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Working Party on Indicators for the Information Society

MEASURING THE IMPACTS OF ICT USING OFFICIAL STATISTICS

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FOREWORD

This paper presents available (mainly official) statistics on the impacts of ICT and discusses a number of statistical issues associated with ICT impact measurement. It attempts to place ICT impacts measurement into an Information Society conceptual framework and suggests a number of areas for further work.

The paper was prepared by Sheridan Roberts, consultant to the OECD, with input from OECD staff, members of the Working Party on Indicators for the Information Society (WPIIS) and staff members of national statistical offices. The WPIIS agreed, at its May 2007 meeting, to forward the paper to the Committee for Information, Computer and Communications Policy (ICCP) for declassification after any further comments from WPIIS delegates were incorporated. None were subsequently received although the paper has been slightly updated to reflect developments since May 2007.

The ICCP Committee declassified the document at its meeting on 4-5 October 2007.

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MEASURING THE IMPACTS OF ICT USING OFFICIAL STATISTICS

Introduction

Policy makers everywhere want to know the impacts of ICT. They are interested in both economic and social impacts, though it should be noted that, in a statistical and policy sense, the former have generally received more attention – in OECD countries at least.

While it seems obvious that there are significant economic and social impacts of ICT,[1] showing this statistically is not straightforward.

This paper describes the findings of an OECD project examining ICT impact measurement and analyses based on official statistics.[2] Both economic and social impacts are covered and some results are presented.[3]

The paper attempts to place the study of ICT impacts into the context of a broader conceptual framework of Information Society statistics and provides some suggestions for standardising terminology and methodologies.

Note that while it is not covered in this paper, the environment is also affected by ICT, with direct environmental impacts arising from events such as poor disposal of PCs and the role of ICT in modelling the impacts of climate change.

What do we mean by the term 'impact' in a statistical context?

According to *dictionary.com*, the meanings of the term 'impact' include: *influence*, *effect* and *force exerted by a new idea, concept, technology, or ideology*. Merriem-Webster's online dictionary includes *a forceful contact or onset* and a *force of impression of one thing on another: a significant or major effect (e.g. the impact of science on our society).*

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1. As expressed by the International Telecommunication Union (ITU, 2006), "You want to know the difference information and communication technologies make? Try to live without them…" The belief in the development potential for ICT is very strong, with the *Tunis Commitment* from the second World Summit on the Information Society (WSIS) stating that "The Tunis Summit represents a unique opportunity to raise awareness of the benefits that Information and Communication Technologies (ICTs) can bring to humanity and the manner in which they can transform people's activities, interaction and lives, and thus increase confidence in the future." (WSIS, 2005).

2. Statistics produced by government statistical agencies according to the UN's fundamental principles of official statistics as adopted by the United Nations Statistical Commission in 1994: http://unstats.un.org/unsd/statcom/doc94/e1994.htm. Note that government statistical agencies are not limited to national statistical offices.

3. National statistical offices (NSOs), and other 'official' government statistical agencies, have specific core capabilities in respect of statistical frameworks, data collection and compilation. This paper looks at the range of statistical approaches which are consistent with those core capabilities. It therefore does not consider (except incidentally) statistical approaches such as case studies and controlled experiments which are likely to be very important means of collecting information about ICT impacts.

It is evident from these definitions that ‘impact’ can be a strong or weak concept (contrast ‘force’ or ‘major effect’ with ‘influence’). As Figure 3 below shows, an impact can also be narrow or broad. For instance, compare the impact of ICT on a single business with the impact of widespread ICT use by the business sector. Impacts can be classified in other ways as well, for example: economic/social, positive/negative, short/long term, intended/unintended, direct/indirect and intermediate/final. Measures of impacts will reflect these classifications with perhaps the addition of a subjective (perceptions)/objective distinction.

In searching for appropriate terminology and concepts, it is helpful to look at other areas of impact measurement. For example:

- The Australian Bureau of Statistics (ABS) framework for measuring a knowledge-based economy and society (KBE/S) (ABS, 2002) includes a dimension on economic and social impacts which deals with the effects on the economy and society of an increased emphasis on – and use of – knowledge. The dimension deals with the impact of 'intermediate' KBE/S outcomes on broader measures of economic and social progress. An 'intermediate' KBE/S outcome could be an increase in use of the Internet by businesses or a higher proportion of households with access to a computer at home.

