16 *IF IN15=2*	And which of the following best describes your position? *[INTERVIEWER: Read out answer categories]*	(1) General management, director or top management (managing directors, director general, other director) (2) Middle management, other management (department head, junior manager, teacher, technician) (3) DK
IN17 *IF IN15=4*	And which of the following best describes your position? *[INTERVIEWER: Read out answer categories]*	(1) Supervisor (2) Skilled manual worker (3) Other (unskilled) manual worker, servant (4) DK

No ***Branching***	**Question**	**Answer categories**
IN18 *IF IN15=2*	How many employees you are responsible for?	|__|__|__|__|__|__| [DK]
IN19 *IF IN6=2*	For what kind of organisation do you work? *[INTERVIEWER: Read out answer categories]*	(1) a private firm or business or a limited company (2) in the public sector or in a charity, voluntary organisation or trust [PROMPT - DO NOT READ: (2) includes public companies, local or central government, civil service, armed forces, council, schools, universities or other grant funded education establishments, public authorities, charities, voluntary organisations] (3) DK
IN20 *IF IN6=2*	How many employees work in the company/organisation for which you work? *[INTERVIEWER: Read out answer categories]*	(1) <10 (2) 10-49 (3) 50-249 (4) 250 and more (5) DK
IN21 *IF IN4=1*	Do you work mainly ... *[INTERVIEWER: Read out answer categories]*	(1) in your own home (2) in the same grounds or buildings as your home (3) in different places using home as a base (e.g. travelling salesman, free insurance agent etc.) (4) somewhere quite separate from home (5) DK

No *Branching*	Question	Answer categories
Module A: Basic ICT equipment access and use		**GPS**
Transition A *ALL*	Now we would like to ask you a few questions about computers and the Internet	
A1 *ALL*	Have you used a PC, Mac or any other computer, for work or for private purposes - in the last four weeks?	(1) yes (2) no (3) DK
A3 *IF A1=1*	Have you sent or received any e-mail messages, for work or for private purposes, during the last four weeks?	(1) yes (2) no (3) DK
A4a *IF A3=1*	How many of your friends and relatives have their own email address? *[INTERVIEWER: Read out answer categories]*	(1) all or almost all (2) about three quarters (3) about half (4) about one quarter (5) only few or no-one (6) DK
A4b *IF A4a<5*	And with how many of your friends and relatives do you communicate regularly via email? *[INTERVIEWER: Read out answer categories]*	(1) all or almost all (2) about three quarters (3) about half (4) about one quarter (5) only few or no-one (6) DK
A5 *ALL*	Do you have access to the Internet in your home?	(1) yes (2) no (3) DK
A6 *IF A5=2*	Did you once have Internet access in your home?	(1) yes (2) no (3) DK
A7 *ALL*	Have you used the Internet at least once in the last four weeks, at home, at school or work or at any other place?	(1) yes (2) no (3) DK
A8 *IF A7=2,3*	Have you used it in the last 12 months at least once?	(1) yes (2) no (3) DK
A9 *FOR (a):* *IF A7=1 and A5=1* *FOR (b)-(f):* *IF A7=1*	How much time do you spend in a typical week on using the Internet ... [item] *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) at home? (b) at the workplace? (c) at school, university or another educational institution? (d) at a public place where Internet access is free? (e) at an Internet café or other place where you have to pay for access? (f) at another place not mentioned yet	FOR EACH (1) none (2) less than 1 hour (3) between 1 and 5 hours (4) between 6 and 10 hours (5) between 11 and 20 hours (6) more than 20 hours (7) DK

No ***Branching***	**Question**	**Answer categories**
A10 *IF A7=1 or A8=1*	When did you use the Internet for the first time? *[INTERVIEWER: Read out answer categories]*	(1) < 6 months ago (2) 6 - 12 months ago (3) 1 year - 2 years ago (4) 2 years + ago (5) DK
A11a *IF A5=1*	Do you know what technical method you use at home to connect to the Internet?	(1) yes (2) no (3) NA
A11b *IF A11a=1,3*	I will read to you a number of methods to access the Internet. Which of these do you use at home? *[INTERVIEWER: Read out and code those that apply]*	MULTIPLE ANSWERS (1) Dial-up with modem (2) Cable Modem (3) Leased line (4) xDSL (5) ISDN (6) T1 or T3 line [TRANSLATOR: Digital Multiplex connection] (7) Internet access via satellite (8) Other not mentioned (e.g. mobile) (9) DK
A12 *IF A11b=2,3,4,5,6,7*	At home, did you have a connection before which was slower than your current one?	(1) yes (2) no (3) DK
A13 *IF A12=1*	Since moving to this faster type of connection, has the amount of time you spend online per week decreased, increased or remained roughly the same?	(1) Decreased (2) Increased (3) Remained roughly the same (4) DK
A14 *IF A7=1*	In the last four weeks, have you accessed the Internet in any other way than via PC or Mac, at least once?	(1) yes (2) no (3) DK
A15 *IF A14=1*	Which devices did you use for that: Did you use ... *[INTERVIEWER: Read out and code those that apply]*	MULTIPLE ANSWERS (1) Digital TV*, (2) a PDA or palmtop, (3) a mobile phone with WAP or 2.5G** capability, (4) a game console (5) other (6) DK *[* TRANSLATOR: Make sure that you take local brand names and colloquial terms into account]* *** TRANSLATOR: Use term used in your country (e.g. Germany: GPRS)]*

No ***Branching***	**Question**	**Answer categories**
A18 *IF A7=2,3*	Now I will read to you a list of statements about the Internet. Please tell me for each statement whether you agree completely, agree somewhat or do not agree. The Internet ... [item]. Do you ... (a) requires advanced computer skills, (b) is not easy enough to get access to, (c) is too time consuming, (d) is too expensive to use, (e) lacks useful or interesting information (f) is not something for me	FOR EACH (1) agree completely (2) agree somewhat (3) or do you not agree (4) DK
A19 *ALL*	Do you have a mobile phone for your own personal use?	(1) yes (2) no (3) DK
A20 *ALL*	How many of your friends and relatives have a mobile phone for their personal use? *[INTERVIEWER: Read out answer categories]*	(1) all or almost all (2) about three quarters (3) about half (4) about one quarter (5) only few or no-one (6) DK
A23 *IF A19=1 and A15~=3*	Have you used your mobile phone to view webpages or WAP pages, or to read your email, at least once in the last 4 weeks? *[TRANSLATORS: Confusion with SMS* to be avoided!]*	(1) yes (2) no (3) DK
A26 *IF A23=1*	Have you used your mobile phone at least once in the last 12 months to make any purchases in the Internet, to download online information you are charged for or to make online payments?	(1) yes (2) no (3) DK
A27 *IF A19=1*	Have you, in the last four weeks, used SMS* messages for ... (a) communication with other people? (b) paying for purchases, admission tickets or something similar? (c) paying for downloads such as ringing tones? (d) receiving financial information, sport results or other subscription services? *[* TRANSLATOR: Check if another term is more common in your country]*	FOR EACH (1) yes (2) no (3) DK
A30 *IF A19=1* *(For (d) and (e)I: IF A19=1 and (A8=1 or A7=1) and IN4=1)*	Now, think about what your everyday life would be like if you didn't have a mobile phone. Please tell me how much you agree that if you didn't have a mobile phone (ITEM). Would you say that you … *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) you would often not be able to contact your friends and family, or be reached by them (b) you would be less exposed to dangerous electromagnetic radiation (c) you would be more helpless in case of emergencies (d) you would not receive some of the information you need for your job (e) you would have less exchange with some of your business contacts (f) you would have less fun	FOR EACH: (1) agree completely (2) agree somewhat (3) do not agree (4) DK

