



SIBIS
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Statistical Indicators Benchmarking the Information Society

Matching up to the Information Society

An evaluation of the EU, the EU Accession Countries, Switzerland and the United States

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Abstract

This report presents the current understanding of progress of the Information Society within the European Union and countries that are up for accession in 2004, based on the SIBIS surveys and analyses per SIBIS theme and per country. It is unique in its coherent and comprehensive approach in measuring the Information Society and intends to inform policy makers and citizens on progress of the Information Society as well as to further debate and research among the professional statistical community, leading to an improved statistical competence in measuring the Information Society in Europe. The report focuses on basic access and usage elements like Internet readiness, the digital divide and information security. It also displays factors determining access and usage such as the perceptions of possible barriers, digital literacy, learning and training issues and it benchmarks on-line applications like e-commerce, e-work, e-science, e-government and e-health. The report ends with a summary of recommendations for policy-makers and for further research.

Preface

This report is the final Synthesis Report (Deliverable 5.2.2 and 5.2.3) of Work Package 5 (WP5) of the SIBIS project (Statistical Indicators Benchmarking the Information Society), funded by the European Commission under the 'Information Society Technology' Programme (IST, 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'. On this basis SIBIS focuses on basic access and usage elements like Internet readiness, the digital divide and information security. It also displays factors determining access and usage such as the perceptions of possible barriers, digital literacy, learning and training issues and it benchmarks on-line applications such as e-commerce, e-work, e-science, e-government and e-health. The results presented in this report are a timely and direct contribution to benchmark progress on key issues of the information society in general and the e-Europe initiative in particular.

RAND Europe has prepared this report based on all earlier work by the SIBIS project. It is mainly based on the WP5 topic reports, the 'Highlights 2002: Towards the Information Society in Europe and the US' and 'Pocketbook 2002/3: Measuring the Information Society in the EU, the EU Accession Countries, Switzerland and the US' publications¹ that presented the highlights of the topic areas as perceived by spring this year, and the WP5 country reports contributed by accession state partners. All publications of the SIBIS project – including this report – are available in electronic format on the Internet at: www.sibis-eu.org

SIBIS is led by empirica (Germany), and includes the following project partners: RAND Europe (The Netherlands), Technopolis Ltd. (United Kingdom), Databank Consulting (Italy), Danish Technological Institute (Denmark), Work Research Centre Ltd. (Ireland), University of Applied Sciences Solothurn Northwest Switzerland (Switzerland), Faculty of Social Sciences, University of Ljubljana (Slovenia), ASM Market Research and Analysis Centre (Poland), Budapest University of Economic Sciences and Public Administration (Hungary), Faculty of Management of the Comenius University Bratislava (Slovakia), 'Dunarea de Jos' University (Romania), Institute of Economics at the Bulgarian Academy of Sciences (Bulgaria), Estonian Institute of Economics at Tallinn Technical University (Estonia), Social Policy Unit (Sozialinnen Politicus Group) (Lithuania), Computer Science Institute (Latvia), SC&C Ltd. (Czech Republic).

This report has been developed with input and feedback from SIBIS partners. It has been peer-reviewed in accordance with RAND's quality assurance standards (see <http://www.rand.org/about/standards/>).

The views expressed are those of the project team and do not necessarily reflect those of the European Commission. Nothing in this report implies or expresses a warranty of any kind. Results from this report should only be used as guidelines as part of an overall strategy.

For more information, please contact sibis@rand.org or check the web site <http://www.sibis-eu.org>.

¹ In the remainder of the report those publications should be referred to as respectively Highlights 2002 and Pocketbook 2002/3

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1 EXECUTIVE SUMMARY

The ongoing pace of change towards a knowledge oriented society has been recognised by the European Commission as a challenge and an opportunity to prepare Europe for a future we want: socially inclusive, economically competitive, culturally diverse, based on sustained and sustainable growth. In order to achieve progress in a way that is of benefit for all the ambitious e-Europe initiative has been adopted by all European Union (EU) Member States and the EU Accession Countries.

Rather than assuming a central coordinating role, the European Union embraced the so-called 'Open Method of Coordination': by measuring progress and identifying good practice in all participating countries and by presenting the results on a European level so that participating countries can adapt their speed and approach of progress learning from other countries practice.

Socio-economic research, as sponsored by the Information Society Technologies (IST) programme under the European Union's 5th Framework Programme of Research and Technology Development, has helped creating this understanding and identifying good practice. SIBIS' contribution is important in this.

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'. On this basis SIBIS focuses on basic access and usage elements like Internet readiness, the digital divide and information security. It also displays factors determining access and usage such as the perceptions of possible barriers, digital literacy, learning and training issues and it benchmarks on-line applications like e-commerce, e-work, e-science, e-government and e-health.

A core set of 'SIBIS' indicators was tested and applied in benchmarking surveys in all 15 Member States, in the United States (US), Switzerland and the EU Accession Countries (i.e. the New Accession States - NAS) Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia. The surveys collected robust and representative data for benchmarking purposes, enabling comparisons to be made across the EU Member States and, for the first time, between the EU and US on exactly the same set of indicators at the same point in time.

The results of the benchmarking surveys have been presented in a series of reports on nine aspects of the Information Society in the European Union member states and a series of country reports on the ten NAS, covering the seven most relevant of the nine aspects of the Information Society.

This report focuses primarily on presenting the main results from the SIBIS benchmarking surveys. The survey fieldwork was carried out in April – May 2002 and January 2003. Annex 1 of this report presents details of the samples and other methodological aspects of the surveys. The questionnaires themselves can be found in on the SIBIS website: <http://www.sibis-eu.org/statistics/questionnaires.htm>.

BASIC ACCESS AND USAGE

Internet readiness

Within Europe and the US the development of Internet is a well-known phenomenon and 54% of the EU population and around 77% of the US population has ever used the Internet, either as a regular user (respondents who used the Internet in the four weeks

prior to the survey) or an occasional user (respondents who used the Internet in the 12 months prior to the survey). However, in the NAS 73% of the population has never used the Internet and 11 % of the population has never heard of the Internet.

In Europe most users access the Internet principally from home. However, a fast emerging pattern of 'bimodal usage' appears, especially in more sophisticated markets: in the US as in Nordic countries, the UK and the Netherlands there is a large proportion of 'bimodal users' who access the Internet from both at-home, and at-work locations.

Based on experiences of the US and Nordic markets, it has been noted that once a majority of a total population has Internet access there is a migration of users with high tenure (period since first use of the Internet) to faster Internet connections. They seek a better on-line experience such as quicker downloads and 'always on' connections.

Mobile telephony is an important, exceptionally fast-growing sector. Although mobile penetration is currently quite high in most western countries, differences in usage patterns between countries occur, as do divergences in the use of data mobile services for communication: SIBIS results show a mobile phone penetration rate that is generally high across the 15 European Union countries (EU15) countries (almost 70%), whereas in the US mobile intensity reaches only 56% and in the 10 Accession countries (NAS10) only 34%.

Digital divides

A digital divide exists between citizens of the EU Member States and those of the Accession Countries. The extent of the digital divide in a given country can be estimated by looking at the PC and Internet participation of groups considered at risk of being excluded. At-risk groups may include elderly and those with a relatively low level of education, among others. The digital divide index (DIDIX) combines the divides by gender, age, education and income in relation to computer use, Internet use and Internet access at home. The DIDIX in the EU Member States compared to the NAS highlights age, income and education as important factors in determining access to the Internet and PCs. The largest difference in access is between those who have a relatively low level of education and the rest of the population.

Amongst the NAS, Estonia and the Czech Republic show highest values and are not far from the EU15 average. The continued persistence of relatively large digital divides in countries usually considered as 'late adapters' is apparent. Countries with an observable aggravation of divides are those ranking lower with regard to ICT uptake.

Information security

Security concerns have a strong impact on on-line shopping behaviour in Europe as well as in the US. In the EU, for instance, almost 30% of Internet users stated that they would often be stopped from buying on-line because of their concerns. However, it is apparent that divergences exist among countries. Whereas some countries, which could be defined as 'front-runners' (e.g. US and Northern Europe) are limitedly affected by their security concerns and have accepted e-commerce as a relatively common practice, the 'laggards' (e.g. Mediterranean countries, NAS), show lower than average e-commerce usage and strong impact of security concerns.

In the NAS both e-commerce usage and the effects of security concerns on e-commerce are limited, which could be related to the fact that the share of regular Internet users (and thus e-buyers) is lower here than in the EU. If we benchmark individual NAS against the

NAS average rather than against the EU average, it appears that, in this case too, the split between 'front-runners' and 'laggards' is marked: in some countries, such as Estonia, on-line shopping usage is becoming comparable to what is found in some of the EU Member States; others still have a long way to go (Romania, Latvia, Lithuania).

Countries, who lead the way in practicing e-commerce such as the US, are also the most aware of security features of websites and often take them into account. Countries lagging behind in e-commerce usage (such as most NAS), typically also show low awareness and importance of security features of websites.

The most widespread information security breaches are computer virus infections. Almost all organisations have been affected by computer viruses in the 12 months prior to the survey. By comparison, the numbers of businesses affected by other security breaches, such as unauthorised access to their networks or identity theft, are fairly low.

FACTORS DETERMINING ACCESS AND USAGE

Perceptions of possible barriers

Citizens are strongly concerned both about privacy/confidentiality and data security, with a slightly higher concern about privacy. Generally, among the NAS, concerns about privacy and confidentiality as well as those about data security tend to be lower than within the EU. However, looking at Member States of the EU and at Accession Countries individually, both groups exhibit a great deal of variation. For example, Poland and Latvia are countries where both concerns register higher than in the EU. Similarly, In the Netherlands, France, Austria and Sweden concerns about privacy and confidentiality are lower than in the Accession Countries as a whole.

Most non-regular Internet users in Europe believe that advanced computing skills are required for using the Internet. However while in the EU15 less than 60% feel the skill gap as a barrier to Internet usage, this figure is 68% on average in the NAS10, reaching peaks of over 80% in Latvia, Lithuania, Czech Republic and Slovakia. In contrast, psychosocial barriers to Internet usage are stronger in more advanced information societies (e.g. Sweden), suggesting limitations to the current growth in Internet penetration levels.

Digital literacy, learning and training

A significant share of the labour force is participating in work-related lifelong learning. While not giving any information on the type, intensity and field of these activities, SIBIS results show that a high percentage of workers are in the process of preparing for the adaptation of skills to the fast-changing requirements which are a key feature of the IS. At the same time e-learning can play a decisive role in delivering learning systems which meet the demands of today's workers - and the unemployed. The share of the labour force that uses e-learning is 15% on average in the EU and 5% in the NAS, both of which is much lower than the 23% reached in the US.

The level of digital literacy (DL), measured by four types of skills in using the Internet (communicating digitally, obtaining and installing digital tools, questioning the source of information from the Internet regarding its reliability and searching for the required information using search engines) varies strongly within the EU, with the NAS in general as the ones showing the lowest level of DL among the total population. Estonia and Slovenia show a slightly higher level of DL than the Mediterranean countries of the EU and Portugal.

ON-LINE APPLICATIONS

e-commerce

On average, 20% of the EU's population purchases products online. By comparison, for the Accession Countries only about 5 % of the population does so. On-line buyers tend to display a more interactive use of the PC than non-on-line buyers, suggesting that the more sophisticated Internet users purchase on-line.

Almost a quarter of Europe's businesses sell online, whether that is through a website or an e-marketplace and twice as many make on-line purchases. The on-line selling activity varies across the three market domains and across the countries analysed. Business-to-Business (B2B) and Business to Consumer (B2C) correlate closely in terms of on-line sales, whereas Business to Government (B2G) is lagging behind. On average, the volumes of sales generated via e-commerce are small and tend to form a small portion of total sales turnover.

European businesses vary widely in their levels of engagement with e-commerce. In the seven countries covered in the SIBIS establishment survey, only a very small minority of establishments remains completely off-line, although a further one in five companies only uses basic e-mail. For one third of businesses in the countries surveyed, their e-commerce engagement involves back-office transactions through closed network business integration (based on the use of extranets or Electronic Data Interchange). More than two in five businesses engage in some level of front-office e-commerce, with this being restricted to web marketing for one in five businesses and web sales for one in twelve. Just under one in seven businesses engage in both front-office and back-office e-commerce.

e-work

Despite people's strong interest towards telework, home-based telework is not common: just over 7% of workers from the EU, 3% from the NAS and 17% from the US actually telework from home. However, it must be stressed that telework consists of a variety of types apart from home-based telework, including mobile work, centre-based telework and self-employed teleworkers in a 'Small-Office-Home-Office' (SOHO). Hence, figures are higher when other forms of telework are taken into account as well.

Averages, both for the EU and for the NAS, conceal significant differences among different countries. In the EU, home-based telework is common in northern Europe (15-20%) but the Mediterranean area, together with Portugal, barely reaches 5% of intensity. Similarly, although telework is infrequent in the NAS, there are significant disparities between those countries that show a relatively high intensity of home-based telework (8% in Estonia and Lithuania, which are above the EU average), and the others (less than 5%).

In spite of the interest in telework, an extensive shift of work from the office into the home is yet to be seen. Although companies are often willing to give their staff remote access to their computer network, the acceptability of staff working from home whole days seems to be limited. This trend is complemented by the strong increase in mobile teleworking, which means the use of on-line connections for work purposes during business trips.

e-science

Researchers in some disciplines can be considered as avant-garde ICT users in a work environment. Hence, exploring e-science should give clues about future ICT requirements and trends in other areas of society. Although in principle research systems include

academic and private sector research and development (R&D) establishments, SIBIS considered public science and defines e-science as its penetration with computers and computer networks.

The types of available computers (stand-alone PC, workstation, mainframe, supercomputer, cluster of PCs) and the age of the computer used are the most important indicators to assess the quality of computer equipment. SIBIS data shows that whereas national differences do not play a significant role here, discipline-related divergences are far more pronounced: astronomers and computer scientists appear the most 'e-science ready'. Chemists are usually at or a little bit below the average of all scientific disciplines in the dataset; economists and psychologists rate the readiness indicators worse than the average scientist.

SIBIS assessed to what extent scientists do in fact use e-science tools for their work, either for data collection, analysis or diffusion of results. Also in this respect, country differences, even though revealing a patchwork of strengths and weaknesses, are less marked than discipline-related differences: astronomers generally use the Internet most often for collecting and analysing data and retrieving information; but, they do not rely on personal world-wide web (WWW) pages for publishing professional information. On the other hand, much higher percentages of economists, normally not the avant-garde of e-science, and computer scientists have their own WWW pages.

e-government

EU and NAS citizens show a significant preference for some e-government services, that is the interaction with government via electronic means, while for other services the traditional way is still preferred. Regular Internet users would rather turn to the Internet for communicating with their administrations if it did not involve revealing a great deal of personal information (clearly a declaration to the police entails renouncing to one's privacy far more than a library book search or a job search). The amount of personal information required is only one explaining factor for the preferences of citizens; for instance, familiarity with the on-line service and experience using the Internet are also likely to play a role.

Typically, in countries where Internet usage is higher, citizens prefer to communicate on-line with their governments. However, the enthusiasm towards e-government does not always ensue from its actual implementation or from citizens' on-line access. Romania shows a very high preference for using online services, well above the average of the Accession Countries and higher than all EU member states. Yet, availability and usage of those services in Romania is limited: Romanians are very willing and enthusiastic about the possibilities the Internet can create for them in the future.

e-health

The SIBIS survey found that although online searching for health-related information is still a minority activity in Europe, both amongst Internet users (36.4%) and amongst the general population (19.8%), it is of sufficient scale to represent a significant issue for public health policy in general and for patient-doctor interaction in particular. There are significant variations across the EU Member States in the prevalence of health-information searching on the Internet, ranging from between 20% to 50% of Internet users and between 10% and 30% of the population. No EU country reached the levels found in the US, where this form of e-health activity was reported by more than half (58.3%) of Internet users, a figure that translates into more than two in five (44.9%) of the US population overall.

Amongst Internet users, males and younger users were less likely to report online searching for health information but there were few differences across socio-economic groups. However, differences in Internet usage in the first place result in older people and people in less favourable socio-economic circumstances being a lot less likely to use the Internet to search for health-related information. This indicates a need for careful monitoring of the extent to which the advent of health-related information services on the Internet may exacerbate existing health "divides" in the population.

About one in six EU users reported having to search web sites in languages other than their mother tongue in order to find suitable health-related information and this was a lot more than the one in forty of their US (English-speaking) counterparts who reported this. Language is therefore an important factor to be considered in e-health policy and it will be necessary to ensure that sufficient quality information is available for all language groups if linguistically-determined health divides are to be avoided.

CONCLUSIONS

SIBIS was conceived with the aim of measuring the developments of the IS by combining the three levels of IS development: readiness, intensity and impact. The results of the SIBIS project point to important aspects of the IS that provide a necessary complement to existing measures of progress in the IS. Up to now, evaluations of the IS have focused primarily on the supply side, looking at whether services are available and how sophisticated they are. SIBIS measures whether the services are used, to what extent, and why or why not. As a result of SIBIS, it is fair to say that we have today a clearer picture of how Europe is progressing towards becoming the most competitive and dynamic economy of the world. For e-commerce and e-government this is certainly true.

Regional differences can be revealed as a result of SIBIS. Overall, the US leads the way, with high Internet penetration and experience. Northern Europe, however, often has even higher figures. SIBIS shows that, overall, the Accession countries still has a long way to go to reach current EU levels, although, significant differences were measured between the Accession countries so that the leading countries there perform better than the lagging countries of the EU.

The purpose of SIBIS was to test and pilot indicators, which should be used in larger, more comprehensive surveys. The results obtained are very promising, although they still present certain limitations. This issue is considered in greater detail in other SIBIS products - in particular the Indicator Handbook – where the 'best' indicators are given – even when these were not the ones actually tested and piloted within SIBIS.

2 INTRODUCTION

Statistical Indicators Benchmarking the Information Society (SIBIS) is an IST Programme project aiming to produce new methods and data that will contribute to the European effort to measure and benchmark the Information Society. As the Information Society extends to all aspects of social and economic life, good indicators are needed to track its evolution and its impacts.

SIBIS has approached the task of developing and testing such indicators in a systematic manner. To begin with, an assessment was made of the state-of-the-art in Information Society benchmarking. Available indicators were collected and analysed, including ones that have been used for actual benchmarking purposes, ones that have been used in small-scale and non-representative studies and ones that have been proposed but not yet applied in practice.

A core set of 'SIBIS' indicators were then developed, with the emphasis on those aspects of the Information Society that have been the focus of attention in the e-Europe context. These indicators were tested and applied in benchmarking surveys in all 15 EU Member States, in the US, Switzerland and the EU accession countries (i.e. the Newly Associated States - NAS) Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia.

The surveys collected robust and representative data for benchmarking purposes, enabling comparisons to be made across the EU Member States and, for the first time, between the EU and US on exactly the same set of indicators at the same point in time.²

The SIBIS work on indicator development and testing has helped advance the understanding of what aspects of the Information Society should be benchmarked and how best to benchmark these. This is currently being used in an evaluation of the e-Europe 2005 benchmarking proposals.

Apart from this direct contribution to the eEurope exercise, SIBIS will also make the methodological developments from its work more generally available for others to use. To facilitate this, the SIBIS indicators are compiled into a handbook to support the benchmarking activities of EU and national agencies.

This report focuses primarily on presenting the main results from the SIBIS benchmarking surveys. The survey fieldwork was carried out in April – May 2002 and January 2003. A representative General Population Survey (GPS) was conducted in 2002 in all 15 EU Member States, as well as Switzerland and the US, involving a total achieved sample size of 11,832 and in the above 10 accession countries in 2003, involving a total sample size of 10,407. A representative survey of establishments – the Decision Maker Survey (DMS) - covered 7 EU Member States, including the five largest Member States (Germany, Spain, France, Italy and the UK) as well as Finland, expected to be an information society frontrunner, and Greece, expected to be less well advanced. This involved a total achieved sample size of 3,139 establishments. Annex 1 of this report presents details of the samples and other methodological aspects of the surveys. The questionnaires themselves can be found in on the SIBIS website: <http://www.sibis-eu.org/statistics/questionnaires.htm>.

The results of the benchmarking surveys have been presented in a series of reports on nine aspects of the Information Society in the EU member states and a series of country

² As the US is so huge and differences between states are quite likely, the ideal survey would compare the US states with the European countries. However, this was not possible within the scope of the SIBIS project.

reports on the ten accession countries covering seven aspects of the Information Society (authors in brackets):

Topic reports EU member states:	Country reports NAS:
Telecommunications and access (Technopolis)	Bulgaria (Institute of Economics at the Bulgarian Academy of Sciences)
Internet for research and development (University of Applied Sciences Solothurn)	Czech Republic (SC&C Ltd.)
Security and trust (RAND Europe)	Estonia (Estonian Institute of Economics at Tallinn Technical University)
Education (Danish Technological Institute)	Hungary (Budapest University of Economic Sciences and Public Administration)
Work, employment and skills (empirica)	Lithuania (Social Policy Unit (Sozialinnen Politicus Group))
Social inclusion (Work Research Centre)	Latvia (Computer Science Institute)
eCommerce (Databank Consulting)	Poland (ASM Market Research and Analysis Centre)
eGovernment (RAND Europe)	Romania (‘Dunarea de Jos’ University)
eHealth (Work Research Centre)	Slovenia (Faculty of Social Sciences, University of Ljubljana)
	Slovakia (Faculty of Management of the Comenius University Bratislava)
<p>Full reports can be found on the SIBIS website http://www.sibis-eu.org Full details about the project partners can be found in ANNEX2 (page 65)</p>	

This synthesis report draws on those topic and country reports, the published Highlights document and Pocketbook 2002/3 and the simultaneously developed Indicator Handbook, to present an integrated portrait of the Information Society in Europe, the accession countries, Switzerland and the US.

3 BASIC ACCESS AND USAGE

3.1 Internet readiness

Telecommunications infrastructure and access to Information and Communication Technologies (ICT³) are physical cornerstones of the information society and are both wide-ranging and 'horizontal' in nature⁴. In many ways it can be considered as the fundamental 'enabler' – it allows the other e-Europe domains to 'happen'. Within SIBIS telecommunications infrastructure has been interpreted very broadly to include all the networks (cable, mobile, Internet, as well as copper wire) over which all types of information (voice, data, sound, image) is carried. So, although the main focus is on telephony networks, computer networks, the Internet, cable (TV as well as telephony), and wireless forms of transmission are also included.

In Europe, the focus of the Information Society is changing from concentrating on basic issues such as access to infrastructure to more complex issues of e-readiness, both for businesses and for citizens. Basic infrastructure is much easier to measure than the many dimensions and factors associated with what is now needed to be part of the digital economy. The multifaceted nature of Internet availability, support, content availability, the right kinds of skills and the right attitude to technology has given rise to numerous new definitions of e-readiness.

The ICT infrastructure indicators presented within SIBIS focus on what has been – to date – among the most important e-Europe policy goals: to boost the development of, the extensiveness, and the take-up of broadband technologies, as well as ensuring the competitiveness of the broadband markets for both residential and business markets.

Broadband is probably the single most important enabling technological development of current time and it is, therefore, imperative to measure who has access to it, and what it is being used for. One of the principal features of broadband in Europe is its diversity with many broadband access methods, subscription cost and extensiveness of broadband infrastructures available across the different countries.

The definitions of citizen's readiness tend to be centred on issues of availability, awareness of use, access, content and skills for the individual. Business readiness is more complex. One much quoted definition from the Organisation for Economic Co-operation and Development (OECD) for e-commerce is 'the capability to engage in electronic transactions⁵'. This is just one part of e-Readiness; there are issues of transactions and the connectivity and relationships between employers and employees. There are also the transactions and connections across a supply chain, between suppliers and distributors and consumers. Readiness also covers the internal processes of an organisation including the relationships between individuals and organisations. All of these areas rely upon organisations having the appropriate access and understanding of ICTs in order to profit from ICTs in the business setting.