- OECD work on the economic and social importance of culture (OECD, 2006a) explored methods of measuring the importance of culture. Economic measures of the importance of culture proposed were: economic size of the industry in terms of output and value added; level of employment (either in terms of industry or occupation); government funding; private sector funding; consumption details, by commodity; level of exports and imports; and domestic content of output. The paper discusses a number of aspects of the social importance of culture but is not able to make definitive recommendations for social indicators.

- Statistics Canada’s statistical framework for measuring science and technology activities recognises activities, linkages and outcomes. In addition, the framework defines impacts as the “consequences for the social, economic, political and environmental system, and to science, that take longer to emerge and are often more difficult to detect and impute back to their origins.” The framework makes the point that outcomes can lag the start of an activity and that it can be a long time before the impact of an outcome is detected (Statistics Canada, 1998).

- There are also evaluation and monitoring methodologies which are useful for defining terms such as ‘inputs’, ‘impacts’, ‘outcomes’ and ‘outputs’; for instance, Wainwright (2002).

How do ICT impacts fit into measurement frameworks for ICT statistics?

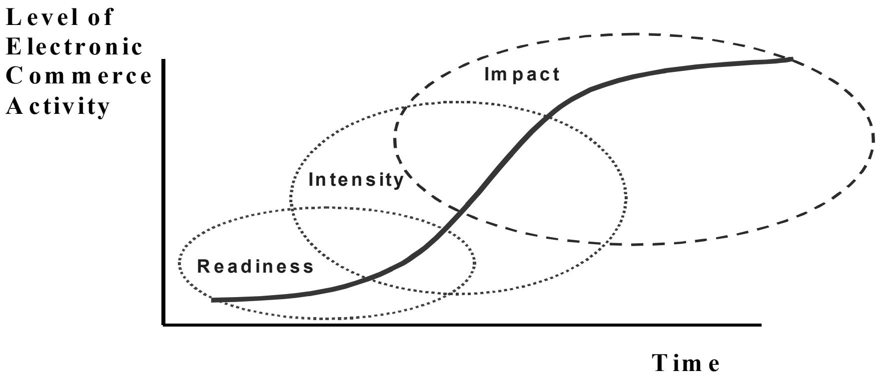
In the widely cited S curve shown in Figure 1 below, there are three stages of e-commerce measurement proposed – readiness, intensity and impact. The framework was originally developed to describe indicators for electronic commerce and includes:

- **E-readiness** – preparing the technical, commercial and social infrastructures necessary to support *e-commerce*. E-readiness indicators allow countries to construct a statistical picture of the state of readiness of the infrastructure necessary to engage in *e-commerce*.

- **E-intensity** – the state of *e-commerce* use, volume, value and nature of the transactions. E-intensity indicators permit countries to profile who is exploiting e-commerce possibilities and who is not, and to identify leading sectors and applications.

- **E-impact** – the value added potentially created by *e-commerce*. Statistics are needed to evaluate whether and to what extent *e-commerce* makes a difference in terms of efficiency and/or the creation of new sources of wealth.

Figure 1. The S-curve: e-commerce measurement priorities



Source: OECD (2000); the Figure's original source is Industry Canada.

The S curve concept is sometimes extended beyond e-commerce to cover ICT use more generally (including, in recent years, electronic business). When the model was first discussed by the OECD's Working Party on Indicators for the Information Society (WPIIS), it was recognised that the third stage – impacts – would be statistically challenging. This has proven to be the case.