No ***Branching***	**Question**	**Answer categories**
Module B: E-commerce and other uses of the Internet		**GPS**
Transition B *IF A8=1 or A7=1*	Now I would like to ask you a few questions about the Internet.	
	PROGRAMMING: B1 to B2: for each item in B1=1 ask directly B2, then go to next item in B1	
B1 *IF A8=1 or A7=1*	You can use the Internet for many purposes. I´m going to read you a list of things you can do online and ask you whether you have done this online for your private purposes. For your private purposes, have you used it in the last 12 months... (a) to find information about a product or service (b) to order a product or service (c) to conduct online-banking or to buy financial products (d) to search for any health-related information (e) to look for a job	FOR EACH (1) yes (2) no (3) DK
B2 *IF B1=1 and A7=1*	*[FOR EACH B1 ITEM]* Have you done so in the last four weeks?	(1) yes (2) no (3) DK
B5 *IF A7=1* *(For (c) and (d): IF A7=1 and IN4=1)*	Many people in this country still do <u>not</u> have access to the Internet yet. Now please imagine our country were without the Internet for one month. What would it mean for your everyday life? Please tell me how much you agree that if our country were without the Internet for a month you would (ITEM). Would you say that you would … *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) be less well informed as a consumer (b) feel socially excluded (c) not receive some of the information you need for your job (d) have less communication with some of your contacts at work / your business contacts (e) have less contact with some of your friends (f) have less fun	FOR EACH: (1) agree completely (2) agree somewhat (3) do not agree (4) DK

No *Branching*	Question	Answer categories
Module D: Skills		**GPS**
D1 *IF A7=1 or A8=1* *[Do not ask item (h) in UK, IRL, USA]*	I would like to ask you a few questions about your skills in using the Internet. How confident would you feel... [item] Please tell me whether you feel.. *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) using a search engine (such as Google or Yahoo) to find information on the Internet *[TRANSLATORS: List two most widely used search engine brands in your country[55]]* (b) identifying the source of information provided on the Internet (c) using e-mail to communicate with others (d) using Internet chat-rooms to contact other people (e) using the Internet to make telephone calls (f) creating a personal web / Internet page (g) downloading and installing software onto a computer *[PROGRAMMING: Do not ask item (h) in UK, IRL, USA]* (h) understanding the content of websites written in English	FOR EACH (1) very confident (2) fairly confident (3) not confident (4) Do not know what this means [DO NOT READ OUT] (5) DK

[55] For example, check http://www.jupitermmxi.com/europelanding.html

No ***Branching***	**Question**	**Answer categories**
Module L: e-Health		**GPS**
Transition L *IF B1(d)=1*	You said before, that you have used the Internet to search for health-related information:	
L1 *IF B1(d)=1*	Have you been able to find health related information on the Internet?	(1) yes (2) no (3) DK
L2 *IF L1=1*	Was the information suitable for your needs?	(1) yes (2) no (3) DK
L3 *IF L2=1*	Websites with health related information are available in many languages. When you searched, did you find Websites in your mother tongue sufficient or did you have to expand your search and consult sites in other languages, or did you even have to rely solely on sites in other languages?	(1) Websites in mother tongue were sufficient (2) Had to expand my search and consult websites in other languages too (3) Had to rely solely on websites in other languages (4) DK
L4 *IF B1(d)=1*	And for what reasons did you search health-related information on the Internet? Did you search health-related information on the Internet to ...[item] (a) seek a second opinion on your own, a family member's, or a friend's medical diagnosis? (b) be better informed on your general health? (c) gather additional information since you care for an ill person or a person with a disability?	FOR EACH (1) yes (2) no (3) DK
L5 *IF B1(d)=1*	How trustworthy would you consider each of the following providers of health-related information: [Item] : Are those ... *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) Universities and other non-profit organisations active in the health sector / the health field (b) pharmaceutical companies (c) private health insurance providers (d) patient advocacy and self-help groups (e) hospitals (f) professional medical associations	FOR EACH (1) very trustworthy (2) fairly trustworthy (3) not trustworthy (4) DK

No ***Branching***	Question	Answer categories
Module J: Security		**GPS**
Transition J *IF A7=1*	Now the topic is internet security.	
J1 *IF A7=1*	How concerned are you about .[item]: Are you ... *[INTERVIEWER: Read out answer categories]* (a) data security on the Internet, i.e. the loss or manipulation of your data? (b) privacy and confidentiality on the Internet, i.e. personal information about you being misused by third parties?	FOR EACH (1) very concerned (2) somewhat concerned (3) not concerned (4) DK
J2 *IF J1(a)=1,2 or J1(b)=1,2*	Are these concerns stopping you from using the Internet to buy goods or services online: often, sometimes, or never?	(1) often (2) sometimes (3) never (4) DK
J3 *IF A7=1*	Would you report violations of your on-line security, privacy and confidentiality to a third independent party, for example a public agency created for this task? *[INTERVIEWER: Read out answer categories]*	(1) yes, very likely (2) maybe (3) no (4) DK
J4 *IF J3=1,2,3*	Would it be easier for you to do so if you could do it anonymously?	(1) yes (2) no (3) DK
J5 *IF A7=1 & (B1(b)=1 or B1(c)=1)*	How often are you aware of security features of websites when you use the Internet to buy online: often, sometimes or never?	(1) often (2) sometimes (3) never (4) DK
J6 *IF A7=1 & (B1(b)=1 or B1(c)=1)*	And how often do you take security features of websites into account when deciding about whether to buy online: often, sometimes or never?	(1) often (2) sometimes (3) never (4) DK