Within SIBIS ICT availability and access is considered from the user's viewpoint. Focusing on consumers, this highlights two aspects. The first aspect studies multi-context users of the Internet - or those who access the Internet from more than one location; for example,

³ In this report Information Communication Technology (ICT) and Information Technology (IT) are synonyms.

⁴ Although at the start of the project 'Telecommunications and Access' has been considered as a separate topic, it has become clear that this topic relates to all the other topics dealt with in SIBIS, e.g. it is the basic foundation for all the other topics.

⁵ Colecchia, A.; Pattinson, B.; Atrostic, B. K. (2000), Defining and Measuring Electronic Commerce. OECD discussion paper, Paris.

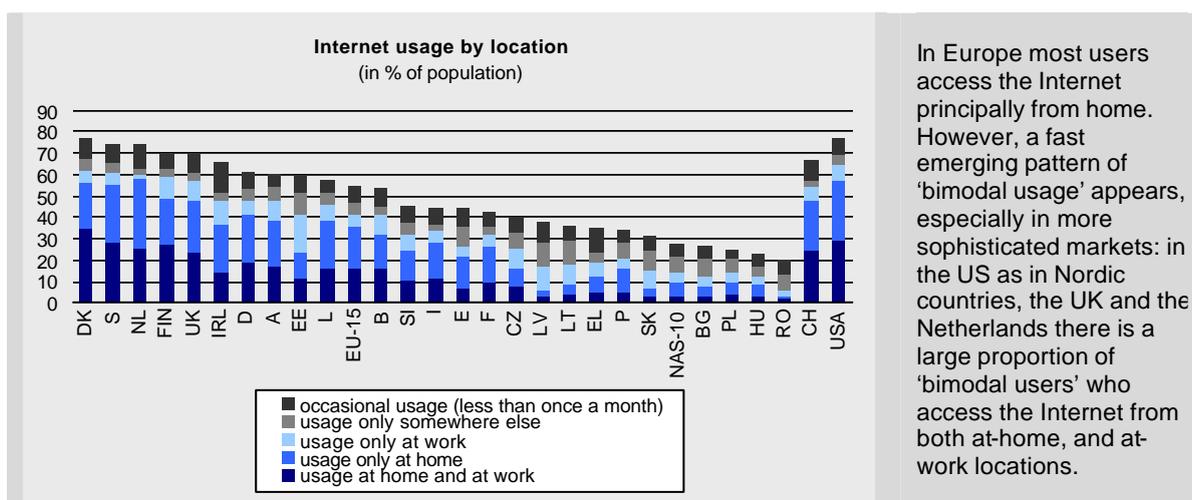
at home, at work, at a Public Internet Access Point (PIAP), etc. The second aspect is the availability and use of some of Internet access devices, not only the common access devices like dial up modems, but also the newer devices like platforms such as Digital TV, game consoles, or the mobile phone. These new devices are slowly becoming available in Europe and the US and have been developed in order to facilitate an ‘always on’ culture, both for information services and for buying and selling – a larger networking effect. This means that access to services through other devices will facilitate the improvement and the impact of the information society.

Looking at readiness regarding businesses instead of citizens, the main focus of readiness is on e-business or participation in aspects of e-commerce. This requires more than just access to the Internet and needs businesses to invest in software and other forms of hardware (e.g. routers’ readiness). Focus is on the co-presence of main ICT technologies within an organisation, as well as the level of accessibility which a company’s website has (i.e. the company has designed the corporate/ commerce website following formal accessibility guidelines so that everyone can potentially access it).

This section considers indicators regarding the level of ICT implementation - a necessary step towards doing e-commerce or e-procurement activities. Section 5.1 of the report is focused exclusively on more sophisticated ecommerce indicators. These will look at ‘intensity’ and ‘impact’ of e-business, rather than merely measurements of the readiness to do business.

Within Europe and the US the Internet is a well-known phenomenon and 54% of the EU population and around 77% of the US population has ever used the Internet, either as a regular user⁶ or an occasional user⁷. However, in the NAS 73% of the population has never used the Internet and 11 % of the population has never heard of the Internet.

Generally, countries with a high penetration of at-home and at-work Internet users are those countries with more experienced Internet population. Respondents in these countries reported lower level of access from ‘other locations’ than at-home/at-work, and less ‘occasional usage’. In less mature Internet countries many users do not have at-home connections, showing a higher proportion of people accessing the Internet from non-home locations. Likewise, occasional usage is more common (Figure 1).



In Europe most users access the Internet principally from home. However, a fast emerging pattern of ‘bimodal usage’ appears, especially in more sophisticated markets: in the US as in Nordic countries, the UK and the Netherlands there is a large proportion of ‘bimodal users’ who access the Internet from both at-home, and at-work locations.

Figure 1 – Internet usage by location
Base: all respondents, weighted

6 Respondent used the Internet in the last 4 weeks

7 Respondent used the Internet in the last 12 months

Dial up modems are still the most popular method of at-home connection. SIBIS classified this as narrowband (less than 64Kbit/s). ISDN has been classified as mid-band and the definition of broadband has followed EITO's approach looking at the type of technology used, rather than establishing a speed threshold. Hence satellite, cable modem, xDSL, leased line, fibre, and multiplex (T1/T3) have been included as broadband technologies.

Traditionally two factors influence Internet users to migrate to a faster connection. Based on experiences of the US and Nordic markets, it has been noted that once a majority of a total population has Internet access there is a migration of users with who have been using the Internet for a long time (long tenure). They seek a better on-line experience e.g. quicker downloads, always on connections (Figure 2).

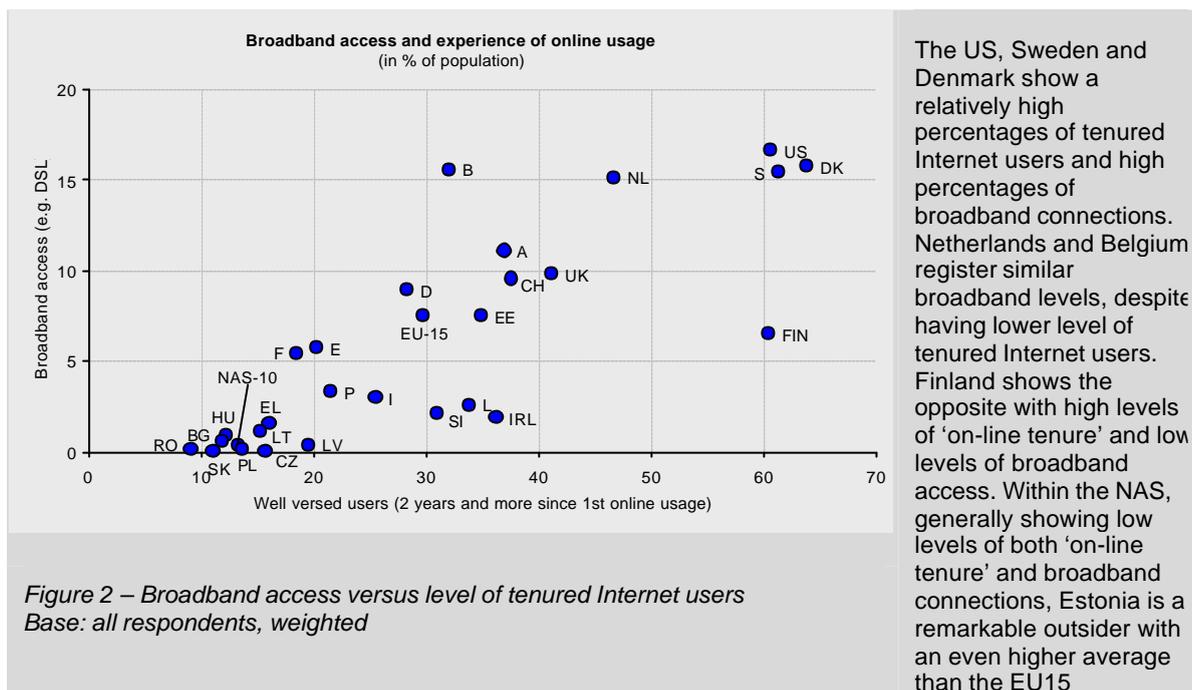
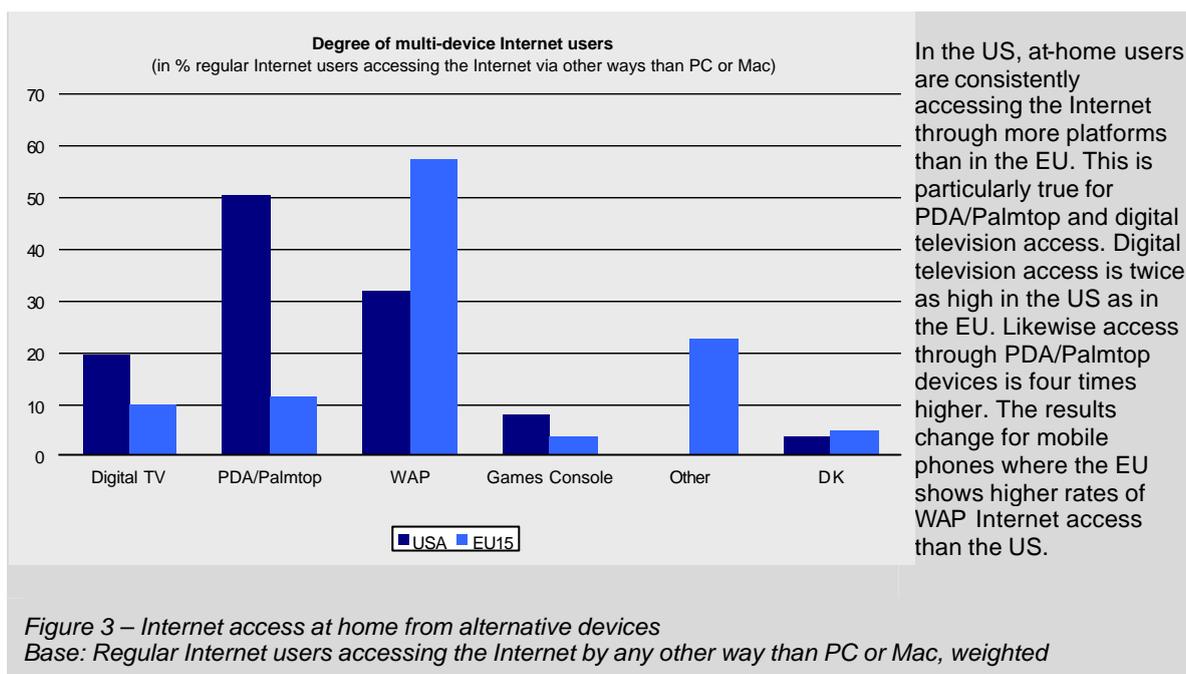


Figure 2 – Broadband access versus level of tenured Internet users
Base: all respondents, weighted

Within the e-Europe 2005 target, emphasis has been put on the potential that alternative platforms have, as a way of expanding the persuasiveness of the Information Society beyond the realms of PCs. For Europe and the US, SIBIS has looked at the degree to which different devices are being used for Internet connections. The data suggests that there are emergent patterns of bimodal usage (Figure 3)⁸.

⁸ The 'other' category seems to be quite high. There can be several reasons for this, including semantic confusion, for example not counting a 'laptop' as a PC



Mobile telephony is an important, exceptionally fast-growing sector. Although mobile penetration is currently quite high in most western countries, differences in usage patterns between countries occur, as do divergences in the use of data mobile services for communication: SIBIS results show a mobile phone penetration rate that is generally high across the EU15 countries (almost 70%), whereas in the US mobile intensity only reaches 56% and in the NAS10 only 34% (Figure 4).

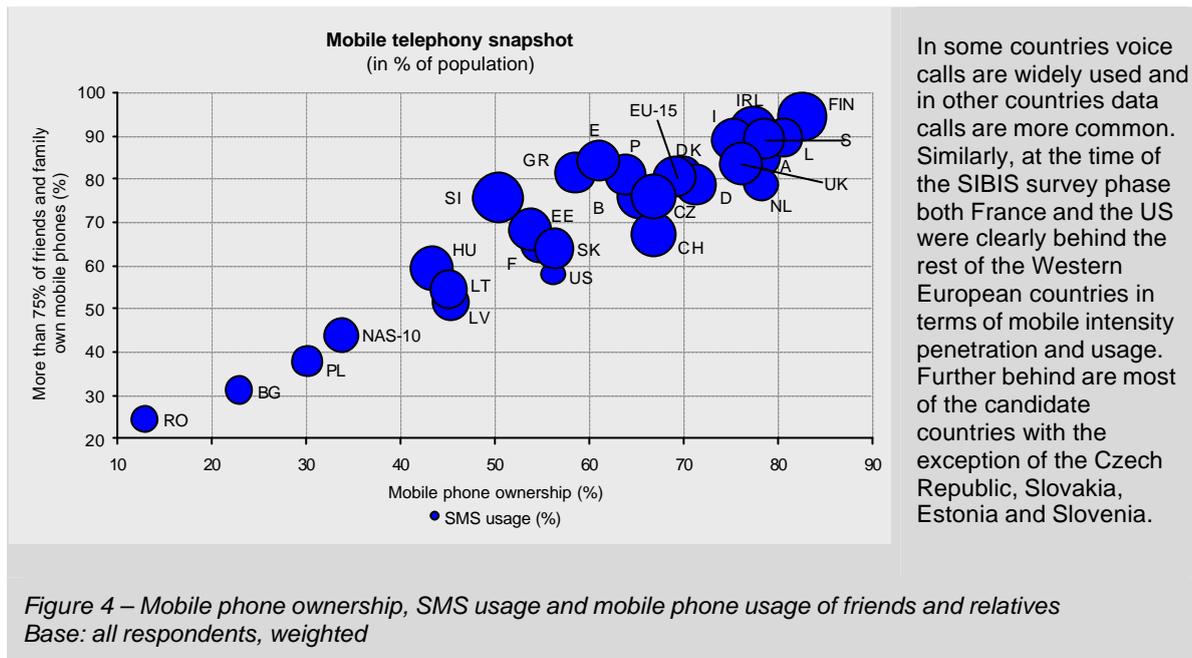
Furthermore, results have portrayed that SMSs⁹ are generally popular across mobile phone owners younger than 50 years old. This is especially true for mobile phone owners younger than 25, since the majority of them (80%) have used SMSs in the last four weeks.

The most popular use of SMS is for communication with people¹⁰. SMS is currently the most widely available communication service on a mobile phone apart from voice calls. This is an area of technological advancement where it will quickly become imperative to measure new emerging technological innovations and other types of services on offer, both via SMS and through other channels.

Although there is some tendency for countries with greater mobile penetration to have more usage of SMS by mobile phone owners there is enough divergence to suggest that other factors also play a role. Some countries, like Belgium and Switzerland have high levels of SMS usage and some countries, like the Netherlands, Sweden and Luxembourg have low levels of SMS usage. Although showing a more or less similar level of mobile phone ownership, French people are a lot more likely to be SMS users than their US counterparts.

⁹ Short Message Service. A service available on digital networks, typically enabling messages with up to 160 characters to be sent or received via the message centre of a network operator to a subscriber's mobile phone

¹⁰ Other usage options are for example payments for purchases, downloads, ringtones or receiving subscription services



Conclusions

Progress in the field of telecommunications infrastructure and access to ICT was being measured long before the advent of the Information Society and eEurope. It is only in recent years that measurements are starting to change from systems of basic counting of instances (of technology take-up) to ones which look at the usage and impact that benefit society as a whole.

The work undertaken at the beginning of the SIBIS project confirmed that although many basic quantitative indicators were already available across Europe, these were not always utilized in a consistent and coherent manner. Also, there was no specific pan-European methodological approach to the understanding of telecommunications infrastructure and access to ICT.

Before the start of the SIBIS project, the concentration on the development of indicators has been on tracking the 'penetration of technologies' and on 'access levels' (so-called 'readiness' indicators) and this indicated that there was an enormous scope for development of indicators measuring what this access really means and what patterns of use of new technologies exist. There was even less information available on the impact of the use of new technologies.

Within the context of the SIBIS project, some of these more 'extended' questions about citizens' use and impact of new technologies have been addressed. Also, all the indicators that have been developed as part of SIBIS in this area have been developed and tested in a consistent methodological way across all 15 EU member states, the 10 Accession countries and the US.

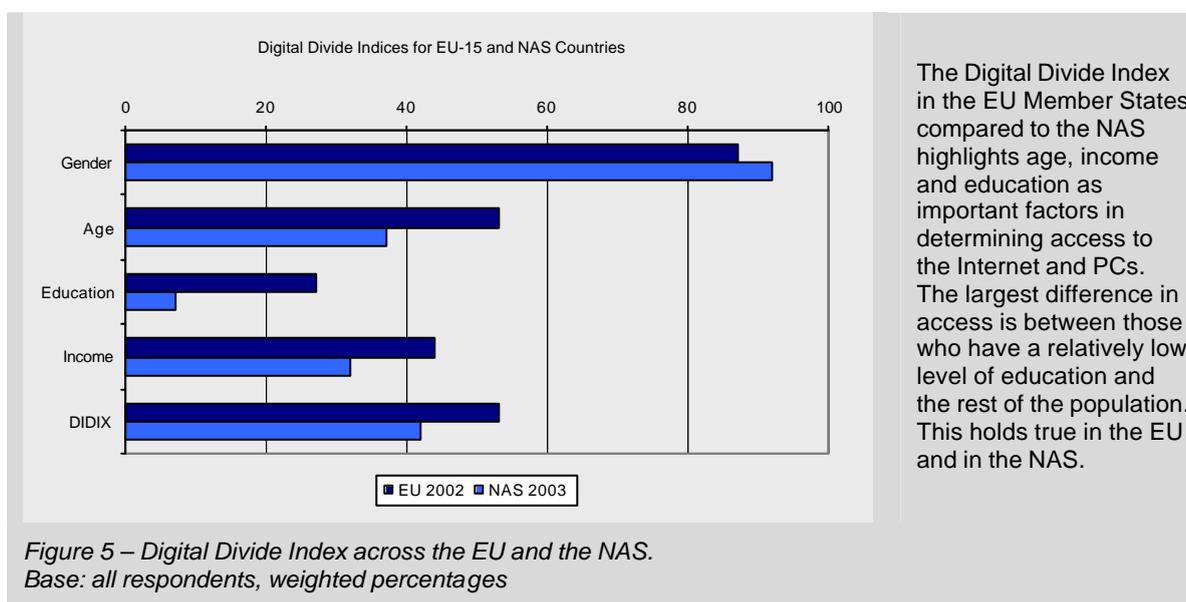
Many of these indicators relate to the priorities set by for eEurope2005 and can be used to inform policy decision making, to benchmark, and to monitor the effects on regulation. The SIBIS benchmarking results not only emphasize the value of the quantitative results obtained through the SIBIS project when doing comparisons across the EU15 member states, NAS10, Switzerland and the US, but also provide a qualitative insight into the usefulness, validity, and constraints of indicators on telecommunications and access to ICT.

In conclusion, the SIBIS survey, and subsequent desk research shows evidence of national differences and great disparities across Europe. There are some large differences in Internet usage, adoption rates, mobile penetration and mobile data and SMS usage, particularly between Northern European countries, Mediterranean countries and the Accession countries.

3.2 Digital divides

As the information society becomes more pervasive, debates on whether certain categories are (or risk to be) excluded gain strength. The rationale for researching the digital divide is traced back to the implicit assumption that the lack of access and potential for voluntary participation can confer disadvantages, or compound them where these are already present. It is also important to establish whether and to what extent the digital divide coincides with other ‘existing’ socio-economic divides and social inequalities.

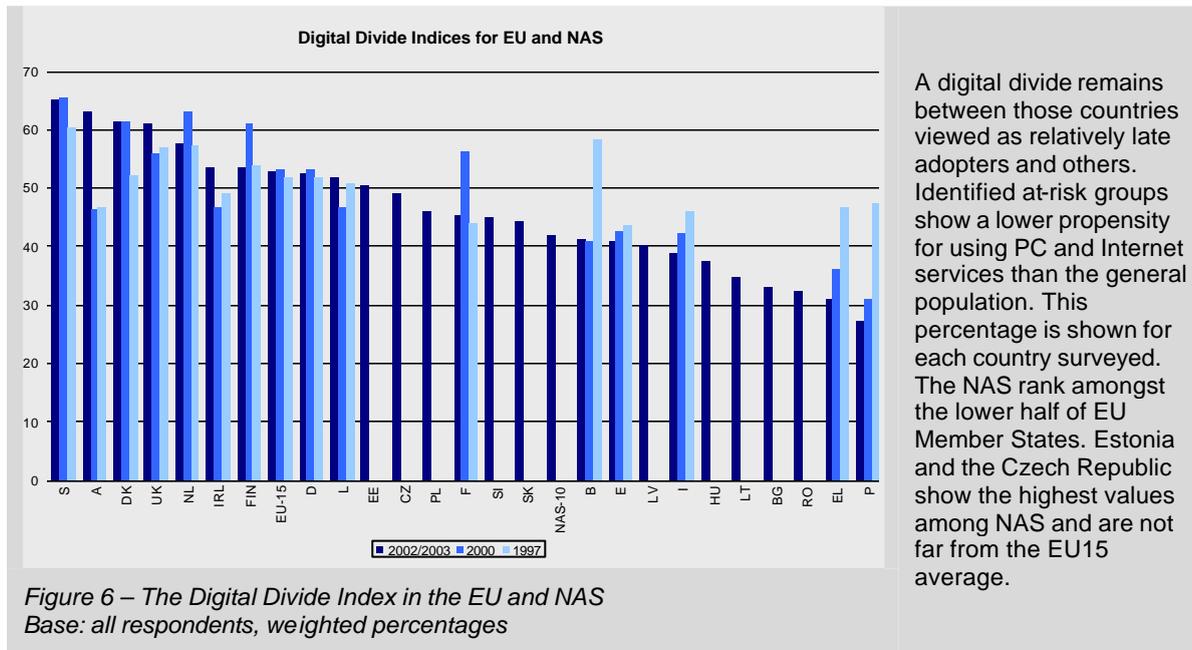
It is clear that a digital divide exists between citizens of the EU Member States and those of the accession countries. The extent of the digital divide in a given country can be estimated by looking at the PC and Internet participation of groups considered at risk of being excluded. At-risk groups may include elderly, those with a relatively low level of education, among others. The digital divide index (DIDIX, Figure 5) combines the divides by gender, age, education and income in relation to computer use, Internet use and Internet access at home. It measures the relative adoption of ICT by potentially deprived societal groups – relative as compared to the population as a whole. The lower the DIDIX value, the greater the gap between the risk group and the population average. If the ICT adoption rate of a risk group is equal to that of the population average then the DIDIX value would be 100.



The extent of the digital divide differs for each of the at risk groups, illustrated by the values of corresponding indices. The gender divide appears greater in the EU than in the Accession countries. Based on other risk factors, the extent of the digital divide is greater in the Accession countries than in the EU countries. The most apparent divide is in relation to education. Age leaving school turns out to be the major determinant, the most powerful predictor in multivariate analyses of ICT usage. ICT diffusion among people having left school under the age of 16 is only about one fourth of that in the whole population. And

even when allowing for the fact that older people are on average less well educated than younger people, education appears to exert greater effects than age.

Time series data for DIDIX based on SIBIS and earlier Eurobarometer surveys show that the overall magnitude of the digital divide in Europe has remained more or less constant at a DIDIX value of about 50 since 1997 (Figure 6). This means that ICT uptake amongst the combined at risk groups has remained only half as advanced as it is in the whole population. However, there are indications of changes in some of the specific divides.