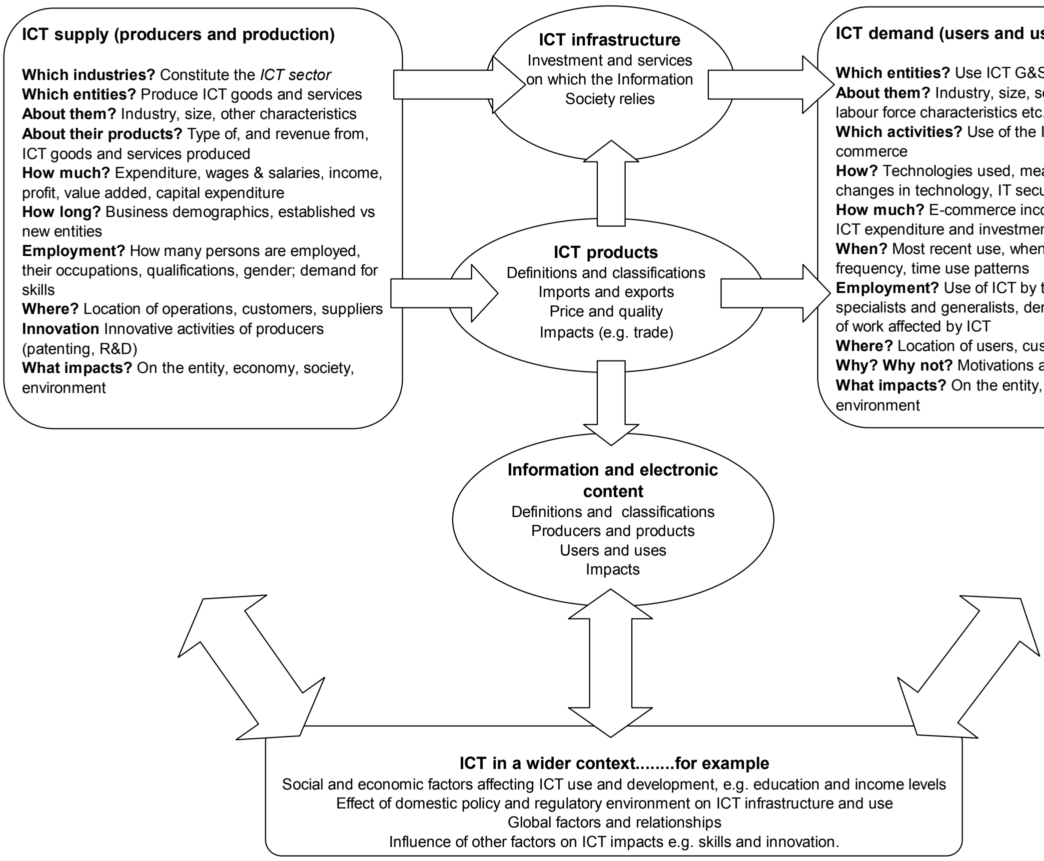
The OECD's forthcoming revision to the *Guide to Measuring the Information Society* (2007a) proposes a more comprehensive conceptual model for information society statistics (see Figure 2 below). As the model shows, impacts reflect the general model in that there are impacts of every aspect of the information society, for instance:

- The impacts of ICT use and production on entities, the economy and society.
- The impacts of trade in ICT products.
- The impacts of use and production of content (in particular, 'electronic' or 'digital' content which only exists because of ICT).
- The influence of other factors on ICT impacts, for example, skills and innovation as important co-factors in the impact of ICT on firm performance.

In addition, various factors have an impact **on** ICT, for example, the domestic policy and regulatory environment, and global factors and relationships. Whilst these are important measurables for policy monitoring purposes, they will not be further considered in this paper.

The complexity and diversity of ICT impacts are important reasons for the interest in the ICT 'phenomenon'. However, these characteristics also help to explain why measurement of ICT impacts is not a simple undertaking. Another major reason that ICT impacts are difficult to measure is that any impact of one factor on another is difficult to demonstrate because a positive correlation cannot readily be attributed to a cause-and-effect relationship. A complicating factor is explained by the ITU (2006) when it compares measurement of the impact of ICT with that of electricity, stating that "Part of the difficulty is that both ICTs and electricity are "enabling" or "General Purpose Technologies"…… which means their use and their impacts are ubiquitous yet difficult to measure because they are mainly indirect. It is not electricity or ICTs as such that make the (bulk) impact on economy and society but how they are used to transform organization, processes and behaviours."