No ***Branching***	Question	Answer categories
Module K: e-Government		**GPS**
Transition K *IF A7=1*	Now I would like to ask you a few questions about the contact to government agencies through the Internet.	
	PROGRAMMING: K1 to K3: for each item in K1=1 ask directly K2, If K2=1 ask directly K3, then go to next item in K1	
K1 *IF A7=1*	Here is a list of activities that require citizens to get in touch with public administration. For each activity, please answer whether you would prefer to use the Internet or prefer to use the traditional way, that is face-to-face, by postal mail, fax or phone: *[INTERVIEWER: Repeat answer categories for the first 2 items]* (a) Tax declaration / filing your income tax return (b) Use of job search services of public employment service (c) Request for passport, driver's licence, birth certificates or other personal documents (d) Car registration (e) Declaration to the police, e.g. in case of reporting theft (f) Searches for books in public libraries (g) Announcement of change of address	FOR EACH (1) Internet (2) traditional way (3) do not use this service [DO NOT READ OUT] (4) DK
K2 *IF K1=1*	FOR EACH Is it possible to use the Internet for this in the area you live?	FOR EACH (1) yes (2) no (3) DK
K3 *IF K2=1*	FOR EACH Have you ever tried using the Internet for this?	FOR EACH (1) yes (2) no (3) DK
K4 *IF A7=1*	For each of the following statements about online services of public administration, please indicate whether you agree. Public services on the Internet ...[item]. *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) are not useful enough (b) are faster than the traditional way (c) require that you install special equipment or software (d) reduce the number of mistakes public authorities make (e) do not seem as safe as using the traditional way (f) make it possible to deal with the authorities at more convenient times (g) make it possible to deal with the authorities at more convenient locations, e.g. from home or from the workplace (h) are difficult to use	(1) agree completely (2) agree somewhat (3) do not agree (4) DK

No ***Branching***	Question	Answer categories
Module E: Telework		**GPS**
Transition E *IF IN4=1 or IN13=1 or IN7=1*	Now let's talk about another topic: With the help of telephone, fax and computer, many types of work can be done from home. If work results are transferred electronically, this is sometimes called telework.	
E1 *IF IN4=1*	Do you presently telework from home, for at least some of your working time?	(1) yes (2) no (3) DK
E2 *IF E1=2,3*	Have you teleworked on a regular basis before, in the last five years?	(1) yes (2) no (3) DK
E3 *IF E2=1*	Did you spend, on average, at least one full working day a week at home when you were teleworking?	(1) yes (2) no (3) DK
E4 *IF E1=1*	Do you spend, on average, at least one full working day a week teleworking from home?	(1) yes (2) no (3) DK
E5 *IF E1=1*	You indicated before that you work on average *[PROGRAMMER: Insert result from IN5b, if blank insert result from IN11]* hours per week. How many of these do you spend at home in a typical week?	|__|__|__| [DK] *[PROGRAMMER: Insert check with IN5b or IN11]*
E7 *IF E1=1 and IN6=2*	Has the equipment you use for teleworking at home been mainly, not mainly but partly, or not at all been paid for by your employer?	(1) mainly paid for by employer (2) not mainly, but partly paid for by employer (3) not at all paid for by employer (4) DK
E8 *IF IN7=1 or IN13=1 or (E1=2,3 or E4=2,3)*	If it was offered to you, how interested would you be in ... [item]. Would you be ... *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) doing almost all your work teleworking at home (b) telework where you did not spend all your working time, but at least one full working day per week at home (c) work in an office provided near your home which would allow you to reduce commuting?	FOR EACH (1) very interested (2) somewhat interested (3) not interested (4) DK
E9a *IF E1=2,3 or E4=2,3*	Would you say that your job is feasible for telework, under the assumption that you spend at least one full working day per week at home?	(1) yes (2) no (3) DK
E9b *IF E9a=2 and IN6=2*	What are the main reasons why you consider your current job not to be feasible for telework? Is it because ... *[INTERVIEWER: Read out answer categories and code all that apply]*	MULTIPLE ANSWERS (1) your company does not permit telework? (2) your superior does not approve of telework? (3) your job requires face-to-face contact with customers, colleagues or other persons (4) your job requires access to machines or other things which cannot be accessed from home (5) Other reasons (DO NOT READ OUT) (6) DK

No ***Branching***	**Question**	**Answer categories**
E10 *IF E1=1*	For what reasons did you start teleworking? Please indicate for each of the following aspects how important it was for your decision to start teleworking. [item] Was this ... for you. *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) I needed a more peaceful working environment (b) I want to participate more in family life (c) I want to be closer to clients or customers (d) I need to look after a child or an other person who needs care (e) My company asked me to start teleworking (f) I want to reduce commuting (g) I wanted to have more flexibility in how to organise my work	(1) very important (2) somewhat important (3) not important (4) DK
E11 *IF E1=1*	Most working people are not allowed to work from home. Please consider you would <u>not</u> be allowed to telework from home, for whatever reasons. What would that mean for your ability to do your job? Would it mean that you...[item]. Do you ... *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) could not be in paid work at all (b) could not do your job as well as with telework (c) would have to look for another job which is located closer to your home (d) would have to reduce your working hours per week	FOR EACH: (1) agree completely (2) agree somewhat (3) do not agree (4) DK

No ***Branching***	**Question**	**Answer categories**
Module F: Mobile work		**GPS**
Transition F *IF IN4=1*	Now let's talk about the topic of mobile working.	
F1 *IF IN4=1*	In the last four weeks, have you spent any of your working time away from your home and from your main place of work, e.g. on business trips, in the field, travelling or on customer's premises?	(1) yes (2) no (3) DK
F2 *IF F1=1*	You indicated before that you work on average *[PROGRAMMER: Insert result from IN5b, or if blank result from IN11]* hours per week. How many of these do you spend away from home and your main place of work?	|__|__|__| [DK] *[PROGRAMMER: Insert check with IN5b or IN11]*
F3 *IF F2>5*	In the last four weeks, have you used online computer connections when travelling? By this I mean have you accessed the Internet for business purposes, or electronically transferred data to colleagues?	(1) yes (2) no (3) DK
F4 *IF F3=1*	For what purpose did you use these online connections? Have you used these to ... (a) access the Internet (b) send or read e-mails (c) connect to your company's internal computer system	FOR EACH: (1) yes (2) no (3) DK
F5 *IF F3=1*	Where did you use an online computer connection? Have you used it in the last four weeks at ... (a) a hotel, conference site or similar location? (b) another company's premises? (c) an Internet café or an other commercial teleservice center? (d) or on the move, using a mobile device for data transfer?	FOR EACH: (1) yes (2) no (3) DK

No ***Branching***	**Question**	**Answer categories**
Module G: Tele-cooperation/Tele-collaboration		**GPS**
Transition G *IF IN4=1 and (A1=1 or A7=1)*	And how about the use of telecommunication technology at your work place:	
G1 *IF IN4=1 and A1=1*	When you communicate with external contacts, do you sometimes use e-mail, video conference or electronic data transfer? *[PROGRAMMER: skip the following if IN6=1]* By external persons we mean customers, clients, suppliers, other business contacts, but also colleagues working at other locations of the same company.	(1) yes (2) no (3) DK
G2 *IF G1=1*	In a typical week, how often do you ...[item] for these external contacts? *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) use e-mail (b) use video-conferencing (c) use e-mail attachments or other electronic data transfer	FOR EACH (1) 10 or more times a day, (2) at least once a day, (3) at least once a week (4) less often than once a week (5) never (6) DK
G4 *IF IN6=1 and A7=1*	I would like to know about the role the Internet plays in your business. Do you sometimes attract new business through the Internet or via e-mail?	(1) yes (2) no (3) DK
G5 *IF IN6=1 and A7=1*	Do you sometimes deliver work results to your clients or customers through the Internet or via e-mail?	(1) yes (2) no (3) DK
G6 *IF G4=1 and G5=1*	Does it sometimes happen that you communicate with clients or customers exclusively by electronic means, i.e. via Internet, e-mail, phone or fax and without meeting face-to-face?	(1) yes (2) no (3) DK