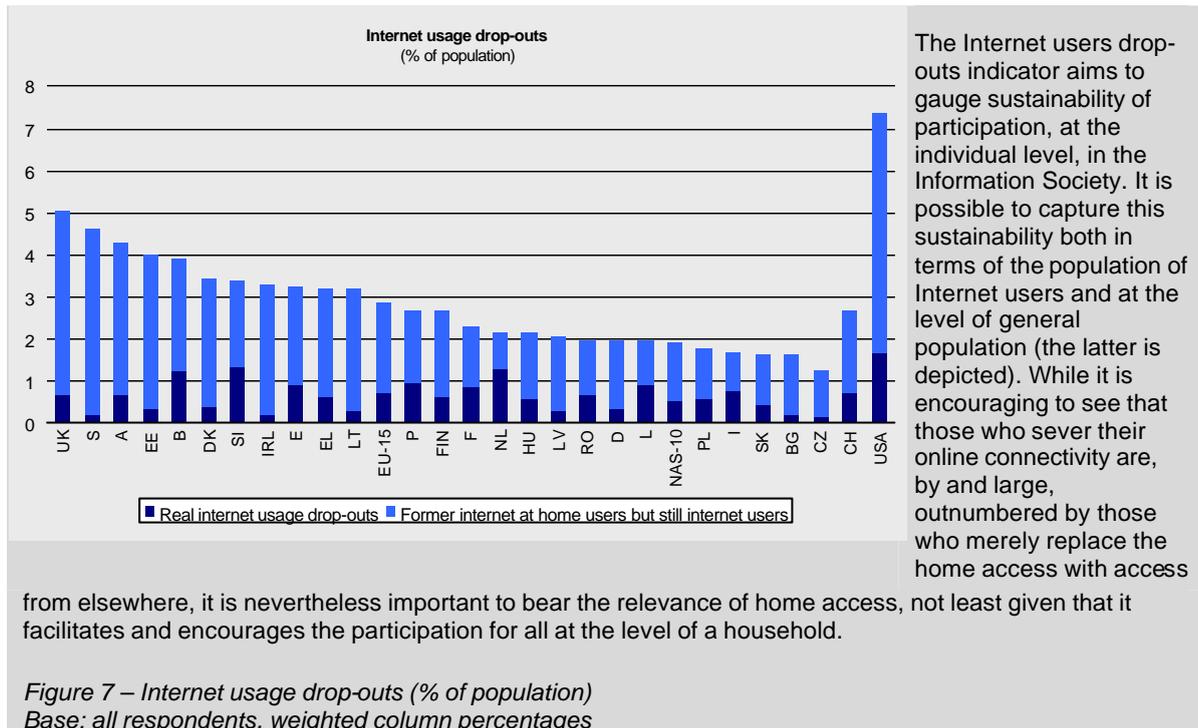


The continued persistence of relatively large digital divides in countries usually considered ‘late adaptors’ is apparent. On the other hand, the fact that some marked improvements, over a relatively short period of time, are possible has been demonstrated by the case of Austria and Ireland. Countries with an observable aggravation of divides are those ranking lower with regard to ICT uptake. The accession countries do not lag behind very much but can be found amongst the lower half of EU Member States. Estonia and the Czech Republic show highest values and are not far from the EU15 average. At the national level progress in overcoming the digital divide can, and has been, made (e.g. most notably Austria, but also Germany and Ireland) this divide is set to remain one of the most relevant policy challenges at national level. Accession Countries are seriously lagging behind in this regard. On the other hand, low values even in apparently advanced information society countries (e.g. the Netherlands, Finland and Denmark) point towards societal challenges but the findings (i.e. index values) are partly attributable to the smaller size of the low education groups in these countries¹¹.

The fraction of Internet users who renounce Internet access is a crucial indicator of the direction today’s information society is taking. Clearly, the more people decide not to participate in the information, the less inclusive it becomes. SIBIS measures Internet usage drop-outs under a double perspective: real drop-outs are individuals forgoing Internet at home access and neither using the Internet in last four weeks nor in the last year from an alternative access point, while all other drop-outs are former Internet-at-home users who decided to have access elsewhere. All over Europe and the US drop-outs are the exception rather than the rule (less than 10%), indicating that the current levels of

¹¹ More details about this analysis can be found in reference [6]

Internet usage are rather sustainable, although there is a clear prevalence of former at-home users as opposed to real drop-outs (Figure 7).



Conclusions

All must have an opportunity to participate in the information society. For this reason, it is important to identify whether an information divide exists among the EU and NAS and what causes for this divide might be. A significant divide exists between NAS and EU Member States. Countries with higher levels of Internet penetration show less pronounced digital divides. Some Accession Countries are closer to EU countries, however, and this may be due to the relatively long time digital service have been available there. An important concern is the extent to which the digital divide derives from relatively lower levels of education in some countries. Data on educational attainment point to the greater divide that exists between countries where a higher percentage of the population has had to leave school early.

3.3 Information security

Information and network security are increasingly recognised as crucial elements for ensuring wide participation in the Information Society. Citizens, businesses, and governments alike can enjoy significant benefits as a result of a secure on-line environment. As innovative business models are being developed to exploit the positive functionalities provided by these new global communication and information media, concerns about the security and privacy of information infrastructures and services may inhibit their full take-up. These concerns may hamper users' trust towards these new information and communication instruments. Also the eEurope 2005 Action Plan stresses the importance of on-line security and trust for the Information Society's development.

While the importance of a secure information infrastructure was not disputed, before SIBIS data on such issues was scarce. Some attempts to measure issues of information security (such as occurrence of breaches, their seriousness etc.) had been made, but were not

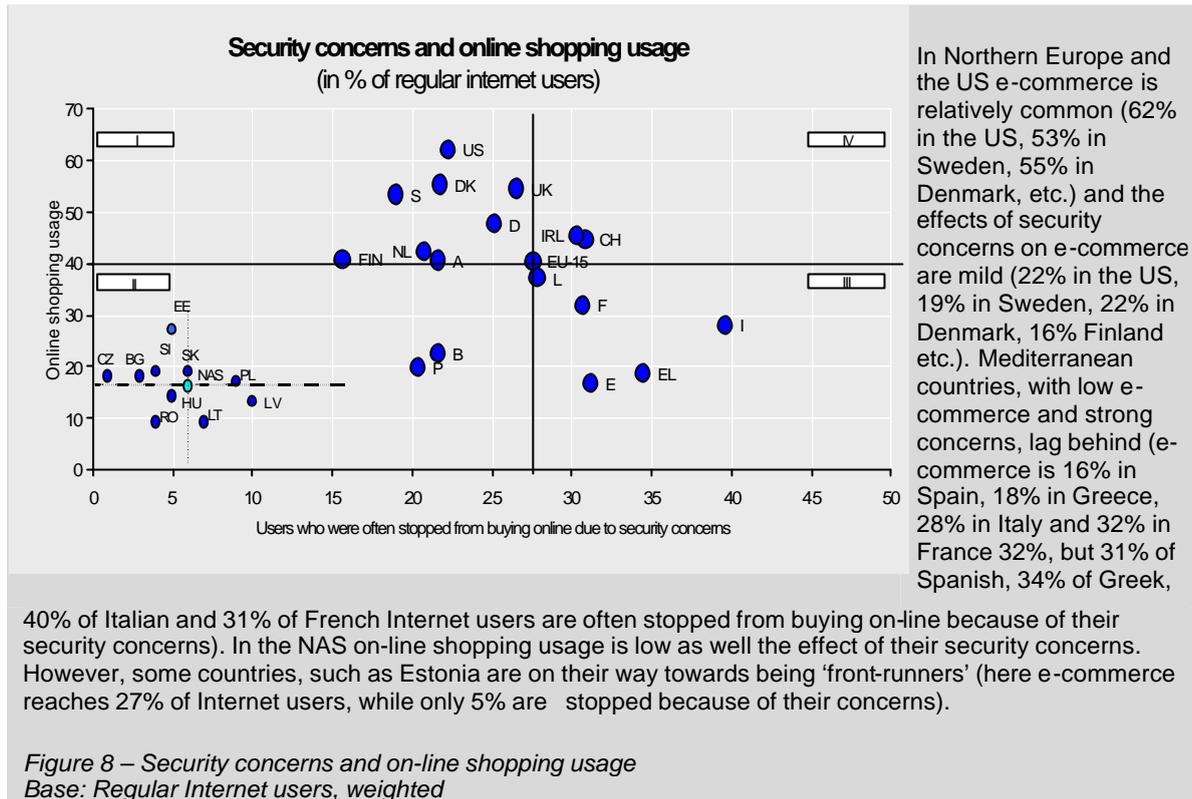
focused on the EU and the NAS, and were typically conducted on-line, thus excluding persons with limited Internet access. SIBIS represents a first attempt in this direction.

Citizens are key stakeholders of the European IS and the subjects of e-inclusion. Their perceptions of security and the protection of their privacy on-line have significant impacts on the development of e-commerce. If individuals are suspicious, and, therefore, reluctant to send the identifying or financial information required for completing transactions over the Internet, the fraction of commercial and societal activities that can benefit from transition to the electronic medium will be significantly restricted. Businesses are also crucial stakeholders. In part businesses have similar concerns and problems as consumers with regard to security. There is, additionally, the issue of guaranteeing privacy on one hand, and wanting to benefit from micro data on customers (such as purchasing behaviours) on the other hand. Whereas collecting such data is attractive in order to target customers and predict market behaviour more accurately, it may backfire, as potential consumers may want to opt out of this process and in certain cases it even violates EU Directives on privacy.

From what has been said above, it is clear that enhancements in on-line security are crucial for fostering on-line trust, which in turn is a necessary support for companies' efforts to increase their on-line transaction activities. Hence, the measurements of Business-to-Consumer (B2C) intensity and of security are correlated. Moreover, information security management as well as technical solutions are necessary conditions for the establishment of a successful and fully compliant on-line commercial activity. It is clear then, that information security is a pivotal element for prompting the delivery of services and goods on-line, as also shown by indicators measuring self-assessed impacts of on-line sales and purchases. Finally, information security is also essential to support new forms of interactions between employers and employees through processes and applications such as telework or on-line training facilities.

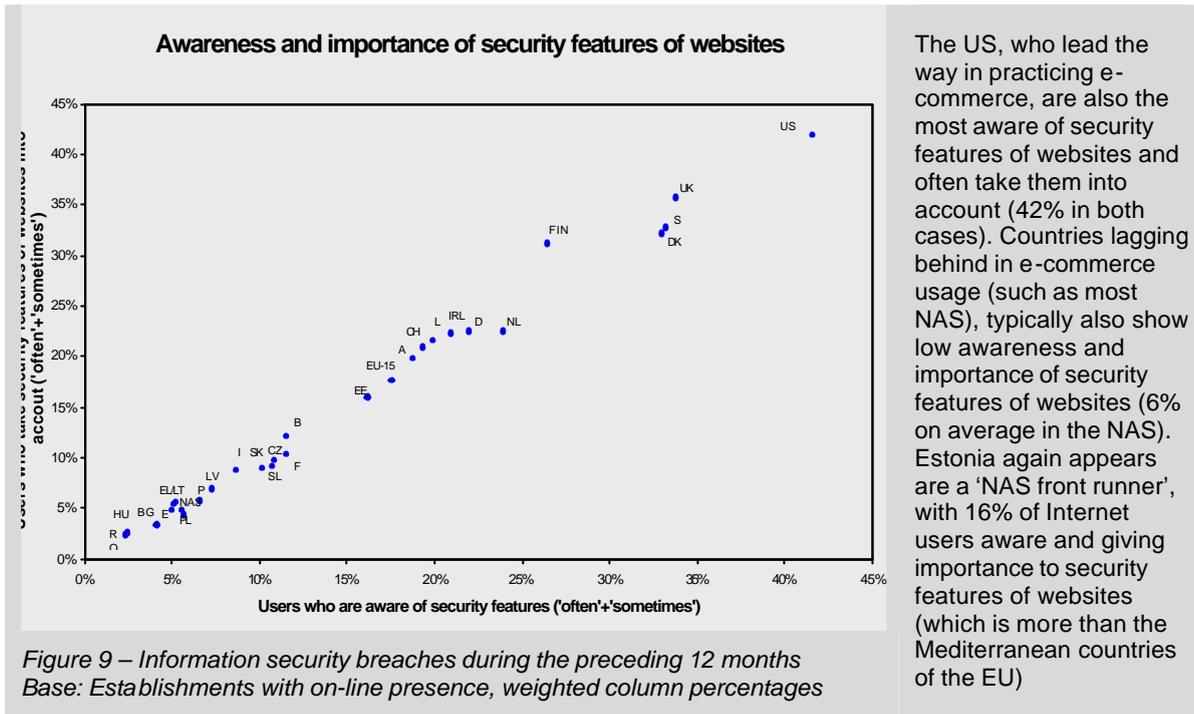
Figure 8 below, drawn from SIBIS GPS data, shows that security concerns do indeed have a strong impact on on-line shopping behaviour in Europe as well as in the US. In the EU, for instance, almost 30% of Internet users stated that they would often be stopped from buying on-line because of their concerns. However, it is apparent that divergences exist among countries. Whereas some countries, which could be defined as 'front-runners', are limitedly affected by their security concerns and have accepted e-commerce as a relatively common practice (Quadrant I), others, the 'laggards', show lower than average e-commerce usage and strong impact of security concerns (Quadrant III).

Benchmarking all countries against the EU average, shows that northern Europe together with the US are the 'front-runners', while Mediterranean countries are still lagging behind. All NAS fall into quadrant II, where both e-commerce and the effects of security concerns on e-commerce are limited, which could be related to the fact that the share of regular Internet users (and thus e-buyers) is lower here than in the EU. If we benchmark individual NAS against the NAS rather than against the EU average, it appears that, in this case too, the split between 'front-runners' and 'laggards' is marked: in some countries, such as Estonia, on-line shopping usage is becoming comparable to what is found in some of the EU Member States; others still have a long way to go (Romania, Latvia, Lithuania).

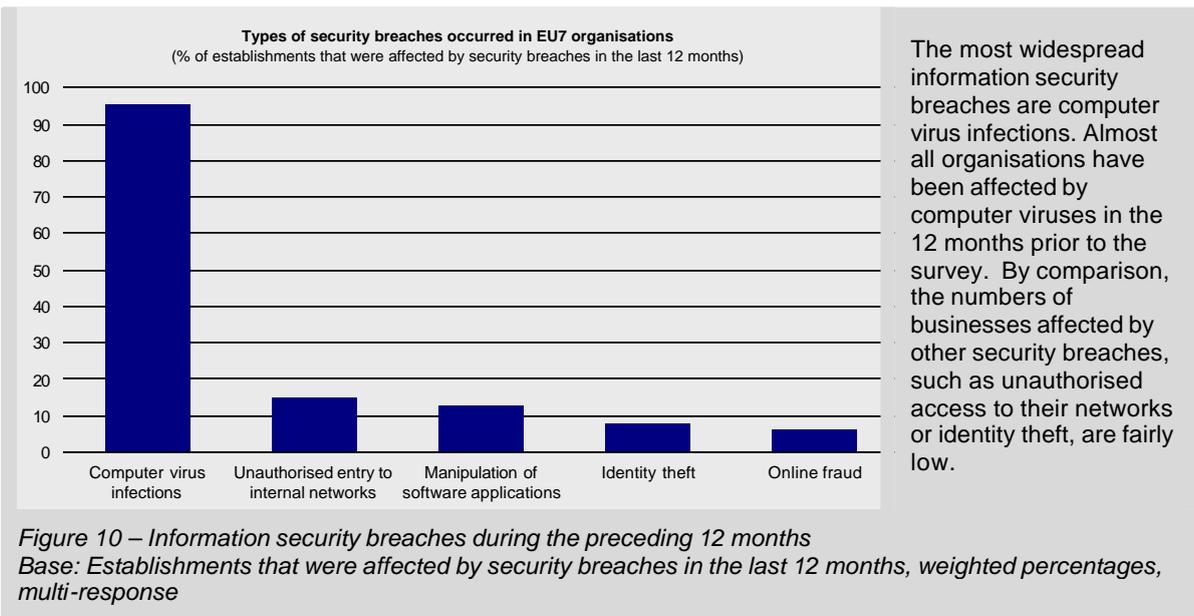


From what has been said above, it is clear that, in spite of significant differences, people's concerns are potentially can discouraging discourage for who wishes to buy on-line Yet, security features of websites, such as the deployment of anti-virus protection, might be a way of redressing these concerns. Hence, it is crucial to assess whether or not citizens know about the existence of such features and to what extent they take them into account while doing e-commerce. Most e-buyers are aware of security features of websites and, moreover, keep them into account when deciding whether or not to shop on-line. However, figures are considerably lower with regards to the larger population, suggesting that at this time electronic commerce represents no more than a niche for most national economies.

Figure 9 below shows that the fraction of individuals who are aware of and take into consideration these features is highest in those countries that lead the way in e-commerce (the US, the UK and Northern Europe) and lowest where the practice of e-commerce still lags behind (mainly the Mediterranean area and the NAS- with the exception of Estonia).



Business owners share with consumers worries about on-line security. Although most EU businesses do adopt some form of information security policy, between 13% (Greece) and 43% (Finland) of organisations have suffered at least some sort of security breaches in the year previous to the SIBIS survey. A more detailed examination of security breaches reveals that computer virus infections are, in fact, more common. The number of other security breaches reported, such as unauthorised access to their networks or identity theft was fairly low. However, this does not say something about the financial effects for the business itself, these could have been massive. Figure 10 shows that, on average among the seven surveyed countries, over 90% of establishments that had been attacked, had in fact suffered viruses. There are no significant differences per country.



Conclusions

The importance of network security is, today, undisputed. A certain level of security is necessary to encourage businesses and citizens to go on-line and foster e-commerce, e-government and, generally, a truly inclusive information society. Hence, citizens and businesses share concerns about security and trust of on-line services. As seen in the case of citizens, this concern can influence the on-line shopping behaviour of citizens. Once they are on-line, they gain experience and knowledge, thereby acquiring more awareness and understanding of security issues. Compared to their counterparts in the EU countries, respondents from Accession Countries tend to be less concerned about on-line security and less likely to engage in on-line shopping, likely because on-line services are at an earlier stage of development than in the EU. Looking at select EU countries the reported frequency of on-line security breaches varies significantly. In countries with fewer security breaches, this appears to result from the lower frequency of on-line usage. The most likely type of breach is infection by a computer virus.

4 FACTORS DETERMINING ACCESS AND USAGE

4.1 Perceptions of possible barriers

As outlined above, widespread inclusion in the IS is possible only under conditions of information and network security, which are necessary to foster trust in electronic commerce and e-government services. Citizens are key stakeholders of the IS; as receivers of on-line services and tools, assessing their perceptions of on-line security and access barriers is essential to ensure that the IS does not exclude any given social group. For example, it is acknowledged that a lack of trust and confidence in services provided electronically is a significant obstacle to the development of e-government; moreover, as seen in section 3.3, electronic commerce can be inhibited by security and privacy concerns. In these cases, it is not only administrations and businesses that suffer, but also the individual, who is in fact excluded from the new possibilities enabled by the electronic means. Hence, insufficient protection (or a perception of insufficient protection) of personal privacy and security in these systems is a potentially serious impediment in the development of the information society and, therefore, is important from the policy perspective.

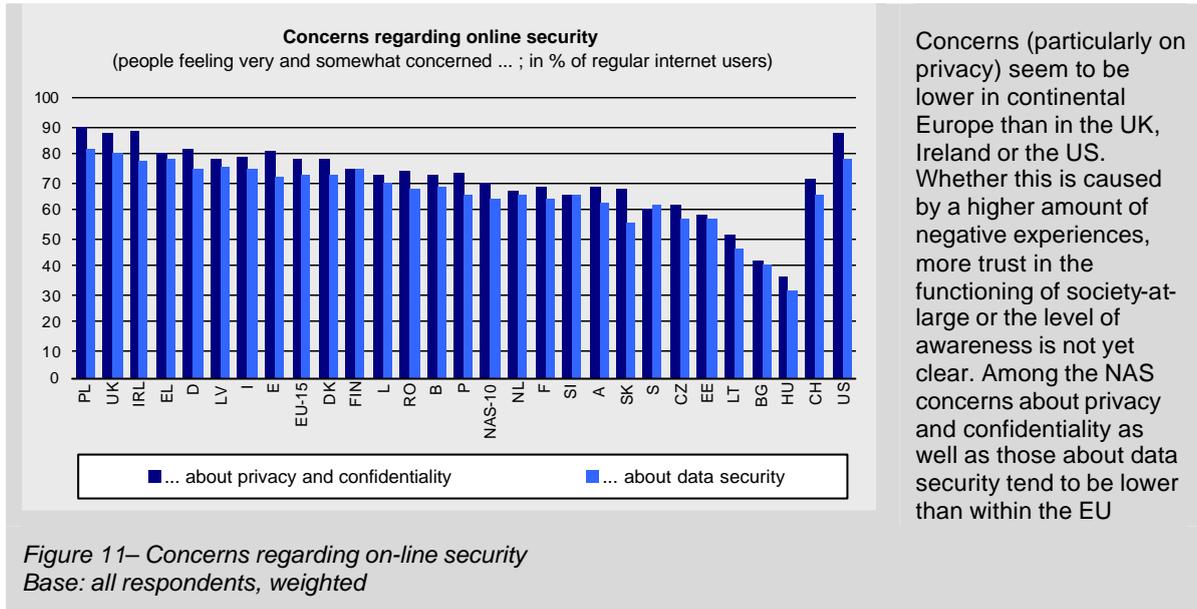
Individuals might be prevented from participating in the IS for a number of reasons. SIBIS developed indicators assessing to what extent citizens in Europe and the US feel concerned about on-line security, privacy and confidentiality, and what elements are felt as being particularly impeding to an effective Internet access.

Aside from the effects on e-commerce (see section 3.3 above), concerns regarding data security and privacy on-line can also be symptomatic of people's trust towards on-line environments. SIBIS argued that the specific issue of 'trust' was not suitable for benchmarking. In other words, it did not appear possible to measure 'trust' as such as this is a subjective perception on the part of the user. Hence, trust is naturally multidimensional, which in turn prevents us from quantifying it. Although it is legitimate to assume that information security issues and individual perceptions of access are correlated to the 'trust' individuals feel towards on-line environments, this assumption does not necessarily entail a cause-effect relationship. As a consequence, SIBIS has neglected any attempt to measure 'trust'. Nevertheless, measuring individual perceptions of security and privacy over the net is significant because indirectly connected to the development of trust in the on-line world. Clearly, concerns about privacy and data security and perceptions of the security and accessibility of a website have implications on citizens' usage of the site.

Access barriers are elements which can impede individuals' participation in the IS. However, measuring the relevance and effect of these barriers is extremely hard, because they are primarily perceived as such by the individual alone. Indicators on 'access barriers' presented here focus on the perceptions about website accessibility of non-regular Internet users and non-users. Some might consider their lack of skills as the chief impediment to access the net; others will perceive access costs as a burden too high to overcome; others still, might deem the low usability of Websites or the simple fact that 'the Internet is not for me' as a reason for remaining excluded.