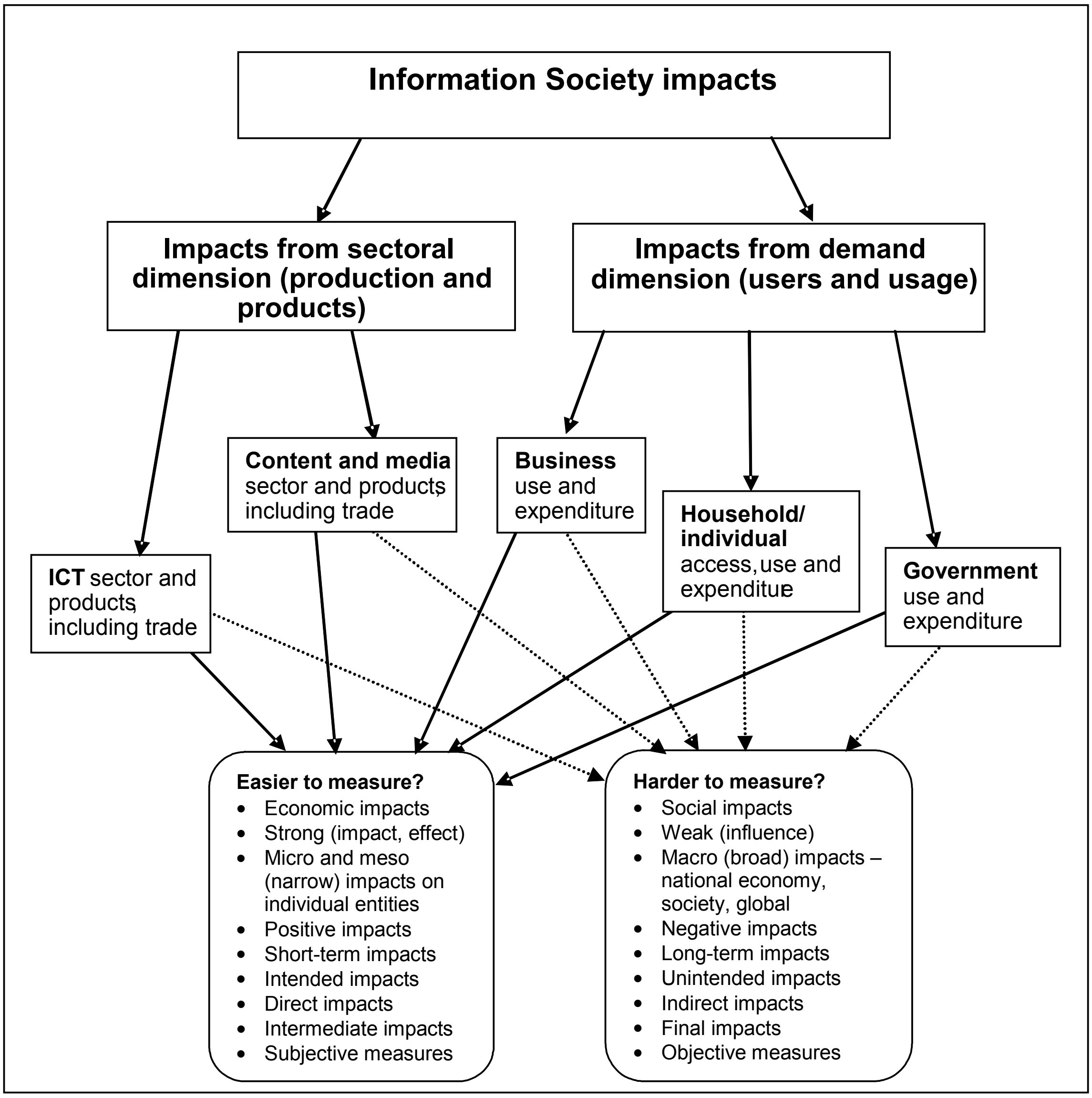
Figure 2. Information society statistics conceptual model



Source: OECD *Guide to Measuring the Information Society* (as revised in 2007, OECD 2007a).

The discussion above suggests a model of ICT impacts as shown in Figure 3 below:

Figure 3. Information society impacts measurement model



A quite different approach to ICT impacts measurement[4] is an *a priori* one which entails use of an objectives classification to ascertain the **purpose** of undertaking a particular ICT activity. The socio-economic objective (SEO) classification for R&D resources (per the *Frascati Manual*, OECD 2002) is a candidate for such a classification as it is already an international standard.[5] Similar to the purposes for undertaking R&D, ICT impacts extend to all areas of human endeavour including economies, societies and the environment. Examples include the role of ICT in space exploration, defence and intelligence, commerce and science. There is already an ICT dimension of R&D measurement (via the sector performing it). However, this suggestion goes beyond that, proposing that an objectives classification be applied to other areas of ICT measurement, such as ICT supply and use. The construction of successful objectives measures would require more comprehensive data sources than currently exist, for example, government expenditure on/investment in ICT. It would also require changes to current ICT demand and supply surveys.

In respect of the ICT dimension of R&D, a relatively simple but useful data enhancement would be the collection of information on R&D **into** ICT. This would most likely be via the Field of Science classification recommended by the *Frascati Manual*. Currently, the manual does not separate ICT R&D from other fields of study. However, individual countries may do so.[6] The *Manual* encourages countries to use more detailed field of science classifications and foreshadows work on a more detailed international classification of fields of science for statistical use.