No ***Branching***	**Question**	**Answer categories**
Module H: Outcomes of work		**GPS**
Transition H *IF IN4=1*	I would like to ask you a few more questions about your work.	
H1 *IF IN4=1*	Please tell me for each of the following, how often you experience this. How often do you .. [item]? *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) Find your work stressful (b) Come home from work exhausted (c) Find your job prevents you from giving the time you want to your partner or family (d) Feel too tired after work to enjoy the things you would like to do at home (e) Find your partner/family gets fed up with the pressure of your job	FOR EACH (1) often (2) sometimes (3) never (4) does not apply [DO NOT READ] (5) DK
H2 *IF IN6=2,3*	In your current work arrangement, do you agree with the following statements about your job? [item] Do you ... *[INTERVIEWER: Read out answer categories for the first 2 items]* (a) I have a lot of say over what happens in my job (b) I need to keep learning new things continuously (c) I have concerns about whether my job is secure (d) I have a high income (e) I can adapt my starting & finishing times to my personal preferences (f) I can adapt the number of weekly working hours to my personal preferences	FOR EACH: (1) strongly agree (2) somewhat agree (3) disagree (4) DK
H3 *IF IN4=1*	On the whole, are you very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied or very dissatisfied with your job / your main job?	(1) very satisfied (2) somewhat satisfied (3) neither satisfied nor dissatisfied (4) somewhat dissatisfied (5) very dissatisfied (6) DK

No ***Branching***	Question	Answer categories
Module C: Educational attainment and lifelong learning		**GPS**
Transition C *IF IN4=1 or IN13=1 or IN7=1*	Now I would like to ask you a few questions about training and learning.	
C2 *IF IN6=2,3*	Did you participate in some kind of work-related training activities that were provided either by your company or by an other organisation, in the last four weeks?	(1) yes (2) no (3) DK
C9b *IF IN7=1 or IN6=1*	Did you participate in some kind of training activities with the aim of preparing you for a future job, in the last four weeks?	(1) yes (2) no (3) DK
C14a *IF IN4=1*	Apart from the training that may have been provided by others, did you engage in some kind of self-directed learning related to your work, in the last four weeks?	(1) yes (2) no (3) DK
C14b *IF IN7=1 or IN6=1*	Apart from the training that may have been provided by others, did you engage in some kind of self-directed learning which was aimed at preparing you for a future job, in the last four weeks?	(1) yes (2) no (3) DK
C18 *IF A1=1 and (C2=1 or C9b=1 or C14a=1 or C14b=1)*	Did you use, in the course of your training and learning in the last four weeks, electronic learning materials such as learning programmes on CD-ROM, in company-internal computer systems or on the Internet?	(1) yes (2) no (3) DK
C19 *IF C18=1*	What did you use? Did you use (a) CD-ROMs or other so-called offline media such as diskettes, audio or video tapes etc.? (b) online learning materials provided on the internal computer system of your organisation or through the Internet	FOR EACH (1) yes (2) no (3) DK
C20 *IF IN2=2 and A1=1*	Did you use, in the course of your studies in the last four weeks, electronic learning material such as learning programmes on CD-ROM, on the internal computer system of your school/university or through the Internet?	(1) yes (2) no (3) DK
C21 *IF C20=1*	What did you use? Did you use (a) CD-ROMs or other so-called offline media such as diskettes, audio or video tapes etc.? (b) online learning material provided on the internal computer system of your school/university or through the Internet?	FOR EACH (1) yes (2) no (3) DK

No ***Branching***	**Question**	**Answer categories**
Module Z: Standard demography		**GPS**
	Finally we would like to ask you a few more questions for statistical purposes:	
Z17 *ALL*	How many people live in your household, yourself included?	|__|__| [DK]
Z18a *IF Z17>1*	How old is the youngest?	|__|__| [DK]
Z18b *IF Z17>1*	How many are 15 years and older?	|__|__| [DK] *[PROGRAMMER: Build in check with Z17 and Z18a]*
Z14 *ALL*	Do you have any long-standing illness, disability or infirmity that limits your activities in any way? By long-standing I mean anything that has troubled you over a period of time or that is likely to affect you for a period of time.	(1) yes (2) no (3) DK
Z19 *ALL*	We also need some information about the income of this household to be able to analyse this survey. What is your household's monthly net income (after tax)? Please count the total wages and salaries per month of all members of this household; all pensions and social security benefits; child allowances and any other income like rents etc. *[ADD IF NECESSARY: Of course, your answer (as all other answers in this interview) will be treated confidentially and referring back to you or your household will be impossible.]* Is it less or more than <income 1>, <income 2> or <income 3>.	(1) less than <income 1> (2) <income 1> to less than <income 2> (3<income 2> to less than <income 3>. (4 <income 3> or more (5) DK (6) Refusal
Z20 *ALL*	Looking back over the last three years, has your household income increased, decreased, or remained roughly the same?	(1) increased (2) decreased (3) remained roughly the same (4) DK (5) Refusal
Z21 *ALL*	Gender *[INTERVIEWER: Ask only if in doubt]*	(1) male (2) female

No ***Branching***	**Question**	**Answer categories**

	Data provided by survey organisation	**Categories**
P0	Survey Number	101438
P1	Country Code	|__|__|
P2	Interview Number	|__|__|__|__|
P3	Date of Interview:	Day |__|__|, Month |__|__|
P4	Time of the beginning of the interview (USE 24 HOUR CLOCK):	Hour |__|__|, Minute |__|__|
P5	Number of minutes the interview lastet	|__|__|__|
P6	Size of locality	|__|__|
P7	Region	|__|__|
P8a	Postal Code / Area code **must be convertible into NUTS 2 regions**	|__|__|__|__|__|__|__|__|
P8b	**NUTS 2 regions**	|__|__|__|__|__|__|__|__|
P9	Interviewer Number	|__|__|__|__|__|
P10	Weighting Factor	|__| . |__|__|__|__|__|
P11	Language of interview (Luxembourg, Belgium, Finland, Switzerland)	|__|

8.3.2 Questionnaire for the Decision Maker Survey (DMS)

Structure of the questionnaire:

Introduction and Screener Section

Module A: Basic characteristics

Type of organisation
Number of staff (employees)
Turnover

Module B: Module B: Basic ICTs take-up and intensity of use (e-Business)

e-Mail
Internet
Intranet
EDI
Video-conferencing
Call-centre
Staff access to ICTs

Module C: e-Commerce

Website/ Internet presence
Online sales
Barriers to e-commerce (selling)
Benefits from / Outcomes of e-commerce
Online procurement
Barriers to online procurement
Benefits from/ Outcomes of online procurement
Online supply chain integration
- e-Marketplaces

Module D: e-Business security

Security breaches
Information security strategy
Barriers to security
Security provisions

Module F: e-Government

Use of e-Government services
Barriers to e-Government

Module G: Website accessibility

Design for all" / "universal design" principle awareness

Module E: R&D

R&D staff
Computer staff in R&D unit(s)
IT staff providing computer services to R&D
Outsourced computer services for R&D
Vacancies in IT for R&D

No ***Branching***	**Question**	**Answer categories**
Introduction and Screener Section		**DMS**
	Database/address information:	**Categories**
A11 *ALL*	Main business activity ***PROGRAMMER: Copy from database***	**NACE code (2-digit level)** I__I__I 1 Mining, Energy (includes NACE 10 - 14/ 40, 41) 2 Manufacturing (includes NACE 15 - 37) 3 Construction (includes NACE 45) 4 Distribution (includes NACE 50, 51, 52) 5 Hotels, Restaurants (includes NACE 55) 6 Transport, Communication (includes NACE 60, 61,62, 63, 64) 7 Banking, Insurance (includes NACE 65, 66, 67) 8 Business Services (includes NACE 70, 71, 72, 73, 74 [except: 74.13]) 9 Public Administration (includes NACE 75 [except 75.2]) 10 Education (includes NACE 80) 11 Health and Social Work (includes NACE 85) 12 Other personal or social services (includes NACE 90, 91, 92, 93)

No ***Branching***	**Question**	**Answer categories**
A12 *ALL*	Establishment/ size (if available) PROGRAMMER: Copy from database	According to database a) OPEN (if available) I__I__I__I__I__I__I *6-digit numerical* [1] not available from database and b) in categories, i.e. (1) 0 - 9 (2) 10 - 49 (3) 50 - 199 (4) 200 - 499 (5) 500+ (6) not available from database
S1 (INTRO) *ALL*	At reception/switchboard: Good morning/good afternoon. My name is ... . I am calling for ... [name of institute]. We are presently conducting a scientific survey in several European countries. The topic is the use of information and communications technologies. I would like to talk to the person who is responsible for DP/IT decisions at your location. INT.: NOTE: THIS SHOULD BE THE HEAD OF THE DP/IT DPT. OR A SENIOR PERSON IN THE DP/IT DPT. IN SMALLER FIRMS IT CAN ALSO BE THE MANAGING DIRECTOR, THE GENERAL MANAGER OR THE OWNER. INT.: ADD, IF NECESSARY: Your participation is very important to us, because your firm has been selected through a statistical procedure that will result in a typical selection of firms in [COUNTRY] INT.: ADD, IF NECESSARY: The interview will last approx. 15 minutes	(1) put through to target person ➞ CONTINUE (2) target person currently unavailable ➞ MAKE APPOINTMENT FOR CALLBACK (3) no such person ➞ TERMINATE (4) refusal to participate ➞ END

No ***Branching***	**Question**	**Answer categories**
S2 (INTRO) *ALL*	At target person: Good morning/good afternoon. My name is ... . I am calling for ... [name of institute]. We are presently conducting a scientific survey in several European countries. The topic is the use of information and communications technologies. We are talking to people who are responsible for DP/IT decisions at their respective locations. Can I just check: Would you be the right person to talk to at your location and can we do the interview now? INT.: ADD, IF NECESSARY: Your participation is very important to us, because your firm has been selected through a statistical procedure that will result in a typical selection of firms in [COUNTRY] INT.: ADD, IF NECESSARY: The interview will last approx. 15 minutes	(1) yes, interview now ➞ CONTINUE (2) yes but no time at the moment ➞ MAKE APPOINTMENT FOR CALLBACK (3) no, other person responsible at this location ➞ ASK TO BE PUT THROUGH TO THAT PERSON , RESPECTIVELY ASK FOR CONTACT DETAILS. AT NEW TARGET PERSON START AGAIN WITH QUESTION S2 (4) no, other person responsible at another location ➞ TERMINATE (5) refusal to participate ➞ TERMINATE
A13 *ALL*	Function of target person What is your position in your establishment? What of the following is the most appropriate? INT.: READ OUT. SINGLE ANSWER.	(1) Owner/Proprieter (2) Managing Director/Board Member (3) Head of Establishment/Site (4) Head of IT/DP (5) Other senior member of IT/DP Department (6) Other ➞ TERMINATE

No *Branching*	Question	Answer categories
Module A: Basic characteristics		**DMS**
Transition A *ALL*	Let us start with some general questions about your establishment.	
A2 *ALL*	Does your organisation have only one establishment, or has it more than one establishment? By establishment we mean a single indentifiable unit at a particular address. ***[TRANSLATOR: Be very careful to identify a correct translation for "establishment"]***	(1) only one establishment (2) more than one establishment (3) DK
A4 *IF A2=2*	How many employees does your organisation have in total in [country], including yourself? INT.: IF "DK" SAY: If you do not know it exactly, can you give me an estimate?	|__|__|__|__|__|__| *6-digit numerical* [DK]
A5 *ALL*	And how many employees work for your organisation AT THIS ESTABLISHMENT, including yourself? INT.: IF "DK" SAY: If you do not know it exactly, can you give me an estimate? ***PROGR.: CHECK:*** ***IF A2=(2), Answer in A5 MUST be < Answer in A4!*** ***IF NOT RE-ASK A4 / A5***	|__|__|__|__|__|__| *6-digit numerical* [DK] → **TERMINATE INTERVIEW**
	PROGR.: CHECK QUOTA (according to answer in A5) *1 up to 9 employees → QUOTA* *2 10 - 49 employees → QUOTA* *3 50 - 199 employees → QUOTA* *4 200 - 499 employees → QUOTA* *5 500+employees → QUOTA* *IF "DK" TO QUESTIONS A5*	
A3 *IF A2=2*	Is your establishment ...? INT.: READ OUT ALL ANSWER CATEGORIES. SINGLE ANSWER.	(1) the headquarters of an internationally operating organisation (2) the headquarters of an organisation that only operates in this country (3) a division or branch operation of an internationally operating organisation (4) a division or branch operation of an organisation that only operates in this country (5) other [INT.: DO NOT READ] (6) DK