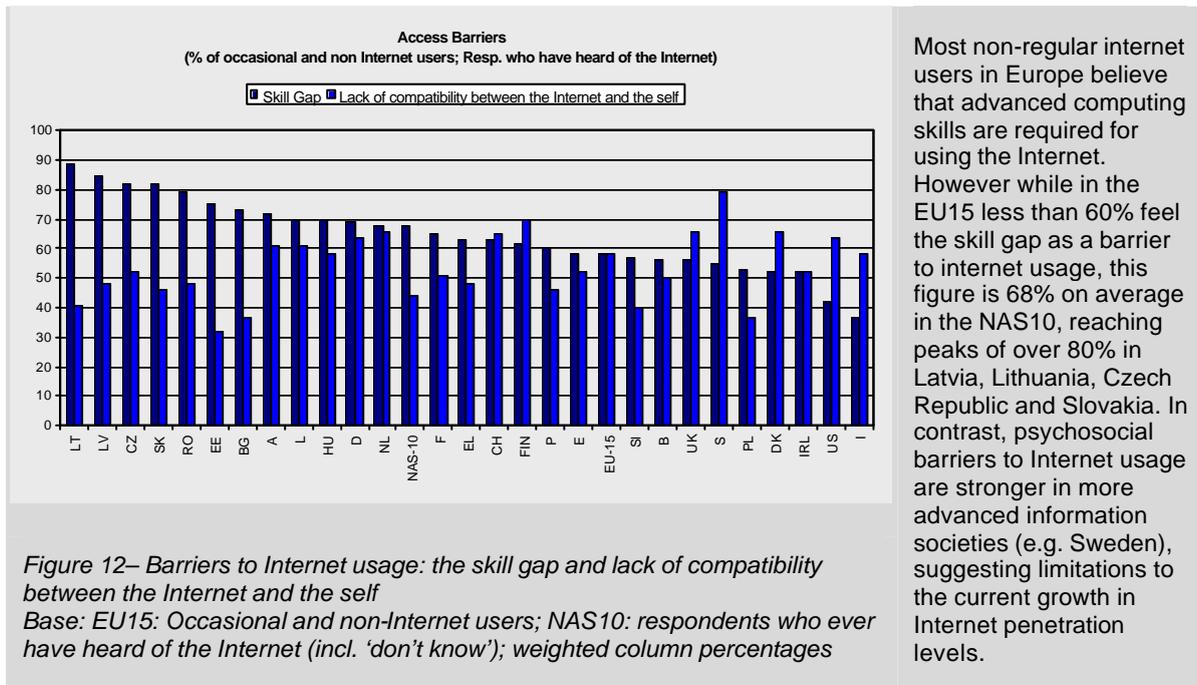
Figure 11 below shows that citizens are strongly concerned both about privacy/confidentiality and data security, with a slightly higher concern about privacy. Generally, among the NAS, concerns about privacy and confidentiality as well as those about data security tend to be lower than within the EU. However, looking at Member States of the EU and at Accession Countries individually, both groups exhibit a great deal of variation. For example, Poland and Latvia are countries where both concerns register

higher than in the EU. Similarly, In the Netherlands, France, Austria and Sweden concerns about privacy and confidentiality are lower than in the Accession Countries as a whole.



Concerns (particularly on privacy) seem to be lower in continental Europe than in the UK, Ireland or the US. Whether this is caused by a higher amount of negative experiences, more trust in the functioning of society-at-large or the level of awareness is not yet clear. Amongst the NAS concerns about privacy and confidentiality as well as those about data security tend to be lower than within the EU

Although perceived and actual access barriers are contingent on individual circumstances, some barriers might be considered as relatively more important, while others might be more easily alleviated. Amongst a variety of possible self-perceived access barriers tested in SIBIS, the 'skill gap'¹² seems the most relevant in the European context to achieving a wider participation in the IS, while the lack of compatibility between the Internet and the self¹³ is a critical psychosocial barrier to going on-line, Figure 12 shows this information and considers respondents 'agreeing completely' and 'agreeing somewhat' to the given statement.



Most non-regular internet users in Europe believe that advanced computing skills are required for using the Internet. However while in the EU15 less than 60% feel the skill gap as a barrier to internet usage, this figure is 68% on average in the NAS10, reaching peaks of over 80% in Latvia, Lithuania, Czech Republic and Slovakia. In contrast, psychosocial barriers to Internet usage are stronger in more advanced information societies (e.g. Sweden), suggesting limitations to the current growth in Internet penetration levels.

¹² e.g. people saying that "using the Internet requires advanced computer skills"

¹³ e.g. people saying that "Internet is not something for them"

Conclusions

Establishing trust in the security of on-line systems is a necessary component to the development of the information society. Among the EU Member States and the NAS, citizens express varying levels of concern regarding privacy and confidentiality as well as about data security online. Although concern appears to be higher in the EU countries than in the NAS, significant overlap exists in the level of concern expressed in the two groups of countries. Alongside with security and privacy concerns, many individuals feel that barriers to using the Internet exist and can be hard to overcome. SIBIS data suggests that the perception of the Internet as necessarily requiring advanced computing skills is stronger in the NAS10 than in the EU15, while psychosocial barriers (i.e. the sensed lack of compatibility between the Internet and the self) is stronger in the EU15, where internet penetration is higher.

4.2 Digital literacy, learning and training

The concept of the Information Society and the pace with which it has been changing over the years have led researchers, policy-makers and practitioners to believe that new skills are required. The Information Communication Technologies (ICT¹⁴) industry is growing by the day with perceptible consequences on economies throughout the world. Moreover, ICT-related skills are key to people's effective use of technologies, which in turn is of interest to businesses wishing to successfully test their products. Last, the application of ICTs has also affected the demand for skills that are not related to ICTs themselves. These indirect effects result, in particular, from the shortening of product life cycles that is being enabled by technology. The intensity of research and development associated with creating new products has steadily increased. Competitive forces are bound to lead to a further acceleration of the process of translating innovation into marketable products and processes. As new products and processes are associated with new skill requirements, skill life cycles, too, have shortened and will decrease further in the future.

Because they are so important to economic and social well being, Eurostat, the Luxembourg-based statistical office of the EU, has been active in measuring skills' developments through an indicator on life-long learning derived from the Community Labour Force Survey (LFS). However, a chief problem here is given by diverging question wording in different countries. For instance, while the United Kingdom's LFS instrument takes care to include all types of training activities, the German questionnaire focuses exclusively on 'Fortbildungsmaßnahmen' (further education measures), a term which is generally reserved for formal training courses provided by the state for the unemployed, and which lead to a certificate if finished successfully. With the purpose of overcoming situations of this sort and to provide a clear picture of the current situation in the field, SIBIS developed and piloted a number of indicators on skills and digital literacy in the information society, some of which will be presented in the following pages. While SIBIS identified *acquisition of skills*, *provision of skills* and *skill requirements* as the three areas of interest, this sections focuses primarily on the first two¹⁵.

The *acquisition of skills* can take place through work-related training, including training activities in view of a future occupation, self-directed learning, and e-Learning (i.e. the use of electronic learning materials, whether on-line or off-line). SIBIS data suggests that, although the participation of the European labour force in work-related training and self-directed learning is not uncommon, significant differences still persist, nation-wise. The US,

14 In this report Information Communication Technology (ICT) and Information Technology (IT) are synonyms.

15 SIBIS research on the third area ('skill requirements') addresses future needs as opposed to current SIBIS results. SIBIS suggests that the main work to be done in this area is harmonisation of existing concepts and terminologies which are being used in national studies on the issue, which would prepare for the required pan-European survey on IT skill requirements. Such a survey is needed to support EU policy-makers in their search for the right strategy on IT skills provision.

the Nordic countries and the Netherlands are the only countries where 30% or more of the labour force is involved in work-related training provided either by their company or by some other organisation. Quite the reverse, participation in work-related training in the Mediterranean states and Portugal, does not exceed 20% of the labour force, while the Accession Countries generally lag even further behind, with some countries facing a mere 4-5% of participation (Romania and Bulgaria). In a number of cases, however, self-directed learning is far more common than formal training courses. In Germany more than twice as many people engage themselves in this form of learning as opposed to work-related training (52% vs. 25%); Romania, which appears as the ultimate laggard in work-related training, has a higher share of self-directed learners than Greece or France (Romania: 16%; Greece: 12%; France: 13%); in Austria, where 25% of the labour force participates in training provided by third parties, 48% engages in self-directed learning. Generally, where work-related training is already common (Nordic countries, US etc.), it does not distance so much from self-directed learning.

In general, the participation in life-long learning¹⁶ over Europe is not insignificant. E-Learning, however, is not as widespread, although, as can be expected, it is directly correlated to life-long learning. E-Learning technologies comprise off-line applications such as learning programmes on CD-ROMs as well as on-line applications, usually transferred via the Internet or company/university-internal computer networks. About 15% of the EU labour force is making use of eLearning for work-related training, two third of which already use on-line applications.

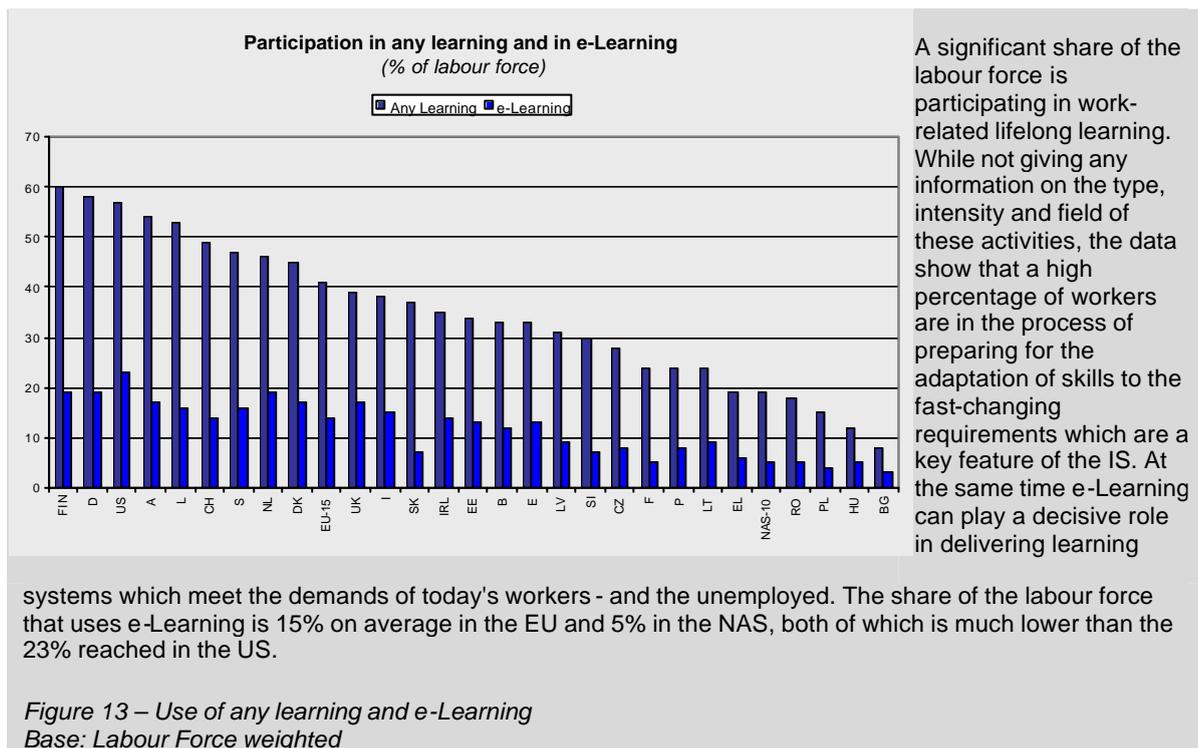


Figure 13 above presents the spread of life-long learning and e-Learning in Europe and the US. As is apparent, certain countries lead the way (US, the Nordic countries and the Netherlands), while others lag behind (most NAS). Moreover, that part of the labour force that participated in life-long learning and had access to a computer during the four weeks previous to the survey was addressed on its participation to e-Learning activities. Clearly, where self-directed learning and formal work-related training are more pervasive, this is

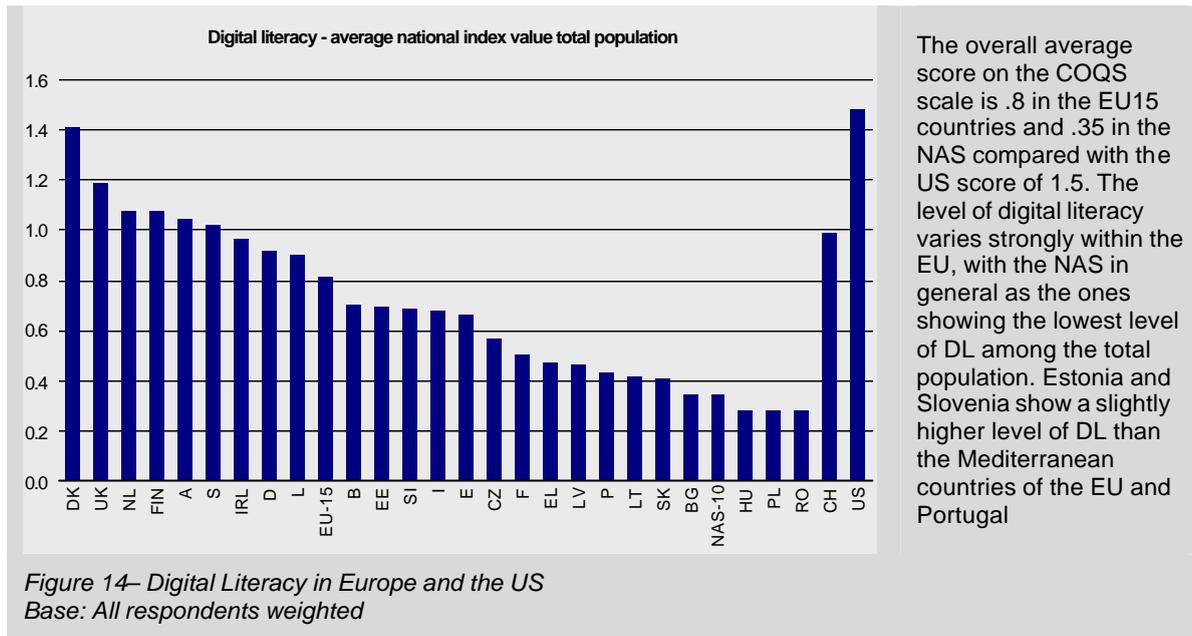
¹⁶ Namely: self-directed learning and training provided by third parties such as employers, unions and public employment services.

true for e-Learning too. However in certain countries the gap between work-related life-long learning and e-Learning is greater than in others. For example, while revealing a fairly extensive participation of its labour force in life-long learning (which surpasses almost half of the current EU states, including France and Belgium), the use of e-Learning in Slovakia is limited, suggesting that, in spite of the labour force's willingness to learn continuously and the provision of formal training by employers, unions etc., the nation's electronic capabilities to prop these efforts are still inadequate.

The *provision of digital skills* on the labour market is generally being referred to as Digital Literacy (DL), although in a broader sense DL covers also 'soft' competencies which are not directly connected to ICTs, but rather brought to the fore by the new technical possibilities of ICTs and by the general development of the IS. SIBIS measured Europeans' and Americans' self-assessed¹⁷ DL through four indicators relating to four types of skills in using the Internet. These include communicating digitally, obtaining and installing digital tools, questioning the source of information from the Internet regarding its reliability and searching for the required information using search engines. The indicators are seen as different skills, which are all parts of digital literacy. They are all related to use of the Internet, but differ in character. Searching the Internet and sending e-mails are relatively uncomplicated activities when using programs with high user friendliness. Downloading and installing programs is more complicated and demands a better understanding of how the software is structured. This interpretation is backed up by the General Population Survey (GPS). 90% of persons being very confident in obtaining and installing software are very confident in communication. Only 40% of the very confident in communication are confident in obtaining and installing software. This indicates a growing complexity. They are not sub-groups of each other though. Some persons are very confident in obtaining software, but fairly confident or not confident in communicating via the Internet. The 'COQS'¹⁸ index (Figure 14) combines these items into a single scale with a range from 0 to 3, with '0' representing the lowest possible digital literacy score and '3' representing the highest.

¹⁷ Assessing skills directly would mean to carry out tests such as they are being used in the International Adult Literacy Survey or the students' tests (such as the famous PISA study) both managed by the OECD. For timely data on fast-moving developments such as digital literacy, this approach is not feasible.

¹⁸ Communicating, Obtaining, Questioning, Searching



Conclusions

There is widespread agreement that the introduction of ICTs as workplace technologies and into all types of everyday applications requires users to apply a new set of basic skills generally referred to as ‘digital skills’. Hence, to be aware of the IS’ developments, it is crucial to know how these skills are being acquired and to what extent they are already in place.

SIBIS took up the challenge of measuring European and American trends in learning and training, and in DL. The outcomes show that in some countries (US, Nordic countries and the Netherlands) life-long learning and e-Learning are far more common than elsewhere (NAS, the Mediterranean area and Portugal). This finding is corroborated by the fact that the DL index (COQS) shows a similar country ranking. In other words, where life-long learning is common DL (measured through eh COQS index) is higher. Hence, it is reasonable to say that investing in life-long learning and e-Learning is not in vain.

5 ON-LINE APPLICATIONS

5.1 e-commerce

e-Commerce is a complex phenomenon whose specific definition can vary considerably. The definition endorsed by OECD in April 2000 is now widely used by researchers, national statistical offices and supranational statistical institutes like Eurostat. This definition focuses on the implementation of electronic transactions, either on Internet networks (narrow definition) or over any type of computer-mediated network (broad definition). The method by which the order is placed or received, not the payment or the channel of delivery, determines whether or not the transaction is an Internet transaction (conducted over the Internet) or an electronic transaction (conducted over computer-mediated networks). This definition implies that the simple process of gathering information on-line does not constitute electronic commerce: in order for electronic transactions to take place, it is necessary that at least the ordering step is carried out.

SIBIS analysis focused on the two main domains of e-commerce which are defined as follows¹⁹:

- Business-to-consumer electronic commerce (B2C) corresponds to 'electronic retailing', i.e. any electronic trading transaction where the purchaser is the end user of the products and services procured.
- Business-to-business electronic commerce (B2B) refers to the implementation of electronic transactions between firms. The term B2B is however also used very often to refer to on-line interactions between firms in a broader sense (e-business) including the management of various business processes (from planning and marketing to inventory control to ordering).

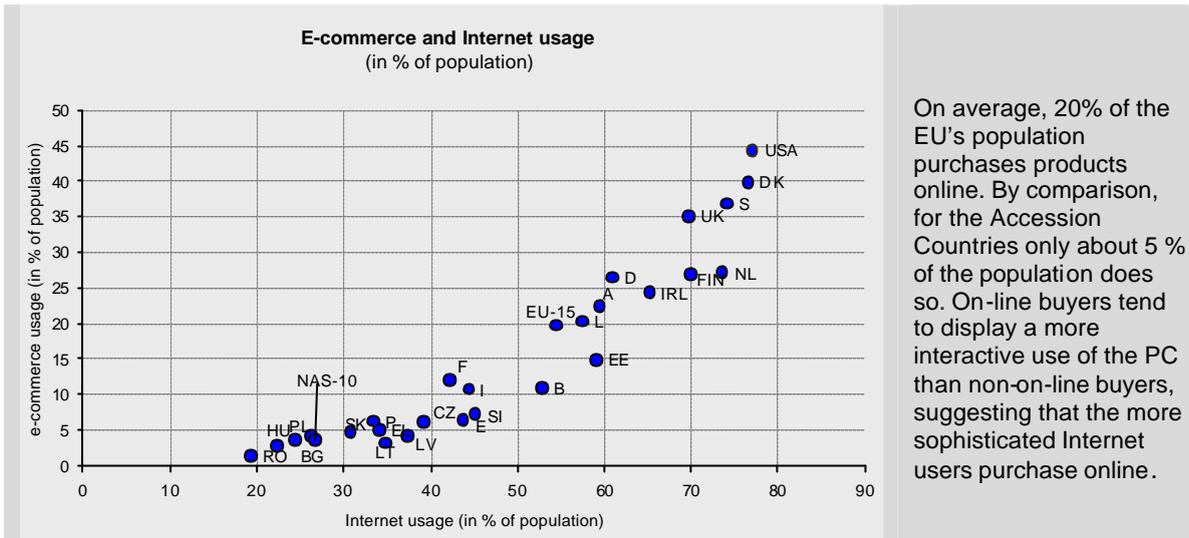
In the European member states e-commerce is growing from the pioneer phase to increasing integration within people's lives and companies' normal business practices, as part of the wider process of digitalisation of the economy as a whole. The US is the frontrunner, while most of the Accession Countries are just discovering e-commerce (Figure 15).

SIBIS data also shows that occasional users of e-commerce services are representing an increasing proportion of the e-commerce users, especially in those countries with increasing on-line tenure²⁰ and experience. The 25 to 49-age class are the most dynamic group of e-commerce users²¹.

¹⁹ e-commerce also includes electronic transactions between businesses and government (B2G), which are part of the e-government section (section 5.4, page 43). However, this section describes at businesses online sales to government (Figure 17).

²⁰ The length (in years or months) of online usage and experience

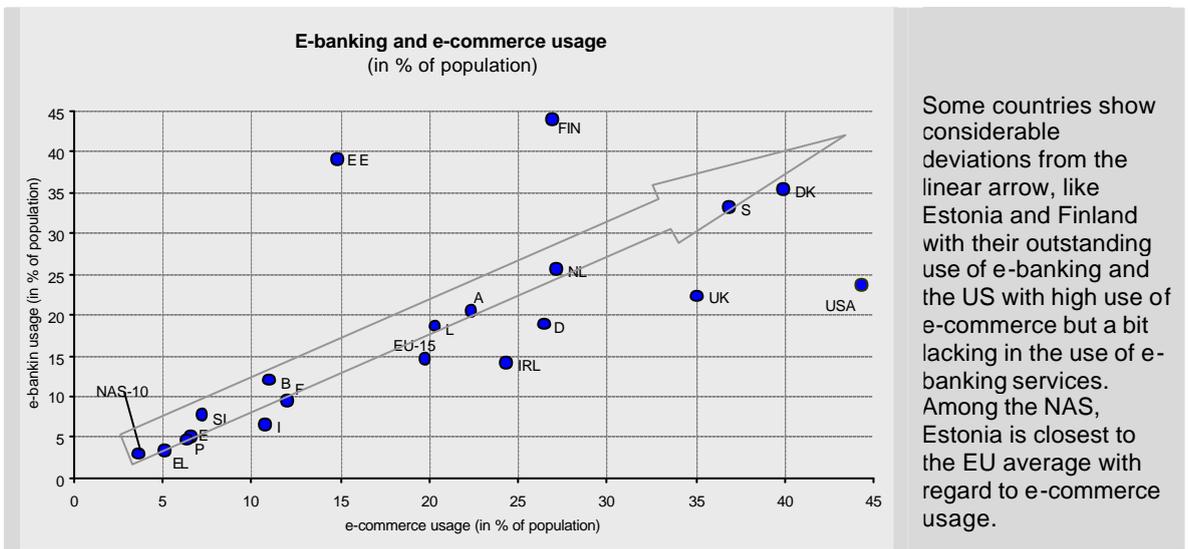
²¹ For more details, see reference [16]



On average, 20% of the EU's population purchases products online. By comparison, for the Accession Countries only about 5 % of the population does so. On-line buyers tend to display a more interactive use of the PC than non-on-line buyers, suggesting that the more sophisticated Internet users purchase online.

Figure 15 – Internet users and e-commerce: ordering products and services online
Base: all respondents, weighted

In Figure 15 e-commerce is defined as ordering a product or service online. Another, more or less comparable important activity to be carried out on-line is e-banking, for example on-line banking or buying financial products online. As expected, e-commerce usage and e-banking usage are highly correlated, shown by the linear arrow in Figure 16, again suggesting that the more sophisticated Internet users are more inclined to use online services. However, one can argue that e-banking and e-commerce need to be considered separately, as everything depends on users' perception of trust towards the two online services and one can imagine that individuals do trust their bank while they would not trust an online shop.