No ***Branching***	**Question**	**Answer categories**
A8 *ALL* *EXCEPT IF A11 (NACE Code) = 75, 80, 85*	Please indicate your establishment's turnover in the last financial year. INT.: IF "DK", SAY: If you do not know it exactly, can you give me a rough estimate? INT.: PLEASE TRY TO GET AT LEAST AN ESTIMATE. INDICATE IF ANSWER IS GIVEN IN EURO OR IN PREVIOUS NATIONAL CURRENCY (/UK: RESP. OR IN GBP)	(1) Turnover given **IN EURO** (2) Turnover given **IN PREVIOUS NATIONAL CURRENCY (UK: Always use GBP)** (3) DK, no answer to turnover Turnover given: |__|__|__|.|__|__|__|.|__|__|__|.|__|__|__| *12-digit numerical*
A9 *ALL* *EXCEPT IF A11 (NACE-Code) =75, 80, 85*	Has the turnover of your establishment increased, decreased or roughly stayed the same when comparing the last financial year with the year before?	(1) increased (2) decreased (3) roughly stayed the same (4) DK

No *Branching*	Question	Answer categories
Module B: Basic ICTs take-up and intensity of use (e-Business)		**DMS**
Transition B *ALL*	Now we would like to ask you some questions about the use of Information and Communications Technologies in your establishment.	
B1 *ALL*	Does your establishment use e-mail?	(1) yes (2) no (3) DK
B2 *ALL*	Does your establishment have access to the World Wide Web, i.e. the Internet?	(1) yes (2) no (3) DK
B3 *ALL*	Does your establishment have an Intranet, i.e. an internal computer network that uses the Internet protocol?	(1) yes (2) no (3) DK
B5 *ALL*	Does your establishment use EDI, i.e. electronic data interchange using the EDI standard?	(1) yes (2) no (3) do not know what this is [IF SPONTANEOUSLY SAID] (4) DK
B6 *IF B5=1*	Is your EDI Internet based?	(1) yes (2) no (3) do not know what this is [IF SPONTANEOUSLY SAID] (4) DK
B7 *ALL*	Does your establishment use video-conferencing in your own facilities?	(1) yes (2) no (3) DK
B8 *ALL*	Does your establishment use a call center for communication with customers or other external contacts?	(1) yes (2) no (3) DK
B9	*deleted*	
B10	*deleted*	
B11 *IF B1=1*	Which applications can be accessed by the majority of your office workers? Can the MAJORITY OF YOUR OFFICE WORKERS ... send e-mails to external addresses?	(1) yes (2) no (3) DK
B12 *IF B2=1*	(What applications can be accessed by the majority of your office workers?) Can the MAJORITY OF YOUR OFFICE WORKERS ... browse Internet sites?	(1) yes (2) no (3) DK
B13 *IF B3=1*	(What applications can be accessed by the majority of your office workers?) Can the MAJORITY OF YOUR OFFICE WORKERS ... browse INTRANET sites?	(1) yes (2) no (3) DK
B14	*deleted*	

No *Branching*	Question	Answer categories
Module C: E-commerce		**DMS**
Transition C *ALL*	Now we would like to ask you some questions about E-commerce. Please refer to your establishment when answering.	
C1 *ALL*	Does your establishment put information on the Internet, for example by means of a website?	(1) yes (2) no (3) DK
C2 *IF C1=1 or 3*	Do you sell goods or services via the Internet?	(1) yes (2) no (3) DK
C3a *IF C1=1 or 3*	Do you offer online reservation? By this we mean that your customers can make a reservation for a product or service through the Internet.	(1) yes (2) no (3) DK
C3b *IF C2=1*	Do you distribute digital products or services online? By this we mean that the product is transferred to the customer online, or the service is provided online.	(1) yes (2) no (3) DK
C4a *IF C2=1*	Are some of your online sales to businesses?	(1) yes (2) no (3) DK
C5a *IF C4a=1*	How large a share of your total sales to businesses are conducted online? Would you say ... INT.: READ OUT. SINGLE ANSWER	(1) less than 5% (2) 5 up to 25% (3) 26 up to 50% (4) 51 up to 75% (5) more than 75% (6) DK
C4b *IF C2=1*	Are some of your online sales to consumers?	(1) yes (2) no (3) DK
C5b *IF C4b=1*	How large a share of your total consumer sales are conducted online? Would you say ... INT.: READ OUT. SINGLE ANSWER	(1) less than 5% (2) 5 up to 25% (3) 26 up to 50% (4) 51 up to 75% (5) more than 75% (6) DK
C4c *IF C2=1*	Are some of your online sales to the public sector?	(1) yes (2) no (3) DK
C5c *IF C4c=1*	How large a share of your total sales to the public sector are conducted online? Would you say ... INT.: READ OUT. SINGLE ANSWER	(1) less than 5% (2) 5 up to 25% (3) 26 up to 50% (4) 51 up to 75% (5) more than 75% (6) DK

No ***Branching***	**Question**	**Answer categories**
C6 *IF C2=1*	Are your online sales MAINLY to a local, national or global market? INT.: SINGLE ANSWER.	(1) local market (2) national market (3) global market (4) DK
C7 *IF C1=2* *OR* *IF C2=2 or 3*	I am now going to read you a list of statements about selling online. For each statement, please tell me whether you agree completely, agree somewhat or do not agree from the point of view of your establishment. How about the statement ... [item]. Do you ... INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) Selling our products and services requires face-to-face interaction with customers (b) The necessary technology is expensive (c) The costs for the promotion of the online offer are high (d) The revenue potential of online sales is low (e) Customers might be concerned about data protection or security issues (f) Adapting corporate culture to e-commerce is difficult (g) The necessary skills are not readily available (h) Handling the delivery process causes problems	FOR EACH: (1) agree completely (2) agree somewhat (3) or do you not agree (4) DK
C8 *IF C2=1*	You said earlier that you make sales online. According to your experience, what effect has selling online on ... [item]? Would you say the effect is ... INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) your sales (b) your costs (c) your sales area (d) the quality of your customer service (e) the efficiency of your internal business processes	FOR EACH: (1) very positive (2) rather positive (3) neither positive nor negative (4) rather negative (5) very negative (6) DK
C9 *IF B2=1 or 3*	Do you use the Internet or other online services to purchase goods or services?	(1) yes (2) no (3) DK
C10 *IF C9=1*	Roughly what proportion of the maintenance, repair and organisation goods your establishment buys are purchased online, measured in amount spent? Would you say ... INT.: READ OUT. SINGLE ANSWER	(1) less than 5% (2) 5 up to 25% (3) 26 up to 50% (4) 51 up to 75% (5) more than 75% (6) DK

No *Branching*	Question	Answer categories
C11 *IF B2=2* *OR* *IF C9=2 or 3*	I am now going to read you a list of statements about purchasing online. For each statement, please tell me whether you agree completely, agree somewhat or do not agree from the point of view of your establishment. How about the statement ... [item]. Do you ... INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) Purchasing procurement products or services requires face-to-face interaction with suppliers (b) Our suppliers do not sell online (c) The necessary technology is expensive (d) The cost advantage is negligible (e) We are concerned about data protection or security issues (f) The legal protection of online contracts is not sufficient (g) The necessary skills are not readily available (h) Suppliers´ technical systems are not compatible with ours	FOR EACH: (1) agree completely (2) agree somewhat (3) or do you not agree (4) DK
C12 *IF C9=1*	You said earlier that you purchase goods or services online. According to your experience, what effect has online procurement on ... [item]? Would you say the effect is ... INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) your procurement costs (b) stock-keeping of maintenance, repair and organisation goods (c) the number of suppliers (d) your relations to suppliers (e) the efficiency of your internal business processes	FOR EACH: (1) very positive (2) rather positive (3) neither positive nor negative (4) rather negative (5) very negative (6) DK
C13 *IF C1=1*	Does your establishment have an EXTRANET, i.e. a private, secure network running on the Internet protocol and accessible for selected external users?	(1) yes (2) no (3) DK
C14 *IF C13=1*	For which of the following purposes do you use your Extranet? Do you use it for ... [item] INT.: ONE ANSWER PER ITEM. (a) communication with customers or clients? (b) communication with suppliers?	FOR EACH: (1) yes (2) no (3) DK
C15 *IF B2=1*	Do you have access to the Extranet of one of your supplier, partner or customer organisations? ***PROGR.: IF C1=2 or 3, add:*** By Extranet I mean a private, secure network running on the Internet protocol and accessible for selected external users.	(1) yes (2) no (3) DK

No ***Branching***	**Question**	**Answer categories**
C19 *IF B2=1*	Does your establishment trade goods or services through an e-marketplace? By e-marketplace I mean a business-to-business Internet trading forum in which multiple buyers and sellers exchange goods and services within an industry group or geographic region.	(1) yes (2) no (3) DK
C20 *IF C19=1*	On e-marketplaces, different types of business transactions can be accomplished. In which of the following types is your establishment actively involved? INT.: READ OUT AND CODE ALL THAT APPLY	(1) catalogue-based offering of products or services (2) catalogue-based purchasing of products or services (3) auctions -- as a seller (4) auctions -- as a bidder (5) launching calls for tenders (6) answering calls for tenders (7) powerbuying, i.e. joint purchases together with other organisations to save costs (8) none of these (9) DK

No *Branching*	Question	Answer categories
Module D: e-Business security		**DMS**
Transition D *IF C1=1*	Let us now turn to the topic of information security. Again, please refer to your establishment when answering.	
D1 *IF C1=1*	Many establishments are affected by security breaches such as identity theft, online fraud, manipulation of software applications, computer viruses or unauthorised entry to internal networks. Have any breaches of your information security occurred in your establishment in the last 12 months?	(1) yes (2) no (3) DK
D2a *IF D1=1*	***Progr.: Note for D2a to D2b:*** ***For each item in D2a=1, ask directly D2b; then go to next item in D2a!!*** Which of the following types of information security breaches have occurred in your establishment in the last 12 months? Did you experience cases of ... [item]? INT.: READ OUT. ONE ANSWER PER ITEM. (a) Identity theft (b) Online fraud (c) Manipulation of software applications (d) Computer virus infections (e) Unauthorised entry to internal networks	FOR EACH: (1) yes (2) no (3) DK
D2b *(For Each Item) IF D2a=1*	And how substantial were the consequences of this security breach for your establishment? Would you say they were ... INT.: READ OUT ANSWER CATEGORIES. SINGLE ANSWER (PER ITEM ASKED)	FOR EACH ITEM IF D2a=1 (1) very substantial (2) rather substantial (3) not substantial (4) DK
D3 *IF D1=1*	Where do you believe these breaches mainly came from? Do you think the largest threat to online security came from ... INT.: READ OUT ANSWER CATEGORIES. CODE ALL THAT APPLY	MULTIPLE ANSWERS (1) Customers (2) Suppliers/competitors (3) Former employees (4) Computer hackers (5) Internal users (6) Others, not mentioned yet (7) DK

No ***Branching***	**Question**	**Answer categories**
D4 *IF D1=1*	How have you learned about these breaches, in most cases? Were you ... [item] INT.: READ OUT, CODE ALL THAT APPLY	MULTIPLE ANSWERS (1) alerted by a customer/supplier (2) alerted by employees or did you notice yourself (3) notified by your own information security system (4) made aware by damage or loss of data (5) alerted by the providers of outsourced security services (6) in another way (DO NOT READ) (7) DK
D5 *IF C1=1*	Does your establishment or your organisation have an information security policy?	(1) yes (2) no (3) DK
D6 *IF D5=1*	How would you describe it? As formal or informal?	(1) formal (2) informal (3) DK
D7 *IF D5=1*	Which are your information security priorities? How much priority is given to ... [item] INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) Blocking of unauthorised access (b) Expanding budget for security measures (c) Defining the security architecture (d) Outsourcing security management	FOR EACH (1) high priority (2) medium priority (3) low priority (4) DK
D8 *IF C1=1*	How important are the following factors as barriers to effective information security inside your establishment? How about ...[item]: Is this factor as a barrier to effective information security inside your establishment... INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) High costs for security measures (b) Lack of staff training (c) Lack of staff time (d) Complexity of the technology (e) Lack of employee co-operation	FOR EACH: (1) very important (2) fairly important (3) not important (4) DK

No ***Branching***	**Question**	**Answer categories**
D9 *IF C1=1*	Which of the following tools do you use for information security in your establishment? Do you make use of ... [item] INT.: ONE ANSWER PER ITEM. (a) Control of access to the computer system (b) Cryptography/ data encryption (c) Vulnerability Assessment Tools (d) Firewalls (e) Security Training and Awareness Rising Activities (f) Intrusion Detection Systems (g) End-user Security Training Classes	FOR EACH: (1) yes (2) no (3) DK

No ***Branching***	**Question**	**Answer categories**
Module F: e-Government		**DMS**
Transition F *IF B2=1*	Now let´s turn to the topic of using online services for interacting with public administration.	
F1 *IF B2=1 AND A11 (NACE-Code) NOT =75 (Public Admin)*	***Progr.: Note for F1 to F2:*** ***For each item in F1=2, ask directly F2; then go to next item in F1!!*** I am going to read you a list of activities for which establishments have to get in touch with public administration. For which of these activities do you already use online media such as EDI or the Internet? What about ...[item]? Do you use online media such as EDI or the Internet for this? INT.: ONE ANSWER PER ITEM. (a) Payment of social contribution for employees (b) Corporation tax declaration (c) VAT declaration (d) Submission of data to statistical offices (e) Obtaining environment-related permits (f) Participation in public invitation to tender	FOR EACH (1) yes (2) no (3) DK
F2 *(For Each Item)* *IF F1=2*	Would your establishment prefer to use online media such as EDI or the Internet for this purpose?	FOR EACH ITEM IF F1=2 (1) yes (2) no (3) DK
Transition F3 *IF B2=2 or 3*	Now let´s turn to the topic of using online services for interacting with public administration. It is now possible to conduct at lest some of the interaction with public administration online, i.e. by using EDI or the Internet.	