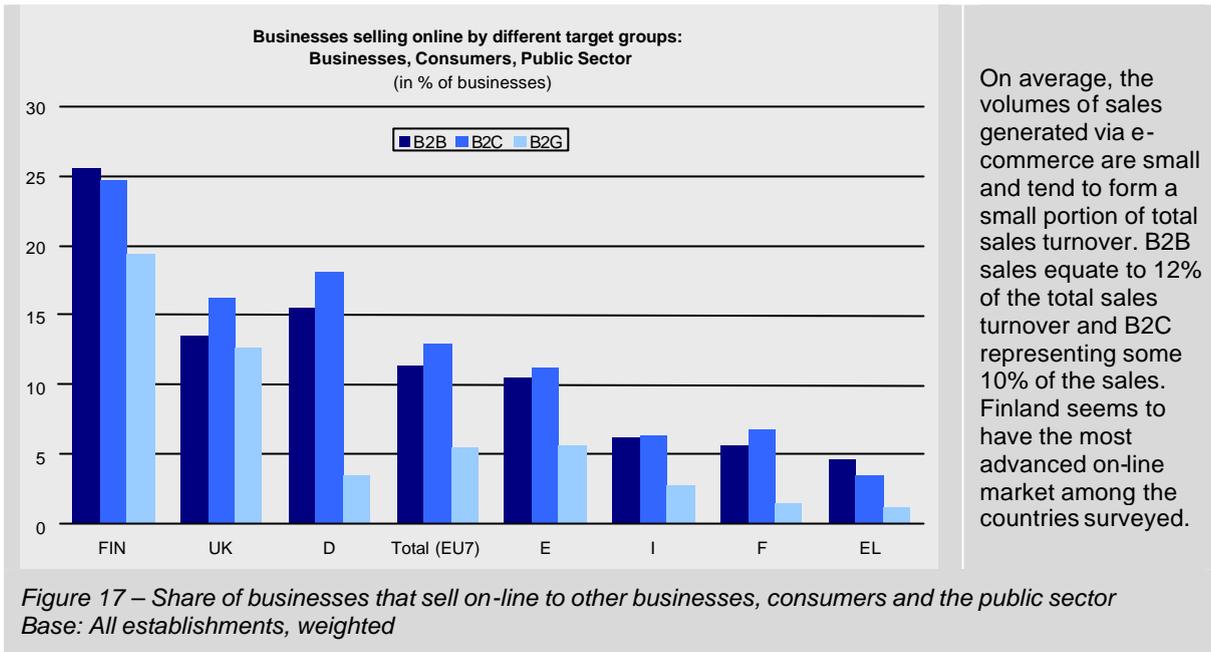


Some countries show considerable deviations from the linear arrow, like Estonia and Finland with their outstanding use of e-banking and the US with high use of e-commerce but a bit lacking in the use of e-banking services. Among the NAS, Estonia is closest to the EU average with regard to e-commerce usage.

Figure 16 – People who have ordered a product or a service (e-commerce users), or have conducted on-line banking or bought financial products (e-banking users)
Base: All respondents, weighted

Almost a quarter of Europe's businesses sell online, whether that is through a website or an e-marketplace and twice as many make on-line purchases.

The on-line selling activity varies across the three market domains and across the countries analysed. B2B and B2C correlate closely in terms of on-line sales, whereas B2G is lagging behind.



SIBIS has developed a new typology of e-commerce that helps to indicate the levels of activity and integration into business processes. This typology classifies enterprises based on the type of transactions they carry out over the Internet and the type of ICT services they employ (e-commerce typology) as follows²² (Figure 18):

- *Offline*: Establishments without access to the Internet, e-mail and without a Website
- *Basic online*: Establishments without a presence on the Internet (e.g. Website), but with access to the Internet or e-mail.
- *Web marketing*: Establishments with a presence on the Internet (e.g. Website), but none of the following
- *Web sales*: Establishments that sell goods or services via the Internet (through own Website and/or via e-marketplaces), but none of the following
- *CBNI - Closed Business Network Integration*²³: Establishments that use Electronic Data Interchange (EDI) or Extranets for communication with forward or backward linkages in the communication network, but none of the following
- *All round e-commerce*: Establishments that sell on-line as well as practice value chain integration.

²² Note that the categories are mutually exclusive

²³ not conducting front office Internet activities

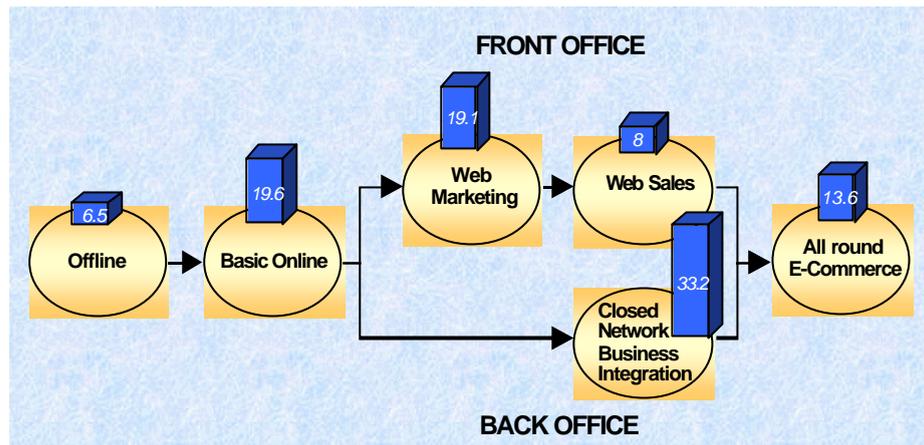


Figure 18 – Degree of business engagement in e-commerce (EU7, % of business)
Base: all respondents; weighted by employment;

It clearly shows that European businesses vary widely in their levels of engagement with e-commerce. In the seven countries covered in the SIBIS establishment survey, only a very small minority of establishments (6%) remains completely off-line, although a further one in five companies only uses basic email. For one third of businesses (33.2%) in the countries surveyed, their e-commerce engagement involves back-office transactions through closed network business integration (based on the use of extranets or EDI). More than two in five businesses (40.7%) engage in some level of front-office e-commerce, with this being restricted to web marketing for one in five businesses (19.1%) and web sales for one in twelve (8.0%). Just under one in seven businesses (13.6%) engage in both front-office and back-office e-commerce. This advanced level of e-commerce is much more common in Finland and Germany, and is relatively rare in Greece and Italy.

Although the volumes of e-sales and e-purchases are still limited, a majority of businesses declare that e-commerce has had a positive impact for them. E-sales judged to positively affect the quality of customer services and the efficiency of the business processes and e-procurement resulted in cost and efficiency benefits. However, quite a large number of businesses judge the impact to have been neither positive nor negative or having difficulty estimating it.

Conclusions

To analyse e-commerce it is better to segment the market between occasional and frequent users, and focus on the second type. E-commerce buyers are, in fact, normally to be found among the more sophisticated Internet users.

Variations by country of the diffusion of e-commerce are still strongly influenced by the degree of readiness of each country infrastructure and the level of Internet penetration.

Concerning development of B2C e-commerce by country, in the future its dynamics are likely to be influenced by a combination of Internet pervasiveness factors and retail market characteristics, including the maturity of on-line offers and characteristics of consumers' behaviour. Even if the Internet is a world phenomenon, available data show that commercial transactions tend to remain local or national, or at most European. Since retail markets are still far from being completely global, national characteristics are likely to remain important for e-commerce development.

B2B is a more complex domain, where the understanding of the interaction between e-commerce innovation and existing business processes is still far from adequate, and

therefore discussion on appropriate indicators is open and lively. The implications for market structure and business value chains are stronger here than in the case of B2C, but less understood. To examine B2B e-commerce SIBIS segmented most indicators by sector (manufacturing, finance, distribution, & public administration) as available surveys on e-commerce have established that differences by sector and business size are even more relevant than for ICT diffusion patterns. Moreover, SIBIS has developed a new typology of enterprises based on their degree of engagement in e-commerce for front-office and/or back-office activities. Results from the survey show that most businesses in the countries surveyed are on-line in some form, but e-commerce is still marginal. Despite this, a majority of businesses report that e-commerce has had positive impacts for them although some have difficulty in assessing what the impacts have been.

5.2 e-work

In recent years, policy-makers, businesses, researchers and statisticians have become increasingly interested in the effects of ICTs on work. The implementation and exploitation of these new technologies has led to profound changes in the organisation of work (at a micro level) and in labour markets (at a macro level), and it has been suggested that the success of today's Information Society largely depends upon the ability of individuals, businesses and governments to adapt to these changes (EC 2000). Also for this reason, the EU has been active in calling for up-to-date statistics on IS-related issues such as ICT-enabled new ways of working, telework, work-related IT skills, employment in IT sectors and occupations.

However, statistical information on these issues has been scant and seldom suitable for the task of informing policy-making, leading to uncertainty and confusion about the direction and intensity of developments regarding ICT-enabled new ways of working. With the purpose of shedding light on these issues, SIBIS developed and piloted a number of indicators on e-work, some of which will be presented in the following pages.

While SIBIS identified four work-related areas where statistics were required²⁴ and where the project could provide a valuable contribution to the current efforts of the European Statistical System (ESS) to develop new indicators, this section of the report focuses on indicators measuring changes to the flexibility of work organization via the application of ICTs. On a conceptual level the dimensions to consider when analysing flexibility developments regarding work organization are working time, the place of work, the type of contract and the work content, namely the skills that are applied in the production process (Hofmann and Walwei 1999). SIBIS integrated these dimensions into a framework for developing indicators that cover current changes in the organization of work and in the structure of labour markets.

Arguably, it is on the location of work and the contractual underpinning of work where ICTs show their strongest influence. The former is affected by applications of ICTs such as telework, mobile work and tele-co-operation, which enable the separation of the location where work is carried out from the location where the work products are being integrated into the production process; the latter concerns, in particular, shifts from one sort of employment to another (for example from dependent employment to self-employment such as e-Lancing). Additionally, the advent of the Internet has given way to observations that traditional employment relationships might become superfluous since transaction costs on the labour market are assumed to have fallen dramatically.

²⁴ These areas include (1) skills, (2) work organisation, (3) Structure of work and (4) outcomes of work. For more information about these areas see the topic report on Work, Employment and Skills, <http://www.sibis-eu.org/> and section 4.2.

SIBIS measured the self-assessed impact of the hypothetical²⁵ situation of not being allowed to work from home anymore on current EU²⁶ home-based teleworkers. The results clearly show that telework is perceived to have beneficial effects on work performance, labour market participation, and geographical mobility. 23% state they could not do their job as well without the possibility of teleworking from home; 9% could not be in paid work at all; 15% would have to work less hours; and at least 10% of all teleworkers would have, according to their own assessment, to look for another job which is located closer to their home. This information, together with the measure of home-based teleworkers in the EU (7%, see below) allows an estimate of the actual effect of telework on the European Union's labour market: about 1% of all employed persons in the EU would not be in the labour force without the opportunity of teleworking from home.

Because of the impacts of telework and because of the call for representative studies based on representative probability samples of the entire adult population, SIBIS surveyed citizens on their interest in and participation to telework and on the feasibility of their job for telework.

Data suggest that, despite people's strong interest towards it, home-based telework is not common: just over 7% of workers from the EU, 3% from the NAS and 17% from the US actually telework from home. However, it must be stressed that telework consists of a variety of types apart from home-based telework²⁷, including mobile work²⁸, centre-based telework²⁹ and self-employed teleworkers in a 'Small-Office-Home-Office' (SOHO)³⁰. Hence, figures are higher when other forms of telework are taken into account too. Considering home-based telework, mobile work and self-employed teleworkers in SOHOs, the EU average rises to 13%, the NAS³¹ to 5% and the US to 25%.

Moreover, the averages, both for the EU and for the NAS, conceal significant differences among different states. In the EU, home-based telework is common in northern Europe (15-20%) but the Mediterranean area, together with Portugal, barely reaches 5% of intensity. Similarly, although telework is infrequent in the NAS, there are significant disparities between those countries that show a relatively high intensity of home-based telework (8% in Estonia and Lithuania, which are above the EU average), and the others (less than 5%) (Figure 19).

25 A hypothetical question has been preferred against a more direct question asking for the effects of starting to telework, as it cannot be assumed that today's teleworkers have recently (or ever) worked in a traditional work setting. Only workers who have changed their work location, for example from a central office to their home, would be able to answer a question such as 'what effect has telework had on your work performance?' However, if telework were to become a mainstream way of working, the ability of respondents to give reliable answers to hypothetical questions of the kind above would decrease. Altogether, it seems that it will still take some time before telework becomes pervasive.

26 NAS data not available

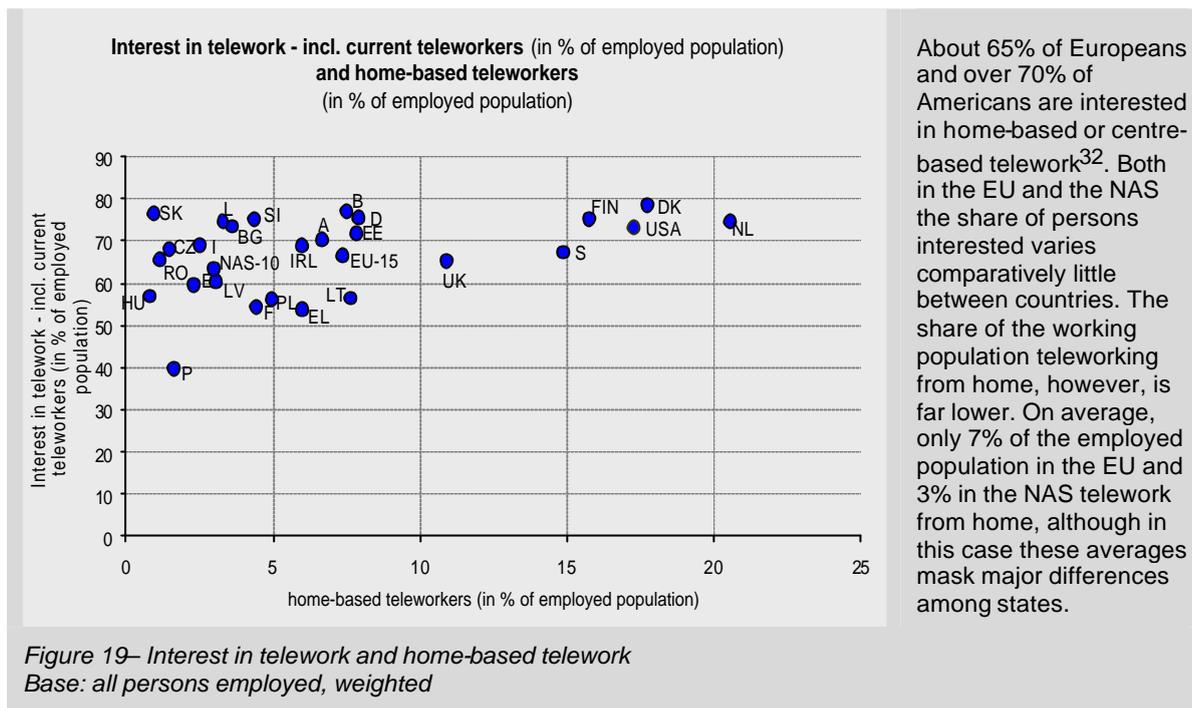
27 Home-based telework implies a relocation of the workplace, for part or whole of the working time, from the establishment site to the home of the worker. According to the intensity of teleworking practice, home-based telework can be 'supplementary' (when teleworkers work at home for less than one day per week), 'alternating' (when teleworkers spend at least one full working day at home), and 'permanent' (when teleworkers spend almost all of their working time at home).

28 Mobile telework is the outcome of ICTs being used to either increase the locational flexibility or enhance the productivity of mobile workers. Mobile teleworkers use online connections, especially e-mail, while travelling, allowing them to continue co-operating with members of staff at the central site (as well as external business partners) and stay closely integrated in the production process. Communication does not have to literally take place 'on the move' (e.g. in a train), but can also occur at a hotel, on the customer's premises or at some other (stationary) place.

29 Centre-based telework includes telework which takes place in so-called 'telework centres' (tele-centres, tele-cottages etc), but it is not possible to differentiate this phenomenon from other types of co-located work, which heavily rely on ICTs for the transmission of work outputs, in a way that is sufficient for survey research (Gareis, K., (1999), 'Benchmarking Progress on Telework and Other New Ways of Working in Europe', Proceedings of the Fourth International Workshop on Telework, Tokio, August 31st - September 3rd 1999, n.p.)

30 Self-employed teleworkers in SOHOs are freelancers and other self-employed persons who work from a so-called small office, home office (i.e. their workplace is at the same location as their home) and transfer work inputs and outputs by electronic means. ICTs are being used for interaction with clients, collaborators and suppliers.

31 Based on 9 NAS countries, excluding Latvia.



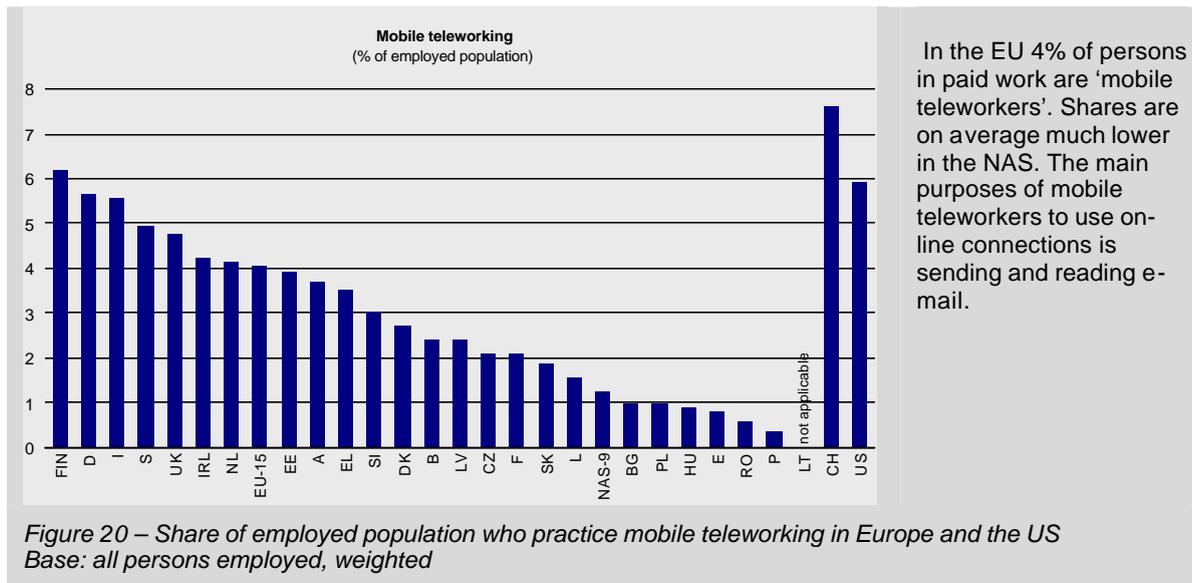
About 65% of Europeans and over 70% of Americans are interested in home-based or centre-based telework³². Both in the EU and the NAS the share of persons interested varies comparatively little between countries. The share of the working population teleworking from home, however, is far lower. On average, only 7% of the employed population in the EU and 3% in the NAS telework from home, although in this case these averages mask major differences among states.

While, as shown in Figure 19, there is no manifest correlation between employees' *interest in* and *practice of* telework, SIBIS highlighted the strong association between the use of the Internet medium, recognisably a key ingredient to a successful spread of these new ways of working, and the spread of home-based telework. Even though teleworking is not all about the Internet, the positive correlation between Internet usage and home-based telework is unambiguous: countries with low Internet usage, such as most NAS, the Mediterranean states of the EU, and Portugal, display a lower share of home-based teleworkers than countries such as the Netherlands, Finland, or Sweden, where Internet usage is more pervasive. Moreover, not only Internet usage directly relates to the extent of telework practice; it also relates to perceptions of non-teleworkers on the feasibility of their occupations for telework. Individuals from countries with low Internet usage and, therefore, limited teleworking, are less likely to deem their profession feasible for teleworking than persons from countries where Internet penetration is extensive. For example, Bulgaria, with just over 25% of Internet usage, has 4% of home-based teleworkers, 10% of non-teleworking employees believing their job would be suitable for telework and 74% expressing interest in telework; the Netherlands, on the contrary, with roughly 75% of Internet usage, have 21% of home-based teleworkers, 41% of non-teleworking employees believing their job would be suitable for telework and 75% expressing interest in telework.

From what has been said above, it is fair to say that, in spite of the interest in telework, an extensive shift of work from the office into the home is yet to be seen. The reasons for this are only partly extractable from the data. Internet penetration unquestionably plays a role in making a job feasible for telework, but other reasons, such as the perceived need for face-to-face interaction with colleagues, customers or other persons, seem to encumber the widespread practice of telework in Europe and the US. Although companies are often willing to give their staff remote access to their computer network, the acceptability of staff working from home whole days seems to be limited.

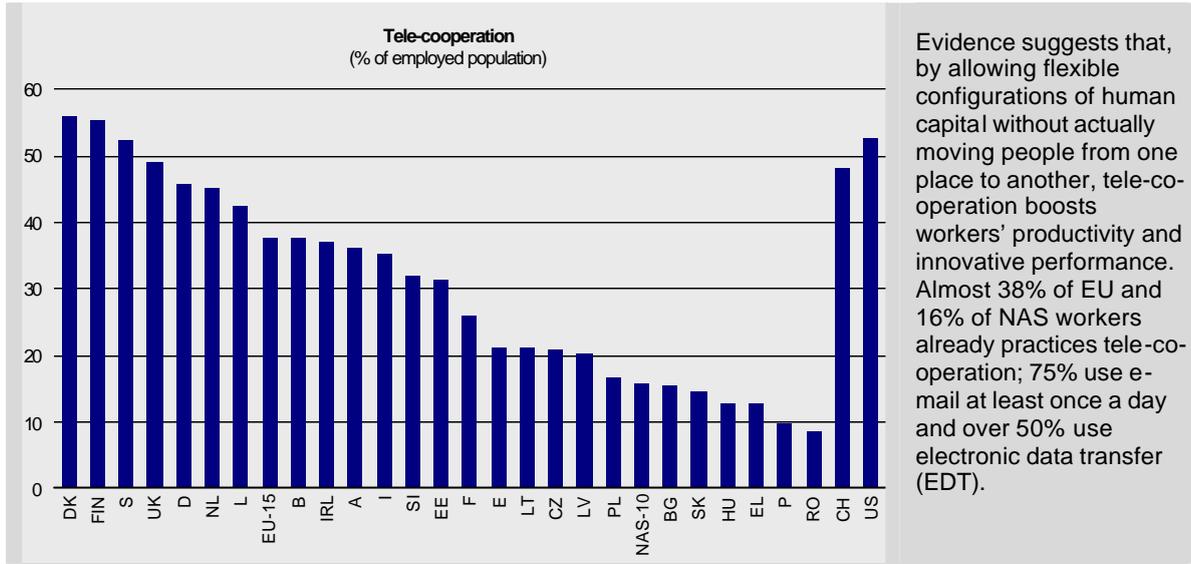
32 SIBIS measured workers' interest in at least one type of telework among home-based telework, mobile telework or centre-based telework but, because it is not possible to differentiate centre-based telework at a tele-centre from other types of co-located work relying on ICTs for the transmission of work outputs in a way suitable for survey research (Gareis, K. (1999) 'Benchmarking Progress on Telework and Other New Ways of Working in Europe', Proceedings of the Fourth International Workshop on Telework, Tokyo, August 31st - September 3rd 1999, n.p.), centre-based telework was discarded as a viable measure of the actual extent of telework.

This trend is complemented by the strong increase in mobile teleworking, which means the use of on-line connections for work purposes during business trips. Here again, the technology is being put in place and increasingly used. The share of mobile teleworkers in the EU has grown from 1.5% to 4% in the course of only three years (ECATT³³ 1999 vs. SIBIS 2002). This is likely to benefit employers, as the efficiency of business processes increases because of more continuous communication flows. The percentage of mobile workers (those who spend at least 10 working hours per week away from home and the main place of work, but do not necessarily make use of on-line applications while travelling) is over 11% in the EU. On average, shares are lower in the NAS, where just over 1% of all persons in paid work are mobile teleworkers and 10% are mobile workers.



(Home-based) telework is usually singled out as the most significant ICT-related development with regard to working locations. However, tele-co-operation (the use of ICTs for direct contacts between workplaces at geographically distant locations) also plays a significant role in shaping the way the majority of work is performed (Figure 20). Its attractiveness stems from the fact that labour, as opposed to capital, is known to be the geographically immobile factor of production. Hence, the possibility to transmit products of work between locations of production without moving the workers themselves is welcomed by industry.

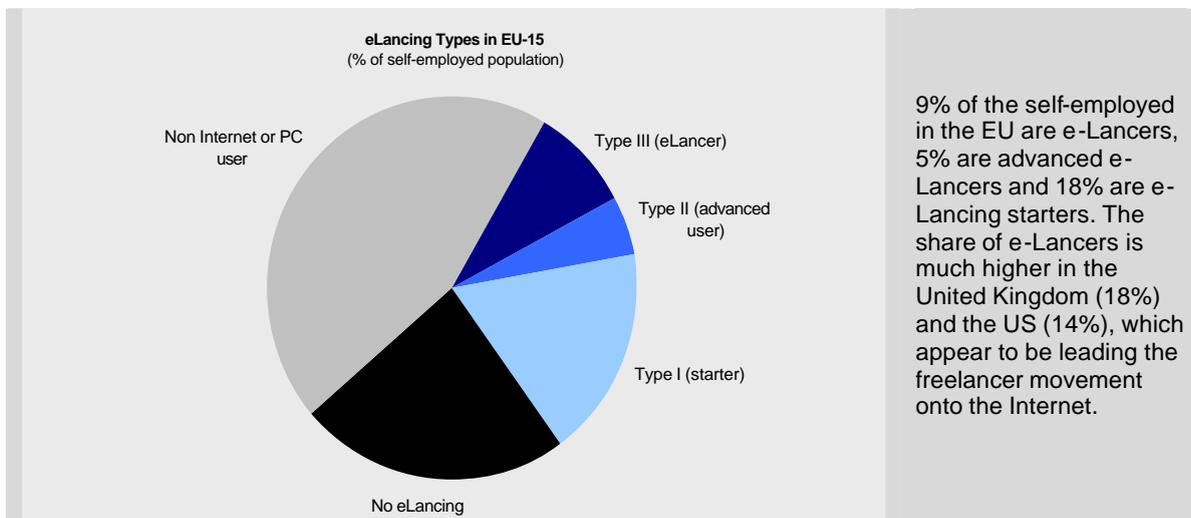
³³ ECATT (2000) 'Benchmarking Progress on New Ways of Working and New Forms of Business across Europe. Final Report', Bruxelles: European Commission, DG Information Society.



Evidence suggests that, by allowing flexible configurations of human capital without actually moving people from one place to another, tele-cooperation boosts workers' productivity and innovative performance. Almost 38% of EU and 16% of NAS workers already practices tele-cooperation; 75% use e-mail at least once a day and over 50% use electronic data transfer (EDT).

Figure 21 – Share of persons in paid work practising tele-cooperation
Base: all persons employed, weighted

Together with impacts on the location of work, ICTs also stimulate shifts from dependent employment to self-employment, such as e-Lancing. In the narrow sense of the term, e-Lancers are freelancers who 'work on the Net'; that is, they carry out all communication with others (supplier, work partners and associates, clients and customers) through the Internet or other computer networks.



9% of the self-employed in the EU are e-Lancers, 5% are advanced e-Lancers and 18% are e-Lancing starters. The share of e-Lancers is much higher in the United Kingdom (18%) and the US (14%), which appear to be leading the freelancer movement onto the Internet.

Figure 22 - e-Lancing types in EU15
Base: Self-employed population, weighted

For survey research, and based on the assumption that e-Lancing in the narrow sense of the term is still unusual, SIBIS distinguishes between three degrees of e-Lancing activity: e-Lancing starters are self-employed workers who attract new business through ICTs or deliver work results to clients/customers through the Internet; advanced e-Lancers are self-employed workers who attract new business through ICTs and deliver work results to clients/customers through the Internet; occasional e-Lancers (or simply 'e-Lancers') are self-employed workers who communicate with clients/customers exclusively by electronic means (Figure 22).

Conclusions

The exercise of developing new statistical indicators on e-work began with the argument that systems of production and labour deployment are changing as a result of the growing importance of information and knowledge vis-à-vis the traditional factors of production. Therefore, it is crucial to measure these developments constantly, adequately, and efficiently. The EU has endorsed this task by stressing repeatedly that the ability of individuals, businesses and governments to adapt to ICT-enabled changes is a prerequisite for the IS to thrive.

Location and contractual bases are the aspects of work where ICTs have the strongest impact. The development of phenomena such as telework, mobile work and tele-cooperation, and the shift towards ICT-enabled self-employment are visible changes from the past. SIBIS shows that Europeans are rife with interest in telework but rarely practice it; that the home is just one amongst many options for work re-location and that soon mobile teleworkers might outnumber home-based teleworkers; and that over one third of EU citizens in paid work and one in six in the NAS tele-co-operate (through e-Mail, EDT or videoconferencing). Moreover, the spread of the Internet has allowed freelancers in the EU to 'move on the Net': 9% of all EU self-employed is an occasional eLancer (i.e. a freelancer who communicates with clients exclusively by electronic means), but this figure grows up to 32% if advanced eLancing users and eLancing starters are taken into account too.

SIBIS data confirms that significant disparities exist among countries (as well as between the EU and the NAS) on indicators about employment structures in the IS. Some states (particularly the Netherlands and the Nordic countries) have high shares of employment in IT sectors and occupations and high penetration rates of new ways of working, even in comparison with the US. Others lag behind, most notably the Mediterranean countries (with the partial exception of France), Portugal, and most NAS. When it comes to ICT-based new ways of working, there is some evidence suggesting that the differential between these countries and the forerunners has not decreased between 1999 and 2002. This implies that still more efforts might be needed to include all of Europe in the developing Knowledge Economy in order to make the EU the most competitive macro-region in the world by 2010.

5.3 e-science

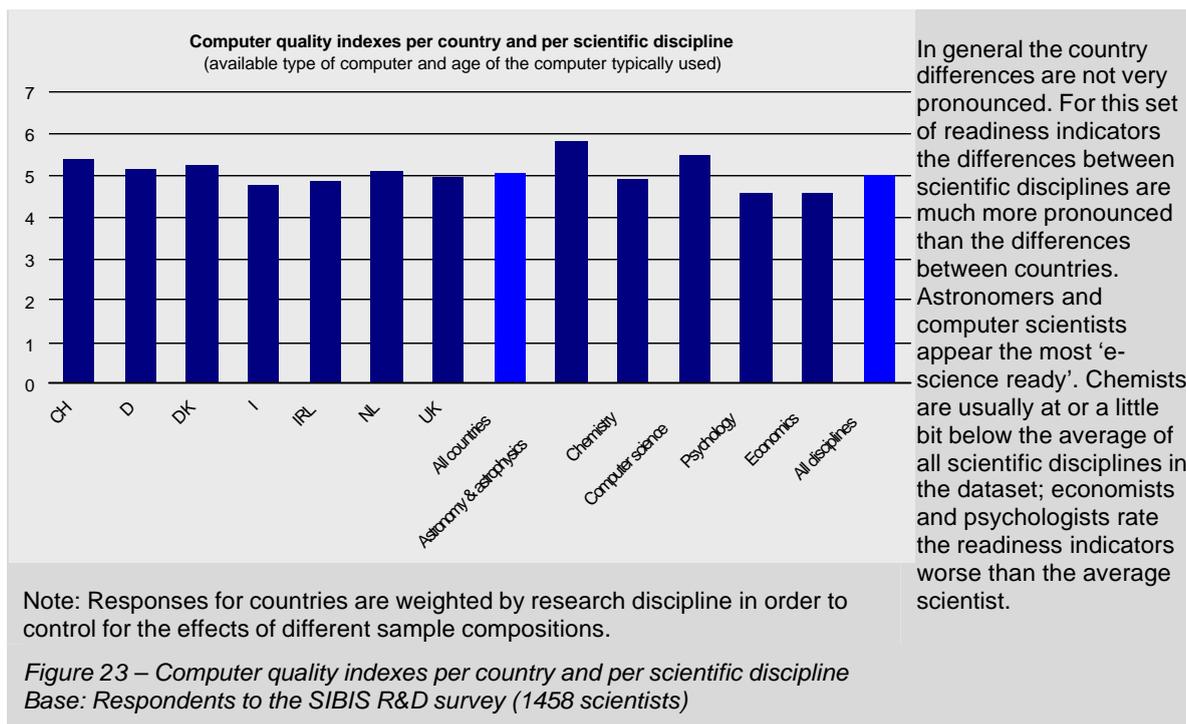
One of the key fields where the opportunities offered by the Internet play a crucial role is research. Research is a source of new knowledge, inventions and technical progress and Internet technologies affect the degree to which it can meet this function. Researchers in some disciplines also can be considered as avant-garde ICT users in a work environment. Hence, exploring e-science should give clues about future ICT requirements and trends in other areas of society. The SIBIS topic 'Internet for R&D' set out to benchmark the use of Internet technologies in European research systems. Although in principle research systems include academic and private sector research and development (R&D) establishments, SIBIS considered public science and defines e-science as its penetration with computers and computer networks. The focus of the empirical work was set on five scientific disciplines (astronomy, chemistry, economics, computer science and psychology) and seven countries (Denmark, Germany, Ireland, Italy, the Netherlands, Switzerland and the UK).

The various constructs that fill the technology space and the human-computer interaction space of e-science can be structured along the lines of readiness, use and impact.

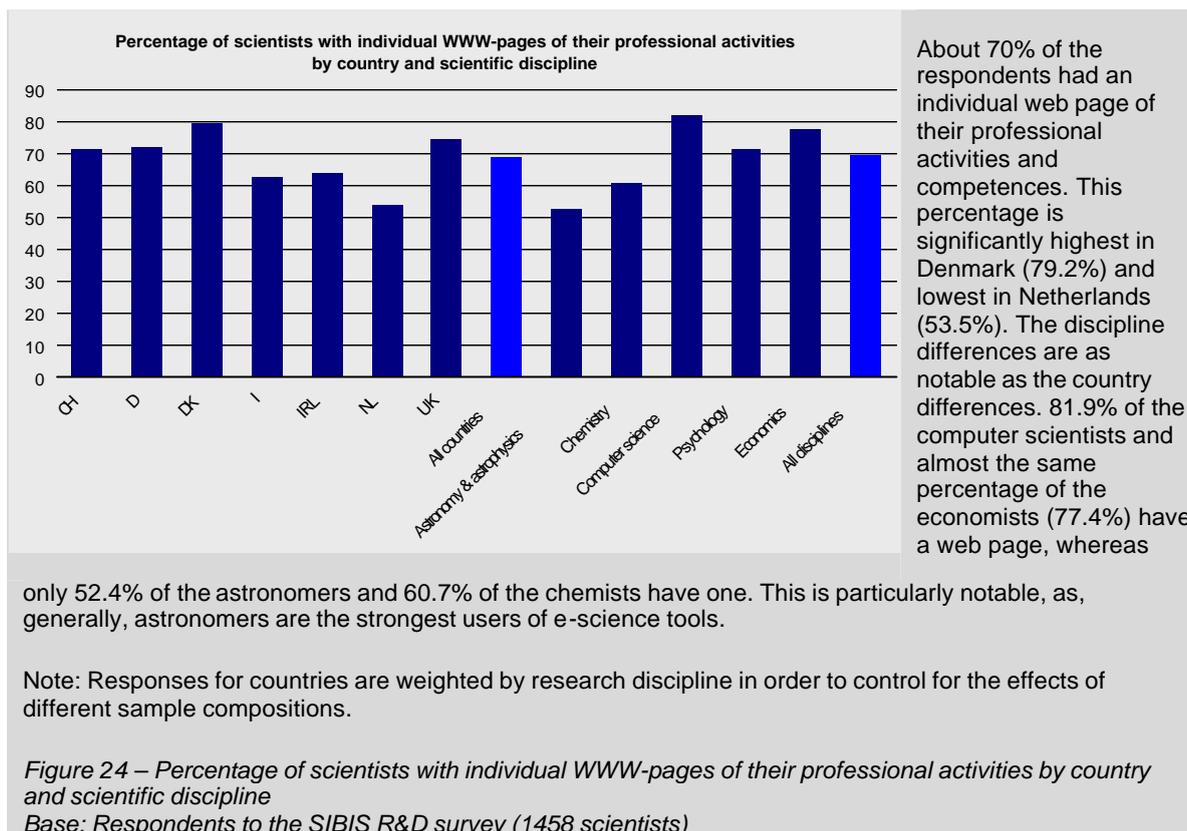
Readiness for e-science covers indicators on the computer and network infrastructure in science and the computer skills and IT awareness of scientists. Capable computers and networks with sufficient transmission capacities are the technical pre-conditions for e-science. Computer skills and an awareness of the capacities of IT for knowledge production are other, rather soft pre-requisites. Use of e-science includes indicators on a variety of purposes in science for which computer networks are employed. Internet-based applications have become integrated into such diverse activities as data collection and data analysis, information retrieval, communication, collaboration and publishing. Some of the applications are especially useful in a certain phase of a research project, namely during planning and definition, implementation or dissemination, whereas others are used during the entire duration of a project. Impact indicators assess on the one hand the production of new knowledge, effectively the main aim of science. In this area indicators might cover different outcomes of scientific work, such as publications and patents. On the other hand scientific collaborations can be affected by the use of Internet technologies. Hence, also indicators on the occurrence of R&D collaborations and the size of collaboration networks are important.

Research networks are an important element of e-science readiness, as they determine the speed and quality of data and information transmission between different research sites. Available data on National Research Networks (NRN), their core capacity (the maximum data transfer rate per second available within the network), their congestion, and their budget size show an unclear picture. The Netherlands perform well for all indicators; some countries, such as Finland and Denmark, have attained a very good position, but are losing ground as a result of their diminished commitment towards further improvement; others, (notably Spain and Belgium) are catching up. Greece, Ireland and Portugal lag behind with low transmission capacities and relatively large congestion levels. Larger countries (Germany, France, the UK and Italy) are difficult to rate. Of course, they have backbone transmission capacities above the average, but they also have many clients and users. The low budget figures might be caused by economies of scale and the congestion levels are close to the EU average.

Besides 'soft' readiness indicators, relating to scientists computer skills and their awareness of the capacities of IT for knowledge production, SIBIS also measured the quality of currently used computer equipment. The types of available computers (stand-alone PC, workstation, mainframe, supercomputer, cluster of PCs) and the age of the computer used are the most important indicators to assess the quality of computer equipment. An index created accordingly, shows that whereas national differences do not play a significant role here (as opposed to the NRN-related measures), discipline-related divergences are far more pronounced. Figure 23 below shows this index.



SIBIS assessed to what extent scientists do in fact use e-science tools for their work, either for data collection, analysis, information retrieval or diffusion of results. Also in this respect, country differences, even though revealing a patchwork of strengths and weaknesses, are less marked than discipline-related differences. In general, Danish scientists make more use of the World Wide Web for dissemination and collaboration than their counterparts from other countries, in Ireland the use of e-science lags behind overall, and in the Netherlands personal web-pages are comparatively unimportant for disseminating information. Differences related to specific disciplines are also notable and typically in line with the e-science readiness picture. Figure 24, however, shows an exception to this overall tendency: astronomers generally use the Internet most often for collecting and analysing data and retrieving information; but, as the figure shows, they do not rely on personal WWW pages for publishing professional information. On the other hand, much higher percentages of economists, normally not the avant-garde of e-science, and computer scientists have their own WWW pages. This points to scientific communication models which differ in regard to how they integrate Internet applications, in this case the World Wide Web.



The impact of computer networks on science can be analysed by looking at the outcomes of R&D (publications, citations of publications, patents) and by looking at the collaboration activities of scientists, as ICTs are supposed to support in particular communication and collaboration in science. Previous scientific analyses have tested at micro-level the hypothesis that Internet applications increase the productivity and raise the output of scientific research and more often than not found positive effects³⁴. The SIBIS results provide a basis for conducting such analyses at macro-level.

Conclusions

E-science is the penetration of public science with computers and computer networks. SIBIS measured various aspects, focusing on readiness for, use of and impact of e-science. In many instances, readiness for and use of e-science are similar across countries. Yet, this is not the case when we compare across disciplines: astronomers and computer scientists are clearly the most 'ready' for, and top 'users' of e-science. The SIBIS study in this area has been fruitful and produced for the first time comparable data for various countries and scientific disciplines. It has also highlighted some key elements which previously lacked of any measurement, but ought to be developed further, for example by analysing causalities: astronomers might use e-science applications more than other scientists because they collaborate to a large extent and have to bridge the distances from their collaborators; but computer networks might as well have supported the further growth of collaborative activities. It is clear that the indicator system and the available data cannot yet be considered comprehensive and further research is needed on a variety of issues, such as in the case of large versus small NRNs, or sub-national RNs.

³⁴ See also reference [2]

5.4 e-government

The growing interest in how to exploit emerging technologies (ICTs) to build customer relationships and deliver services is not a concern for the private sector alone. Since the mid '90s governments³⁵, too, have been active in studying and developing new ways to reach out to their citizens. The electronic facilitation of these relationships between governments and the users of their services has become known as *e-government*, and includes any transaction involving the government and that is carried out, even partially, using electronic means.

Because of the importance of these recent developments, it has become crucial to adequately measure to what extent e-government is taking place and is being chosen by citizens as the preferred way to interact with the public sector. A number of studies³⁶ analyse the availability, level of sophistication, and usage of on-line services. However, these researches focus almost exclusively on the supply side of e-government, while failing to draw attention to users' perceptions of and preference for the services. The few studies which address the question of citizens' preference for e-government overlook what drives citizens towards or away from e-government. Additionally, studies of the business preferences for e-government or existing means of transaction are non-existent. SIBIS complemented these efforts by addressing the demand side of e-government and by asking businesses about their preference for on-line transactions with government. Hence, the focus here is chiefly on *Government to Citizens (G2C)* and *Government to Business (G2B)*.³⁷

The increased role of governments in citizens' and businesses' every day's life means that the range of services provided is very extensive. Examples of areas where government and citizens or businesses communicate include, among others: access to laws, rules, and regulations; information on parks and recreation; personal and corporate income taxes; unemployment or disability compensation; social security; personal documents; car registration; application for building permits; declarations to the police; public libraries; change of address announcements; census bureau surveys; corporate taxes; new company registrations and submission of data to statistical offices. This list is by no means exhaustive and serves to illustrate areas where e-government has or will make its presence felt.

SIBIS has chosen seven services as particularly representative of the areas where interaction with governments occurs, namely: car registration, declaration to the police, personal documents, search for books, change of address, job search and income tax declaration³⁸.

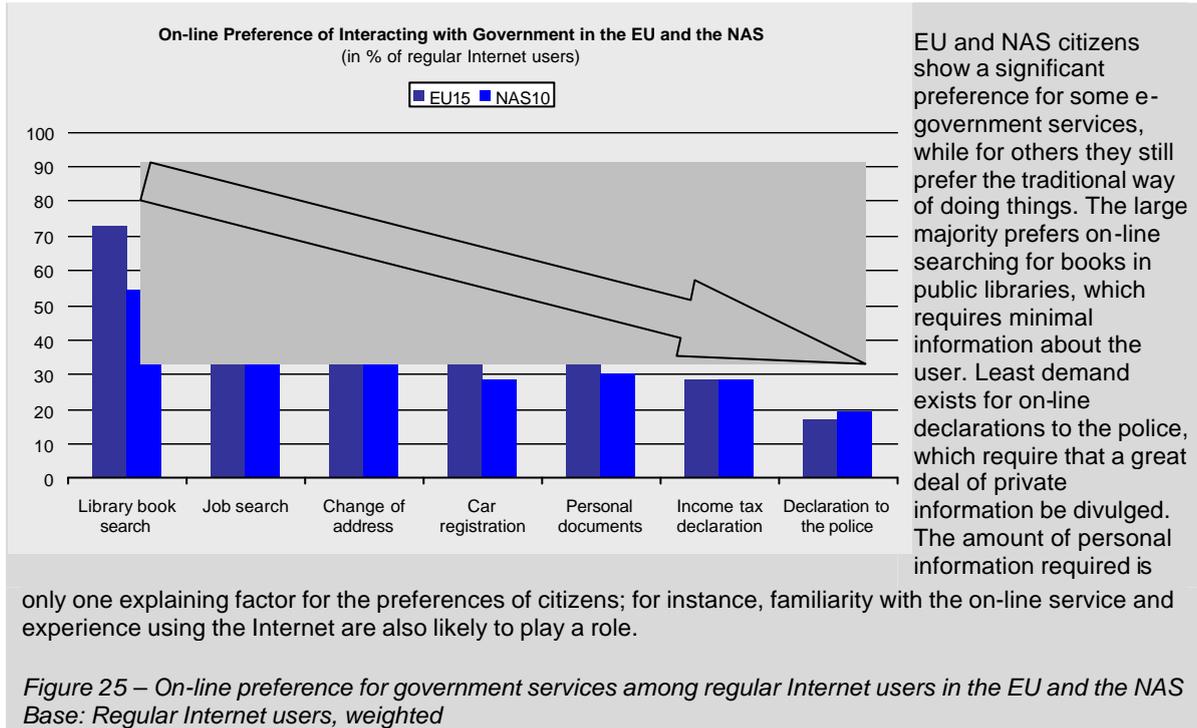
Figure 25 below shows that the demand for on-line as an alternative to traditional access to government services varies across services. It is apparent that European regular Internet users would rather turn to the Internet for communicating with their administrations if it did not involve revealing a big deal of personal information (clearly a declaration to the police entails renouncing to one's privacy far more than a library book search or a job search).

35 Because European countries strongly differ in terms of institutional organisation (some are federal, others even lack local authorities), the term 'government' is understood as any public authority which offers certain services and with which citizens and businesses interact. Hence, 'government' comprises the local, regional and national levels (and increasingly the supranational too).

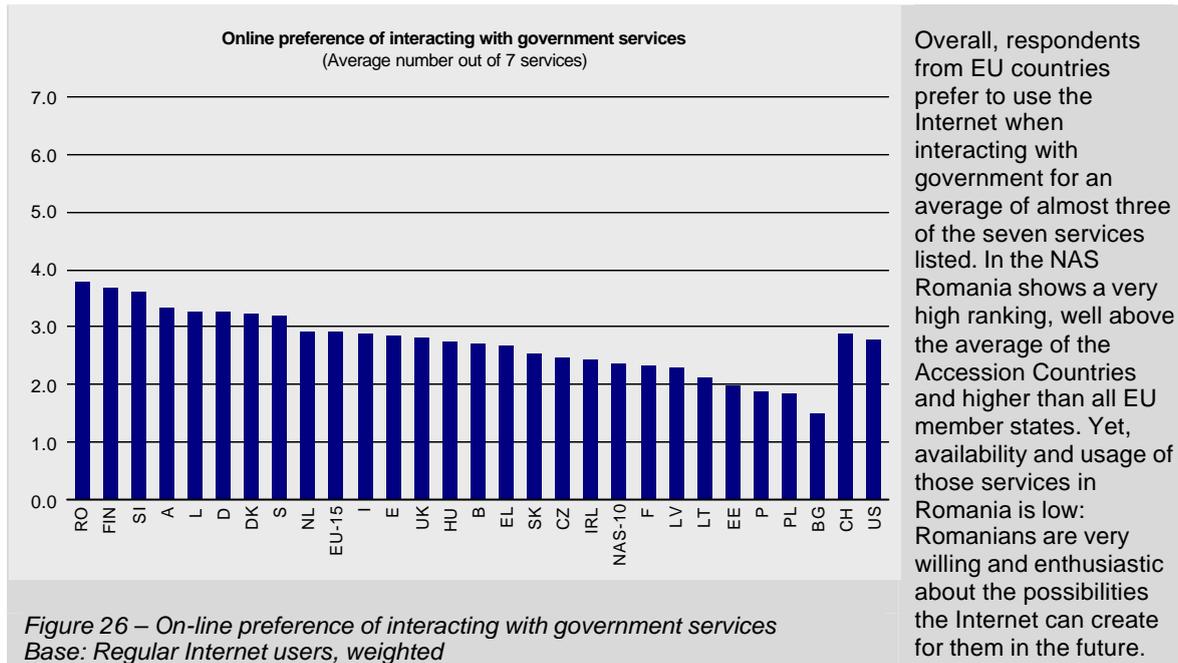
36 See for example the studies done by Accenture (2001, 2002), the web-based survey on electronic public services by Cap Gemini Ernst & Young, the Global (2001), e-Government survey by World Markets Research Centre (Sept. 2001) and several national surveys (2000/2001).