No ***Branching***	**Question**	**Answer categories**
F3 *ALL*	Now I will read you a list of statements about using online media for interacting with public administration. Please tell me for each statement whether you agree completely, agree somewhat or do not agree. Public services on the Internet ... [item]. Do you ... *INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM.* (a) are not useful enough (b) are faster than the traditional way (c) require that you install special equipment or software (d) reduce the number of mistakes public authorities make (e) do not seem as safe as using the traditional way (f) make it possible to deal with the authorities at more convenient times (g) make it possible to deal with the authorities at more convenient locations, e.g. from the workplace (h) are difficult to use	FOR EACH (1) agree completely (2) agree somewhat (3) or do you not agree (4) DK

No *Branching*	Question	Answer categories
Module G: Website accessibility		**DMS**
Transition G *IF C1=1*	Now a few questions about the accessibility of your website for people with special needs.	
G1a *IF C1=1*	What priority has making your website user friendly for ... [item] in your establishment? INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) People with visual disabilities or sight difficulties (b) People with reduced or limited dexterities (c) People with limited literacy	FOR EACH: (1) high priority (2) medium priority (3) low priority (4) DK
G1b *IF G1a (a) =2,3* *or* *IF G1a (b) =2,3* *or* *IF G1a (c) =2,3*	Bearing the these groups in mind: Would you say that your website could be adapted rather easily, would prove difficult to adapt, or could not at all be adapted to these people's needs? INT.: SINGLE ANSWER.	(1) could be adapted rather easily (2) would prove difficult to adapt (3) could not at all be adapted (4) DK
G2 *IF G1a (a) =1,2* *or* *IF G1a (b) =1,2* *or* *IF G1a (c) =1,2*	Does your establishment or your organisation have formal Guidelines for making your website accessible to people with such special needs? By guidelines I mean rules which have to be followed by your website developers?	(1) yes (2) no (3) DK
G3 *IF G1a (a) =1,2* *or* *IF G1a (b) =1,2* *or* *IF G1a (c) =1,2)*	Was your website ever evaluated concerning its accessibility for people with such special needs?	(1) yes (2) no (3) DK
G4 *IF G3=1*	Was this evaluation done internally or using external evaluators? INT.: SINGLE ANSWER.	(1) internal evaluation (2) using external evaluators (3) both (4) DK

No ***Branching***	**Question**	**Answer categories**
Module E: R&D		**DMS**
E1a *ALL*	You said before that **xyz** ***[PROGR.: Insert answer to question A5]*** employees work for your organisation at this establishment. From this, how many work in research & development, i.e. R&D? Please add up possible part time R&D personnel to full-time personnel. INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate? INT.: IF NECESSARY, EXPLAIN: Among R&D we include all creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications.	[OPEN] I__I__I__I__I__I__I *6-digit numerical* INT.: IF NONE, CODE "0". [DK] ***Progr.: Answer to E1a (Number employed in R&D)*** ***must be ≤*** ***Answer to A5 (Total number employed in establishment)*** ***If not, re-ask E1a***
E1b *IF E1a > 0* *and E1a is NOT DK*	R&D can be centralised in R&D units, or it can be distributed over various units of an establishment. Do you have at least one central R&D unit at your establishment?	(1) yes (2) no (3) DK
E2 *IF E1b=1*	What is the size of the computer staff in your central R&D unit(s)? Please add up part time computer staff to full-time staff. INT.: IF NECESSARY, EXPLAIN: By computer staff we mean all staff that - manages the computers, networks and digital resources, or - manages the Internet access and presentation, or - carries out information searches and computations as their major work tasks, or - provides user training. INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit numerical* INT.: IF NONE, CODE "0". [DK] ***Progr.: Answer to E2 (Computer staff in R&D)*** ***must be ≤*** ***Answer to E1a (Number employed in R&D)*** ***IF NOT, re-ask E2***
E3 *IF E1a > 0* *and E1a is NOT DK*	Do you get IT services for R&D from internal computer staff that are not members of your central R&D unit(s)?	(1) yes (2) no (3) DK

No ***Branching***	**Question**	**Answer categories**
E4 *IF E3=1*	What is the size of the internal computer staff outside of your R&D unit(s) who provide IT services for R&D projects? Please add up part time computer staff to full-time staff again. INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit numerical* INT.: IF NONE, CODE "0". [DK] ***Progr.: Answer to E4 (Computer staff outside R&D) must be ≤ Answer to A5 (Total number employed in establishment)*** ***IF NOT, re-ask E4***
E5 *IF E1a > 0* *and E1a is NOT DK*	Do you buy IT services for R&D from external service providers?	(1) yes (2) no (3) DK
E6 *IF E5=1*	What is the number of additional computer staff in your establishment that would be necessary to substitute for the IT services for R&D projects which are currently obtained from external service providers? INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit numerical* INT.: IF NONE, CODE "0". [DK]
E7 *IF E1a > 0* *and E1a is NOT DK*	Do your R&D activities suffer from a low supply of qualified computer staff in your establishment?	(1) yes (2) no (3) DK
E8 *IF E7=1*	Please specify the number of open jobs for computer staff needed to provide IT services for R&D projects in your establishment? INT.: IF "DK", PROMPT: If you do not know it exactly, can you give me an estimate?	[OPEN] I__I__I__I__I__I__I *6-digit numerical* [INT.: IF NONE, CODE "0". [DK]

No ***Branching***	**Question**	**Answer categories**
X1 *ALL*	Finally I would like to ask you for a brief assessment: In the course of the interview we talked, among others, about the areas e-Commerce, i.e. selling and buying online, and e-Government, i.e. interacting online with public administration. That is about areas, which might not necessarily fall into your direct responsibility. Thinking back to the questions about ... [item]: What would you say: How familiar were you with the topics covered in those questions? Would you say... INT.: READ OUT ANSWER CATEGORIES. ONE ANSWER PER ITEM. (a) e-Commerce, i.e. selling and bying online (b) e-Government, i.e. interacting online with public administration	FOR EACH (1) very familiar (2) fairly familiar (3) not very familiar (4) not at all familiar (5) DK/ no answer
X2 *ALL*	And all in all: How interesting did you find the questionnaire as a whole? Would you say ... INT.: READ OUT ANSWER CATEGORIES. SINGLE ANSWER.	(1) very interesting (2) fairly interesting (3) not very interesting (4) not at all interesting (5) DK/ no answer
End Text *ALL*	These were all my questions. I would like to thank you very much for participating in the interview. Have a nice day/evening!	

No ***Branching***	**Question**	**Answer categories**
	Data to be provided by survey organisation	**Categories**
P0	Survey Number	1 0 1 4 3 9
P1	Country Code	|__|__|
P2	Interview Number	|__|__|__|__|__|
P3	Date of Interview:	Day |__|__|, Month |__|__|
P4	Time of the beginning of the interview (USE 24 HOUR CLOCK):	Hour |__|__|, Minute |__|__|
P5	Number of minutes the interview lasted	|__|__|__|
P9	Interviewer Number	|__|__|__|__|__|__|__|__|__|