37 Within the scope of SIBIS it was not possible to look at interactions between governments (so-called G2G).

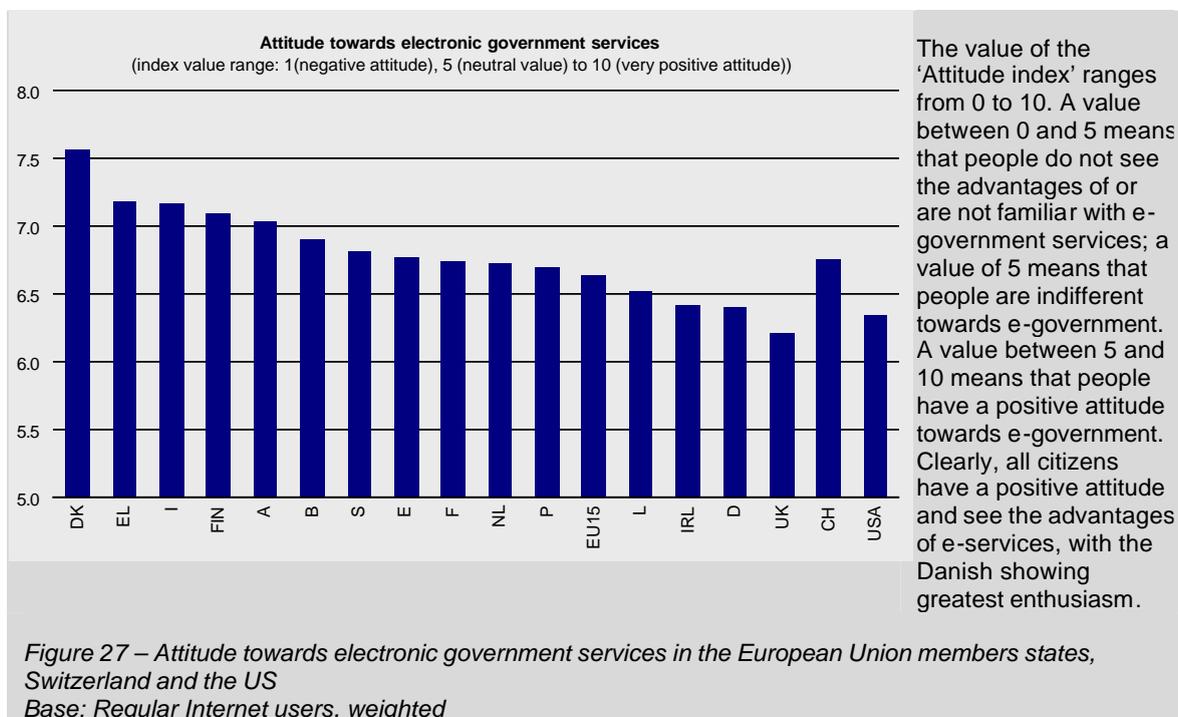
38 The selection is a subset of the 12 public online services for citizens as defined by the European Commission [add reference], which are seen to be of interest to contribute to what other indicators already cover but only partly fills the needs from a policy perspective.



The preference for e-government varies across countries. Typically, in countries where Internet usage is higher, citizens prefer to communicate on-line with their governments. However, the enthusiasm towards e-government does not always ensue from its actual implementation or from citizens' on-line access. Romanian regular Internet users are the most keen to communicate with their government over the Internet, in spite of substandard Internet penetration levels and e-government services availability; similarly, notwithstanding lower Internet usage than its Dutch and Danish neighbours, Germany is more eager to use public on-line services. Figure 26 below shows the preference for e-government intended as the number of e-government services citizens would like to use of the seven services considered by SIBIS. When a country does not rank high this does not by definition reflect inactivity in deploying e-government services, but it can also indicate a different approach with a set of priority actions that are not included in the SIBIS measurement like fore example e-voting.



Besides preferences for certain e-government services as opposed to traditional government services, the *attitude* towards e-government in general remains positive. Through the development of an index founded on the agreement or disagreement with a number of statements on the advantages of electronic government services, SIBIS weighed up the attitude towards e-government across the EU³⁹. On a scale from 0 to 10, all EU countries, the US and Switzerland rank more than 6, where values above 5 indicate that people have a positive attitude towards electronic government services.



39 It was not possible to construct a similar index for the NAS, because the relevant questions on advantages and disadvantages of on-line public services were not included in the SIBIS+ survey.

Finally, e-government also encompasses communications between administrations and businesses (this is the so-called G2B). Companies may wish to submit data to statistical offices, pay social contributions to employees, or participate in public invitations to tenders over the net. Research previous to SIBIS⁴⁰ shows that this kind of on-line services for businesses is often available and more sophisticated⁴¹ than on-line services for citizens. Yet, SIBIS results show that more than 50% of the IT managers surveyed do not use these services and between 10% and 20% do not know if those services are used within their company⁴². Moreover, the willingness to use these services is low too: approximately one third of IT managers not currently accessing government services on-line would prefer to carry out these transactions on-line.

Conclusions

The electronic means is key to the progress and improvement of government services in Europe and the world. Ever more often, states understand that they can use ICTs to interact with their citizens more efficiently, speedily, and with greater efficacy. The implementation of electronic service delivery by the public sector is generally called e-government, and includes G2C, G2B and G2G. On the whole, SIBIS depicted the people of Europe and the US as clearly enthusiastic about e-government, but none the less ready to reject it if they felt their right to privacy was being jeopardized (for example by requiring a great deal of personal information to be divulged, like in the case of a declaration to the police). At the same time, the preference for e-government is not a direct consequence either of a population's Internet penetration or of the actual availability of services over the net. As the case of Romania showed, there might be strong potentials for the development of e-government where Internet usage and service availability notably lags behind the average. Finally, assuming that G2B would have positive effects too, much still needs to be done to promote the use of these services (often already available) by businesses, who seem to be unaware or are have a negative idea of interacting on-line with their administrations.

5.5 e-health

The e-health domain is a very broad and complex domain, partly deriving from the wide variety of players involved. These include government departments, health administrations, insurance agencies, pharmaceutical companies, large hospitals, health clinics, imaging and laboratory facilities, individual doctors in hospitals, clinics or their own offices, other paramedical professionals and staff, administrative personnel, and, of course, individuals moving between the roles of citizen, patient and carer.

Another element of complexity derives from the variations in the ways that healthcare systems are organized in different countries, with varying mixes in terms of public and/or private provision and utilization and whether or not general practitioners play a gatekeeper role in determining access to other services. There are also significant variations in the ways that services are delivered and in what is deemed to be acceptable or good practice.

e-Health is also not just accessing medical information, but involves many different dimensions and legal implications, for example including the possibility to do remote medical tests. What is hampering developments are not just technological issues but also social concerns and liability aspects.

40 For more details see reference [8]

41 The more sophisticated a service is, the more it has progressed towards full electronic handling, see reference [8]

42 The relatively large number of people who answered 'don't know' can be due to the fact that the IT manager may not be the person responsible for interacting with government on those type of services.

Proliferation of on-line e-health services (information, advice, clinical services and pharmaceutical sales) is facilitating increased self-directed, self-servicing activity amongst consumers. It is important to have indicators of both the availability and quality of such services, and of the use (and possible misuse) of such services if policy positions and initiatives are to be well-informed and up-to-date. It is also important to monitor the extent to which such services and their usage are affecting health and healthcare divides across social groups - are they resulting in better health practices and are they reducing or increasing the health differentials that currently exist across socio-economic groups?

There are also many opportunities for increasing the efficiency and effectiveness of the more 'traditional' (i.e. off-line) health services through exploitation of the new opportunities presented by Information Society Technologies. Indicators are needed for benchmarking the extent to which these opportunities are being realized and to point to the types of policy initiatives that may be needed to encourage the diffusion of good practice.

In line with the stated project objectives of linking with the e-Europe initiative, the SIBIS work on e-health focused especially on indicators for benchmarking e-health activities of the general public and of healthcare providers. These are the priority areas identified for benchmarking in eEurope 2005. In recognition of the broader scope of the ehealth domain, however, the project also devoted some effort to collating candidate indicators for other healthcare players, such as educational institutions, insurers/reimburseurs and administrations.

The focus of actual indicator testing and benchmarking in SIBIS was on e-health activities of the general public - whether as citizens, as patients or in the context of providing care for other family members - and specifically on usage of the Internet to search for health-related information. This is one of the most frequent activities on the Internet and has profound implications for the organization of healthcare and for public health.

On-line searching for health related information is of growing importance within the repertoire of health-related activities of the European public and consequently for the health policy in Europe. European Internet users are less likely than their US counterparts to have reported using the Internet (for their private purposes) to search for health-related information. Within Europe, the prevalence of reported on-line health information seeking amongst Internet users varied considerably across the countries, with highest rates in Ireland (48.1%) and lowest rates in Greece (21.6%) (Figure 7).

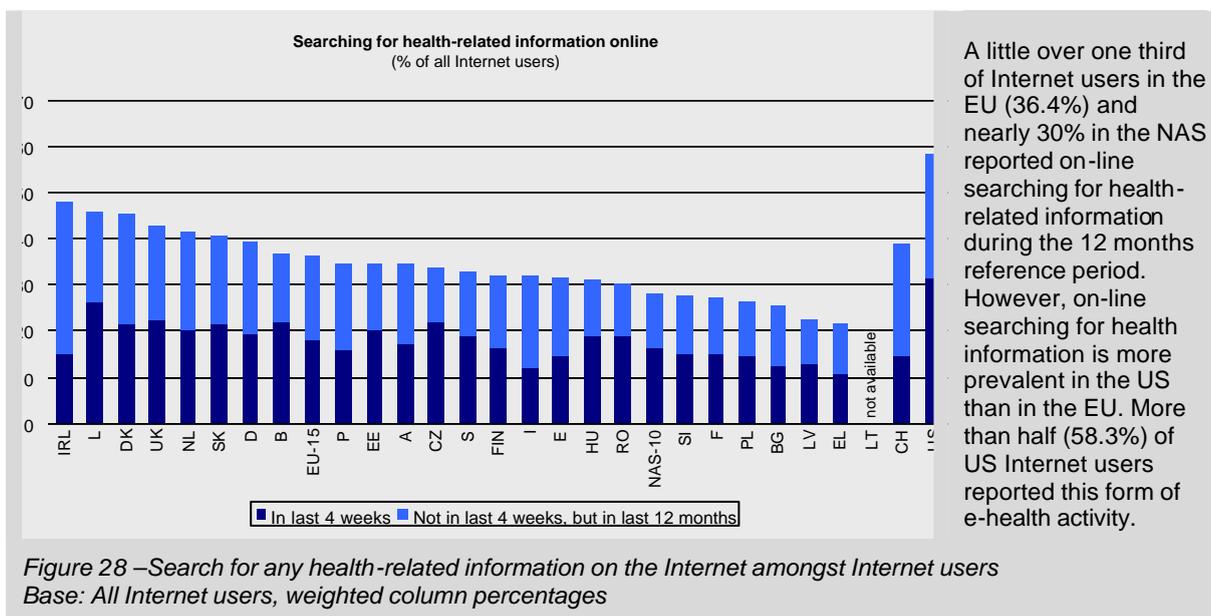


Figure 28 – Search for any health-related information on the Internet amongst Internet users
Base: All Internet users, weighted column percentages

There is a significant trend towards increased levels of e-health activity by Internet users in countries with higher levels of Internet penetration although some countries deviate notably from the general trend (Figure 29). Relevant factors in these differences might include a higher orientation towards or necessity for self-management of one's health in the US in comparison to the Nordic countries with their generally well- developed public health services, although confirmation of this would require further specific studies.

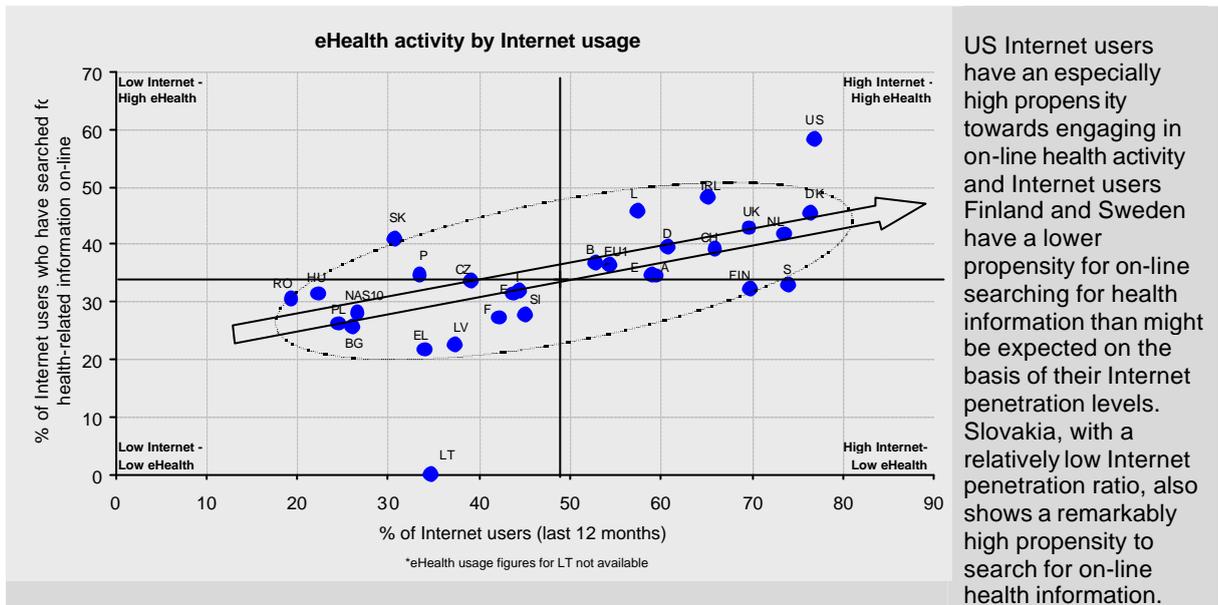


Figure 29 – Internet penetration levels and propensity for on-line searching for health information
Base: All Internet users (last 12 months), weighted

Within the EU, about half of those who searched on-line for health-related information did so to get a second opinion on a medical diagnosis. Such trends will pose increasing challenges for policy, both in regulation of the quality of information on the Internet and in helping healthcare providers and their patients to benefit from the new possibilities for sharing decision-making.

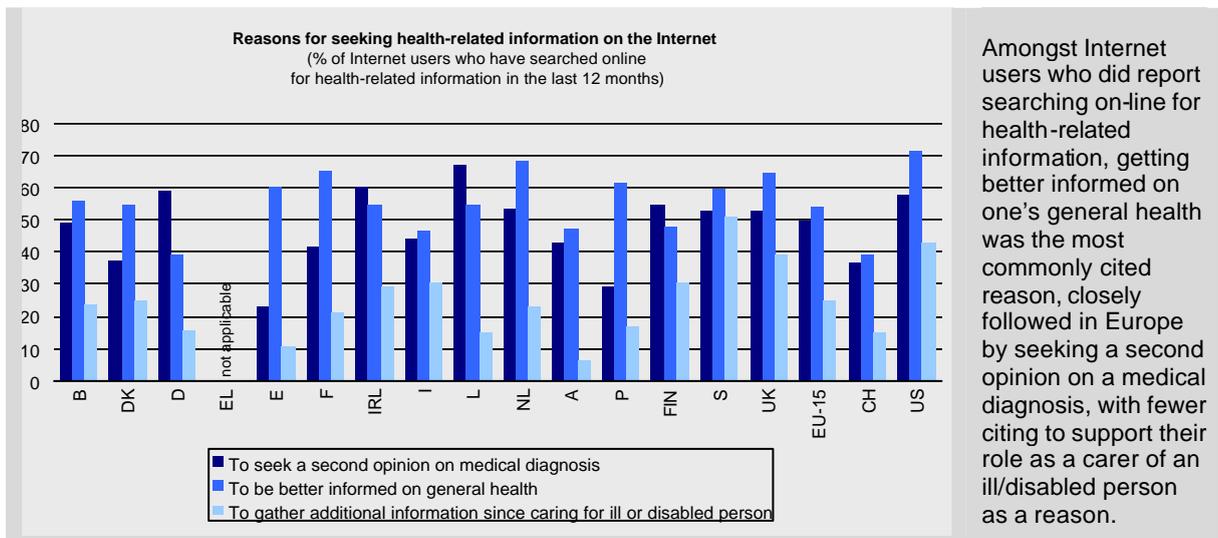


Figure 30 – Reasons for on-line searching for health-related information amongst users
Base: Internet users, who have searched on-line for health-related information, weighted column percentages

In general, Internet users within the EU⁴³ who did report on-line searching for health-related information reported such searches to have been successful. The vast majority (more than 90%) said that they were able to find health-related information on the Internet and of those who found information, the vast majority (more than 90% again) judged it to be suitable for their needs. Taking both aspects into account (being able to find health information at all and, if so, being able to find suitable information), there was relatively little variation across countries, with the lowest overall success rates reported in Italy (80.5%) and highest in the UK (89.9%)

More respondents in the EU (15.5%) than in the US (2.6%)⁴⁴ reported having had to expand their search to non mother-tongue websites to find the information they needed. Within Europe, a variety of factors may affect tendencies to extend searching to non mother-tongue web sites, including whether one is from a majority or minority language group, the amount and quality of information available in the user's main language and the language skills of the user.

In both the EU and US, private health insurance companies and pharmaceutical companies were a lot more likely than other organizations (universities, hospitals, professional associations and patient advocacy groups) to be rated as untrustworthy sources of information by those who searched on-line for health-related information. Around 30% in the EU and 24% in the US rated private health insurance companies as not trustworthy and 25% in the EU and 17% in the US rated pharmaceutical companies as not trustworthy. Interestingly, within the EU there was quite a lot of variation in these ratings across the Member States (Figure 31). Some of these differences may be explained by contextual factors (for example 'private' health insurance in Ireland has been, until recently, synonymous with a single state-regulated provider) but others warrant more detailed exploration in future studies in the area.

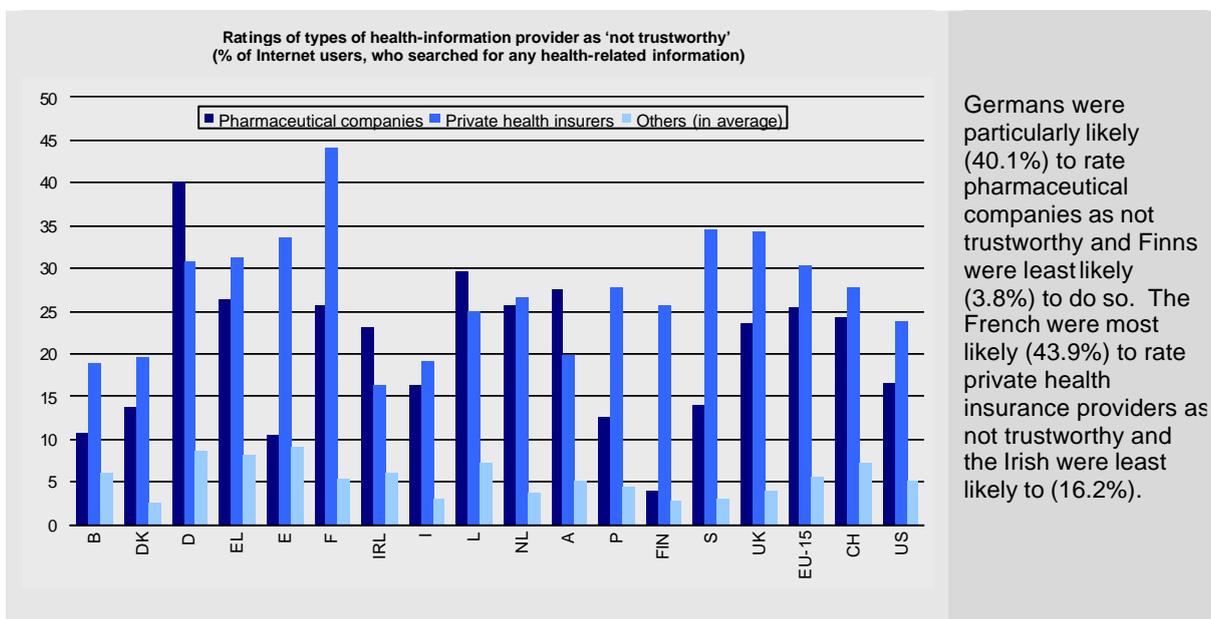


Figure 31 – Perceived trustworthiness of providers of health-related information
Base: Internet users, who have searched on-line for health-related information, weighted

43 No NAS data available

44 % of people who have searched and found health-related information on the Internet

Conclusions

Although on-line searching for health-related information is still a minority activity in Europe amongst Internet users, it is of sufficient scale to represent a significant issue for public health policy in general and for patient-doctor interaction in particular.

If such activity is judged to be a positive development in public health terms, then the EU lags behind the US in the extent to which the general public is availing of the new opportunities. People in the EU are less likely to be Internet users in the first place and, when they are, they are less likely than their US counterparts to search for health-related information online.

Language is an important factor to be considered in e-health policy and it will be necessary to ensure that sufficient quality information is available for all language groups if linguistically determined health divides are to be avoided.

About half of those in the EU who have searched for health-related information on the Internet have done so to get a second opinion on a medical diagnosis. This provides the first robust quantification of the many anecdotal reports of patients becoming more informed and more questioning of the diagnoses and therapeutic recommendations of their doctors. It underlines the need for public health policy in Europe to give attention to supporting patients and doctors to exploit the new opportunities for sharing health management and decision-making in a positive and synergistic manner.

Those who used the Internet to search for health-related information in the EU and the US were less trusting of pharmaceutical companies and private health insurers as sources of information than they were of other sources. Within Europe, there were quite wide variations across countries in whether or not and to what extent users expressed scepticism about these information sources. In relation to other sources of information, users tended to be a little more sceptical of patient advocacy/self-help groups than they were of healthcare organizations, professional associations and universities. This type of information on user attitudes can provide a useful input to the work on developing quality criteria for health web sites and on educating users to be discerning in their information search.

The work of SIBIS has helped add to the state-of-the-art in e-health benchmarking in Europe and provides a basis for further benchmarking based on multi-method approaches⁴⁵. Surveys of the various healthcare players will comprise an important component of this and dedicated surveys that allow more in-depth treatment of the e health topic would be of considerable value. Good quality contextual data on the healthcare systems within which users are operating will be important for interpreting the results of such surveys. Other approaches will also be needed, including web scanning to objectively identify and describe the variety of e-health services that are now available and being used. Finally, there may be scope for automatic monitoring of usage of sites in order to collect data on usage patterns, although careful attention to privacy issues will be crucial if such methods are to be considered.

⁴⁵ see reference [18] for more details

6 CONCLUSIONS

In Europe, the focus of the Information Society has evolved from concentrating on basic issues such as access to infrastructure to more complex issues of e-readiness, both for businesses and for citizens. As participants in the IS gain greater facility with the new medium and become more sophisticated in their use of it, such as in the case of e-commerce, intensity and impact indicators will tend to supplant readiness indicators as the appropriate measure of progress. For this reason, SIBIS was conceived with the aim of measuring the developments of the IS by combining the three levels of IS development: readiness, intensity and impact. In addition to the EU Member States, SIBIS focused on the US, Switzerland and ten Accession Countries.

In addition to telecommunications, topics of research were selected on the basis of the eEurope2002 action plan. As the project moved forward and the new eEurope2005 action plan became available, new areas were included in the SIBIS surveys. In addition, the countries of interest to SIBIS expanded as a result of the new accession of 10 east European countries. Questionnaires were compiled to survey the general population as well as decision makers in businesses about availability, usage of and preference for Internet services as well as about attitudes toward the IS.

The results of the surveys point to important aspects of the IS that provide a necessary complement to existing measures of progress in the IS. Up to now, evaluations of the IS have focused primarily on the supply side, looking at whether services are available and how sophisticated they are. SIBIS measures whether the services are used, to what extent, and why or why not. As a result of SIBIS, it is fair to say that we have today a clearer picture of how Europe is progressing towards becoming the most competitive and dynamic economy of the world. This is true for e-commerce and e-government, for example.

Significant differences in piloted indicators were found among the countries surveyed. For this reason, generalizations about IS indicators might misrepresent differences between, for example, EU and Accession countries. In this way, significant differences in the mean level of readiness in the Accession countries and the EU countries points to a large digital divide between the two groups. However, a more careful analysis of the data that considers each country individually reveals widespread differences within the two groups and, at times, significant overlap between them.

Across the various dimensions that SIBIS considered, certain countries, although not always the same ones, lead the way. Likewise, some countries tend to lag, although they are not always the same ones either. Without posing the question of how geography may influence the development of the IS, regional differences can be revealed as a result of SIBIS. For example, overall the US leads the way, with high Internet penetration and experience. Northern Europe, however, often has even higher figures. In another case, SIBIS shows that overall Eastern Europe still has a long way to go to reach current EU levels, although, as noted, significant differences were measured between the Eastern European countries so that the leading countries there performed better than the lagging countries of the EU.

The purpose of SIBIS was to test and pilot indicators, which should be used in larger, more comprehensive surveys. The results obtained are very promising, although they still present certain limitations. For example, because of limited budget availability and not to overload interviewees only a relatively limited number of respondents were interviewed and the questions used followed a nested structure. This complicated analysis, because in some cases it was impossible to know what additional information might have been gained

from the survey by asking the question to all instead of only those who gave a selected response to earlier questions. This issue is considered in greater detail in other SIBIS products - in particular the Indicator Handbook – where the ‘best’ indicators are given – even when these were not the ones actually tested.

SIBIS provided useful insights into differences between regions (such as the EU vs. Accession Countries) as well as between individual countries. SIBIS thus pointed to factors that are associated with a digital divide that exists between citizens of the EU Member States and those of the Accession Countries, based on looking at PC and Internet participation of respondents. Groups at risk of missing out on the development of the IS groups may include the elderly or those with a relatively low level of education, among others. However, looking at these factors, depending on the type of the survey used, SIBIS may not be capable of reaching the groups that are falling behind to learn about the barriers that prevent their full participation in the IS.

Some factors in the success of the IS play a prominent role across many areas of study. Information and network security are increasingly recognised as crucial elements for ensuring wide participation in the IS. Their impact is clear in areas such as e-commerce and e-government. While the importance of a secure information infrastructure was not disputed, before SIBIS data on such issues was scarce. Some attempts to measure issues of information security (such as occurrence of breaches, their seriousness etc.) had been made, but were not focused on the EU and the Accession countries, and were typically conducted on-line, thus excluding persons with limited Internet access. SIBIS represents a first attempt in this direction, specifically targeting European and US citizens and organisations through telephone-assisted or paper and pencil interviews.

Enhancements in on-line security are crucial to fostering on-line trust, which in turn is a necessary support for companies’ efforts to increase their on-line transaction activities. Hence, the measurements of Business-to-Consumer (B2C) intensity and of security are correlated. Moreover, information security management as well as technical solutions are necessary conditions for the establishment of a successful and fully compliant on-line commercial activity. It is clear then, that information security is a pivotal element for prompting the delivery of services and goods on-line, as also shown by indicators measuring self-assessed impacts of on-line sales and purchases. Finally, information security is also essential to support new forms of interactions between employers and employees through processes and applications such as telework or on-line training facilities.

Aside from the effects of trust on ecommerce, concerns regarding data security and privacy on-line can also be symptomatic of people’s trust towards on-line environments. SIBIS argued that the specific issue of ‘trust’ was not suitable for benchmarking. In other words, it did not appear possible to measure ‘trust’ as such as this is a subjective perception on the part of the user. Hence, trust is naturally multidimensional, which in turn prevents us from quantifying it. Although it is legitimate to assume that information security issues and individual perceptions of access are correlated to the ‘trust’ individuals feel towards on-line environments, this assumption does not necessarily entail a cause-effect relationship. As a consequence, SIBIS has neglected any attempt to measure ‘trust’. Nevertheless, measuring individual perceptions of security and privacy over the net is significant because indirectly connected to the development of trust in the on-line world.

There is widespread agreement that the introduction of ICTs as workplace technologies and into all types of everyday applications requires users to apply a new set of basic skills generally referred to as ‘digital skills’. Hence, to be aware of the IS’ developments, it is crucial to know how these skills are being acquired and to what extent they are already in place. SIBIS developed and piloted a number of indicators on skills and digital literacy in the IS.

Indicators on e-commerce reveal that it is better to segment the market between occasional and frequent users, and focus on the second type. E-commerce buyers are, in fact, normally to be found among the more sophisticated Internet users. Variations by country of the diffusion of e-commerce are still strongly influenced by the degree of readiness of each country infrastructure and the level of Internet penetration. Looking at development of B2C by country, in the future its dynamics are likely to be influenced by a combination of Internet pervasiveness factors and retail market characteristics, including the maturity of on-line offers and characteristics of consumers' behaviour. B2B is a more complex domain, where the understanding of the interaction between e-commerce innovation and existing business processes is still far from adequate, and therefore discussion on appropriate indicators is open and lively. The implications for market structure and business value chains are stronger here than in the case of B2C, but less understood.

SIBIS developed and piloted a number of indicators on e-work. The exercise of developing new statistical indicators on e-work began with the argument that systems of production and labour deployment are changing as a result of the growing importance of information and knowledge vis-à-vis the traditional factors of production. Therefore, it is crucial to measure these developments constantly, adequately, and efficiently. The EU has endorsed this task by stressing repeatedly that the ability of individuals, businesses and governments to adapt to ICT-enabled changes is a prerequisite for the IS to thrive.

One of the key fields where the opportunities offered by the Internet play a crucial role is research. SIBIS set out to benchmark the use of Internet technologies in European research systems. Although in principle research systems include academic and private sector research and development (R&D) establishments, SIBIS considered public science and defines e-science as its penetration with computers and computer networks. Additionally, the focus was set on five scientific disciplines (astronomy, chemistry, economics, computer science and psychology).

Available data on National Research Networks (NRN), their core capacity (the maximum data transfer rate per second available within the network), their congestion, and their budget size show an unclear picture. Besides 'soft' readiness indicators, relating to scientists computer skills and their awareness of the capacities of IT for knowledge production, SIBIS also measured the quality of currently used computer equipment. An index was created accordingly. SIBIS assessed to what extent scientists do in fact use e-science tools for their work, either for data collection, analysis or diffusion of results. Country differences, even though revealing a patchwork of strengths and weaknesses, are less marked than discipline-related differences.

The impact of computer networks on science can be analysed by looking at the outcomes of R&D (publications, citations of publications, patents) and by looking at the collaboration activities of scientists, as ICTs are supposed to support in particular communication and collaboration in science. Previous scientific analyses have tested the hypothesis that Internet applications increase the productivity and raise the output of scientific research and more often than not found positive effects.

The SIBIS study in this area has been fruitful and highlighted some key elements which previously lacked of any measurement, but ought to be developed further, for example by analysing causalities: astronomers might use e-science applications more than other because they collaborate to a large extent and have to bridge the distances from their collaborators; but computer networks might as well have supported the further growth of collaborative activities. SIBIS neglected to account for this sort of interpretation. Additionally, it is clear that the indicator system and the available data cannot yet be

considered comprehensive and further research is needed on a variety of issues, such as in the case of large vs. small NRNs, or sub-NRNs.

The e-health domain is a very broad and complex domain, partly deriving from the wide variety of players involved. Another element of complexity derives from the variations in the ways that healthcare systems are organized in different countries, with varying mixes in terms of public and/or private provision and utilization and whether or not general practitioners play a gatekeeper role in determining access to other services. There are also significant variations in the ways that services are delivered and in what is deemed to be acceptable or good practice.

In line with the stated project objectives of linking with the eEurope initiative, the SIBIS work on eHealth focused especially on indicators for benchmarking eHealth activities of the general public and of healthcare providers. These are the priority areas identified for benchmarking in eEurope 2005. In recognition of the broader scope of the eHealth domain, however, the project also devoted some effort to collating candidate indicators for other healthcare players, such as educational institutions, insurers/reimburseurs and administrations.

Although on-line searching for health-related information is still a minority activity in Europe amongst Internet users, it is of sufficient scale to represent a significant issue for public health policy in general and for patient-doctor interaction in particular. If such activity is judged to be a positive development in public health terms, then the EU lags behind the US in the extent to which the general public is availing of the new opportunities. Language is an important factor to be considered in e-health policy and it will be necessary to ensure that sufficient quality information is available for all language groups if linguistically determined health divides are to be avoided.

About half of those in the EU who have searched for health-related information on the Internet have done so to get a second opinion on a medical diagnosis. Thus, SIBIS provides the first robust quantification of the many anecdotal reports of patients becoming more informed and more questioning of the diagnoses and therapeutic recommendations of their doctors. It underlines the need for public health policy in Europe to give attention to supporting patients and doctors to exploit the new opportunities for sharing health management and decision-making in a positive and synergistic manner. Additional results obtained from SIBIS point the way to the work on developing quality criteria for health web sites and even more on educating users to be discerning in their information search.

7 ABBREVIATIONS

B2B	Business to Business
B2C	Business to Citizen
B2G	Business to Government
CBNI	Closed Business Network Integration
COQS	Communicating, Obtaining, Questioning, Searching
DIDIX	Digital Divide Index
DL	Digital Literacy
DL	Digital Literacy
DMS	Decision Maker Survey
EC	European Commission
EDI	Electronic Data Interchange
EDT	Electronic Data Transfer
EITO	European Information Technology Observatory
ESS	European Statistical System
EU	European Union
EU15	Average of the 15 EU member states
G2B	Government to Business
G2C	Government to Citizen
G2G	Government to Government
GPS	General Population Survey
ICT	Information and Communication Technology
IS	Information Society
ISDN	Integrated Services Digital Network
IST	Information Society Technology
LFS	Labour Force Survey
NAS	Accession countries; originates from New Accession States
NAS10	Average of the 10 Accession countries
NRN	National Research Network
OECD	Organisation for Economic Co-operation and Development
PAPI	Personal Aided Personal Interview
PIAP	Public Internet Access Point
R&D	Research and Development
SIBIS	Statistical Indicators Benchmarking the Information Society
SMEs	Small and Medium Enterprises
SMS	Short Message Service
SOHO	Small Office Home Office
UK	United Kingdom
US	United States
WWW	World Wide Web
xDSL	Digital Subscriber Line

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9 ANNEX 1: METHODOLOGY

9.1 *Methodology of the GPS 2002 survey*

The survey was conducted in April-May 2002 (interviews were carried out between 4th April and 18th May) in all 15 EU Member States plus Switzerland and the US, using computer-aided telephone interviews. The survey was co-ordinated and executed by INRA Deutschland GmbH, Mölln. 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). 11,832 interviews were successfully completed. The average interview length per country varied between 10 (Greece) and 20 minutes (Sweden).

Sampling: Target households were selected at random in all countries, either by random dialling techniques such as permutation of final digits or by drawing a random sample from official sources. In most cases, a geographical stratification was implemented beforehand. For the selection of the target person common random keys were applied in all countries except for the UK where quota was used. In two cases (Spain, the US), screening had to be directed towards male respondents towards the very end of the field in order to gain gender representativeness.

There were three adjustments necessary in order to provide reliable data:

- 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
- 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 was adjusted to the official statistics. The rational weighting factor, which results from the iterative weighting, was included in the data material.
- 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.

	Total		EU15	
	unweighted	weighted	unweighted	weighted
Total sample	11832	11832	10306	10306
Country				
B	585	585	-	-
DK	501	501	-	-
D	1001	1001	-	-
EL	505	505	-	-
E	1015	1015	-	-
F	1000	1000	-	-
IRL	500	500	-	-
I	1000	1000	-	-
L	500	500	-	-
NL	530	530	-	-
A	500	500	-	-
P	500	500	-	-
FIN	669	669	-	-
S	500	500	-	-
UK	1000	1000	-	-
EU15	-	-	10306	10306
CH	522	522	-	-
US	1004	1004	-	-

	Total		EU15	
	unweighted	weighted	unweighted	weighted
Age groups				
Up to 24	1964	2019	1731	1651
25 to 49	5511	5309	4817	4593
50 to 64	2515	2495	2191	2209
65 and more	1833	2000	1558	1839
	9	9	9	14
Terminal education age				
Up to 13	695	717	693	728
14	715	742	701	881
15 to 16	1794	1750	1641	1820
17 to 20	3587	3515	2997	2937
21 and more	3266	3275	2743	2495
Still studying	1687	1751	1463	1372
	88	81	77	73
Internet usage				
Total Internet use	6905	6908	5828	5610
Regular use (last 4 weeks)	5944	5948	4985	4781
Occasional use (last 12 months)	961	960	843	830
Non Internet use	5550	5643	4655	4548

9.2 Methodology of the GPS-NAS 2003 survey

The survey was conducted in January 2003 (interviews were carried out between 1st January and 31st January) in 10 Accession Countries: Bulgaria, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia, using personal aided personal interviews (PAPI). The survey was co-ordinated and executed by NFO AISA Czech Republic, Prague. 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). 10,379 interviews were successfully completed. The average interview length per country varied between 20 (Romania) and 40 minutes (Lithuania).

Sampling: Target households were selected at random in all countries, either by multistage stratified random-route sampling or by drawing a random sample from official sources. Mostly a geographical stratification was implemented beforehand. For the selection of the target person common random keys were applied in all countries, i.e. the next birthday method and the Kish method, except for Bulgaria where quota was used.

There were three adjustments necessary in order to provide reliable data:

- Transformation from household sample to person sample in Poland and Slovenia. 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.

- 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 was adjusted to the official statistics. The national weighting factor, which results from the iterative weighting, was included in the data material.
- Adjustment of weighted sample structure to the NAS10 countries population. This weighting factor was necessary to calculate total figures according to the whole population of the Accession Countries. Furthermore it is useful to compare the NAS with the EU. Population sizes of each of the ten states are weighted to reduce the distortion based on the sample sizes in each country.

	<i>Total</i>		<i>NAS10</i>
	unweighted	weighted	weighted
Total sample	10379	10371	10379
Country			
BG	104	1008	-
CZ	1096	1096	-
EE	1001	1001	-
HU	1000	1000	-
LT	1017	1017	-
LV	1006	994	-
PL	1000	1000	-
RO	1054	1054	-
SI	102	1002	-
SK	1199	1199	-
NAS10	-	-	10379-
Age groups			
Up to 24	2036	1825	1736
25 to 49	4473	4604	4593
50 to 64	2402	2202	2234
65 and more	1468	1740	1816

	<i>Total</i>		<i>NAS10</i>
	unweighted	weighted	weighted
Terminal education age			
Up to 13	374	433	575
14	658	682	855
15 to 16	1099	1151	1099
17 to 20	4784	4816	4869
21 and more	1823	1833	1719
Still studying	1407	1213	1057
Never went to school	59	59	68
Don't know	175	184	138
Internet usage			
Never heard of the Internet (incl. don't know)	1349	1437	1506
Ever heard of the Internet	9030	8935	8773
Total Internet use	3700	3507	2773
Regular use (last 4 weeks)	3025	2852	2215
Occasional use (last 12 months)	675	655	559
Non Internet use	6679	6864	7606

9.3 Methodology of the DMS 2002 survey

The survey was conducted in March-May 2002 (interviews were carried out between 21st March and 15th May) in seven EU Member States using computer-aided telephone interviews. The survey was co-ordinated and executed by INRA Deutschland GmbH, Mölln. The population for this study is defined as all establishments belonging to four aggregated industry sectors in the seven Member States Germany, Finland, France, Greece, the UK, Italy and Spain. The interview was conducted with IT responsible persons in companies across all sectors of the economy. 3,139 interviews were successfully completed. The average interview length per country varied between 14 (France) and 18 minutes (Italy).

Sampling: 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 four aggregated sectors (manufacturing, construction, primary sector; distribution, catering, transport & communication; financial & business services;

public administration, education, health, other personal and social services). Drawing the sample was organised locally by the national executing institutes.

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 (1 to 9, 10 to 49, 50 to 199, 200 to 499 and 500+) 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).

- **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. 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 (Italy), National Statistical Service of Greece (Greece), SIREN (France), Tilstokeskus Official Statistics (Finland), Heins + Partner B-Pool (Germany) and 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. 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 EU-7 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.

	<i>Total</i>	
	<i>unweighted</i>	<i>weighted by employment</i>
Industry sector		
Primary: manufacturing, energy, mining, construction	990	989
Secondary: distribution, catering, communication and transport	873	878
Third: financial and business services	502	501
Fourth: public administration, health, education, other social/ personal	774	772
Businesses with Internet access		
Having access to the Internet	2785	2785
No access to the Internet	354	354
Security breaches		
Establishments affected by security breaches in the last 12 months	514	552

	<i>Total</i>	
	<i>unweighted</i>	<i>weighted by employment</i>
Total sample	3139	3139
Country		
D	512	512
EL	301	301
E	507	507
F	501	501
I	512	512
FIN	306	306
UK	500	500
Number of staff at site		
Up to 9	803	713
10 to 49	769	746
50 to 199	668	648
200 to 499	626	364
500 and more	273	668
Businesses with online presence		
Online presence	1857	1925
No online presence	1264	1190
Don't know	18	24

9.4 Methodology of the R&D survey

The survey was carried out from April to July 2003 in six EU Member States and Switzerland. The survey was co-ordinated and executed by the University of Applied Sciences Solothurn Northwest Switzerland aided by the SIBIS partners. The population of the survey are individual researchers at public research organisations (universities, non-university research institutes, polytechnics/universities of applied sciences). In principle, a traditional (personal, phone, written) as well as a novel, Internet-based survey (e-mail or on-line questionnaire) would have been possible. However, as one of the main targets was to assess the usage of various Internet tools, an on-line survey might have suffered from a severe sample selection bias. Therefore it was decided to carry out a postal survey for which a questionnaire with 48 questions was developed. All scientists in the sample received the questionnaire two times with a cover letter and a postage free (except for the UK) return envelope between April and July 2003.

Sampling: As comprehensive and comparable information on the structure of the population were not available, but at the same time various factors such as scientific discipline, position of the researcher (R&D manager, senior researcher, junior researcher), age and experience, affiliation were assumed to affect the responses, only an exploratory survey was feasible. However, to control the variation in the sample and allow for comparative analyses, five scientific disciplines were selected (astronomy, chemistry, computer science, economics and psychology). A dataset size target of at least 30 scientists per scientific discipline in the smaller countries (Denmark, Ireland, the Netherlands and Switzerland) and 40 scientists in the larger countries (Germany, Italy, and the UK) was chosen. Assuming a response rate of 20% this led to sample sizes of 150 (200) researchers per scientific discipline and country.

Address collection: Addresses of researchers were retrieved by two methods. First they were gathered from scholarly associations at European and national level (either from their published membership records or from their internal address databases).⁴⁷ Second, the remaining gaps were closed through address searches via the Internet which employed the following procedure:

- Step 1: random selection of research institutes (based on national or international Internet link lists for a scientific discipline);
- Step 2: random selection of individual researchers from the staff lists of these institutes as published on their web pages.

One of the tables below gives an overview of the sample sizes per scientific discipline and country.

Response rate: Overall 1578 out of the 6518 respondents replied to the questionnaire and 183 letters were returned, because the respondent had died or left the organisation. This leads to an overall net response rate of 25% (see the table below on the response rates by scientific discipline and country). Out of the 1578 responses, 69 declined to fill out the questionnaire and 51 filled it out only partially, for instance because they were not involved in R&D. The database for the empirical analyses therefore consisted of 1458 usable questionnaires. The address collection via scholarly organisations and the Internet left some insecurities in regard to the actual scientific discipline in which the respondents carried out their research. As the questionnaire also included a question on the three major disciplines of R&D, it was decided to use the responses to this question as the relevant information for attributing respondents to scientific disciplines. Only the core disciplines were included in the discipline-specific analyses.

Weighting: The information on the main scientific discipline of R&D was also used for calculating country and discipline-specific weights. Scientific disciplines affected the performance of e-science indicators to a large extent; variations of sample compositions by discipline would then lead to variations of the country values. To avoid this, each case received a weight which in total equalised the differing sample structures. See the tables below on the effects of the weighting on the dataset.

⁴⁷ The following associations have to be thanked for their generous support: British Computer Society, European Association of Experimental Social Psychology, European Economic Association, German Informatics Society, Italian Chemical Society, Swiss Association for Research in Information Technology.

<i>Sample size per country and scientific discipline (discipline of the address)</i>						
Country	Astronomy	Chemistry	Economics	Computer Science	Psychology	All disciplines
D	200	200	276	300	239	1'215
CH	165	150	195	172	173	855
DK	107	164	157	152	124	704
I	200	221	260	200	251	1'132
IRL	101	150	170	151	91	663
NL	165	158	211	150	171	855
UK	214	200	203	252	225	1'094
Total	1'152	1'243	1'472	1'377	1'274	6'518

<i>Response rates per country and scientific discipline (main discipline of R&D)</i>						
Country	Astronomy	Chemistry	Economics	Computer Science	Psychology	All disciplines
D	17.3	24.6	27.8	27.7	24.1	24.8
CH	27.7	33.6	33.3	34.9	35.5	33.1
DK	37.8	32.5	29.5	33.1	20.2	30.3
I	26.2	31.2	24.4	27.1	27.3	27.2
IRL	23.2	20.7	31.0	25.3	22.2	25.0
NL	20.9	27.2	17.1	11.0	15.8	18.3
UK	18.4	18.6	17.9	16.7	20.4	18.4
Total	23.3	26.7	25.4	25.0	24.0	24.9

<i>Unweighted responses per country and scientific discipline (main discipline of R&D)</i>							
Country	Astronomy	Chemistry	Economics	Computer Science	Psychology	Other disciplines	All disciplines
D	27	36	47	39	54	28	231
CH	24	43	54	67	54	36	278
DK	30	35	28	34	21	35	183
I	43	68	58	36	60	21	289
IRL	13	32	41	31	20	17	154
NL	23	35	36	14	24	12	144
UK	29	33	32	34	39	8	175
Other countries and missing	0	0	3	0	1	0	4
All countries	189	282	299	255	273	160	1458

<i>Weighted responses per country and scientific discipline (main discipline of R&D)</i>							
Country	Astronomy	Chemistry	Economics	Computer Science	Psychology	Other disciplines	All disciplines
D	38	42	44	36	43	29	232
CH	42	50	48	49	52	39	280
DK	33	31	28	30	26	36	184
I	46	56	58	47	56	21	290
IRL	20	31	30	30	22	21	154
NL	26	24	29	25	28	12	144
UK	33	33	35	34	34	8	177
Other countries and missing	0	0	3	0	1	0	4
All countries	242	266	273	254	263	166	1465

10 ANNEX 2: PROJECT PARTNERS

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