Measurement of the economic impacts of ICT

Introduction

In the late 1990s, the OECD started to consider ICT measurement using official statistics. It brought representatives from national statistical offices (NSOs) together to form the WPIIS. Early work focused on the contribution of an ICT sector to a country's economy and resulted in the first definition of the ICT sector in 1998. Work followed on the use of ICT by businesses, with a particular interest in e-commerce and, ultimately, its impact on business performance (as shown in Figure 1).

The results of the OECD's *Growth Project* were released in 2001 (OECD, 2001a). Among other findings was the conclusion that ICT plays three roles in its economic impact:

- Through ICT investment contributing to capital deepening, leading to an increase in labour productivity.
- Through technological progress in the production of ICT goods and services, contributing to growth in the efficiency of capital and labour (multi-factor productivity (MFP) growth) in the ICT sector; and

4. Based on a suggestion from David McGeachie, Australian Department of Communications, Information Technology and the Arts, personal communication.

5. The classification consists of the following classes: Exploration and exploitation of the Earth; Infrastructure and general planning of land use; Control and care of the environment; Protection and improvement of human health; Production, distribution and rational utilisation of energy; Agricultural production and technology; Industrial production and technology; Social structures and relationships; Exploration and exploitation of space; Non-oriented research; and, Other civil research and Defence.

6. For instance, the ABS uses a very detailed classification in its R&D surveys. The classification has a complete division (Information, computing and communication sciences) covering ICT.

- Through MFP growth due to the use of ICT, through efficiency gains in individual firms, or through network/spillover effects from its use.

An important finding of the *Growth Project* was that productivity in the ICT sector can improve an economy's overall productivity, but that successful economies were more likely to have rapid diffusion of ICT, particularly in service industries.

Later empirical work by OECD and others on the role of ICT in economic growth (described in OECD, 2005a and Pilat, 2004) includes:

- Macro-economic analysis.
- Sectoral studies; and
- Firm level studies.

This work is described below, along with more recent work by NSOs in these and other areas of economic impact measurement.

Macro-economic analysis

OECD work in this area has been summarised by Pilat (2004). He described the impacts of ICT investment using growth accounting, noting that the technique requires data on ICT investment, and deflators adjusted for quality change (hedonic deflators). Lack of data, especially comparable data, is still a challenge for OECD countries. For instance, differences in national accounts treatment of hardware and software are still evident, despite the release of OECD measurement guidelines some years ago.

Individual country studies include those of Denmark which calculates labour productivity growth using information on ICT capital (equipment and software), non-ICT capital (plant, buildings, means of transport etc.), level of education and total factor productivity (residual changes in labour productivity that cannot be explained by changes in ICT capital, non-ICT capital and level of education).

Some findings

Broad findings from these studies are that ICT is a dynamic area for investment and accounted for between 0.3 and 0.9 percentage points of per capita growth in GDP (1995–2002).

Danish productivity studies show that ICT capital's contribution to labour productivity growth is increasing over time (5% share of growth in the period 1973–1979 to 31% in 2000–2003) (Nordic Council of Ministers, 2005).

Sectoral studies

Pilat (2004) summarises work done in this area by OECD and others. He distinguishes the role of an 'ICT-producing' and an 'ICT-using' sector.

The ICT-producing sector (also referred to simply as the 'ICT sector') has been defined by OECD (see OECD, 2005a; OECD, 2007a). The OECD has examined the contribution of the ICT sector to aggregate labour productivity growth. Measurement issues include lack of value-added and/or production data and associated deflators for the ISIC class level categories in the ICT sector.

In respect of ICT-using sectors, benefits derive from direct use of ICT by individual firms and spillover effects (benefits from networks). Pilat outlines studies which look at the contribution of an 'ICT-using sector' (including industries such as trade, finance and business services) to aggregate productivity growth. As with other work in this area, measurement problems hamper further analyses and include lack of agreement and best practice on output measures for services.

Some findings

The main findings in respect of the ICT-producing sector show an increasing contribution of ICT manufacturing to labour productivity growth. ICT services industries play a smaller role but have also seen rapid progress.

Findings on the contribution of ICT-using services industries to total labour productivity growth are less clear. For many countries, the contribution reduced between the periods 1990–1995 and 1995–2002. However, for some countries, there was a marked increase between those periods, notably for the United States, Mexico, Australia and Ireland.

Firm level studies

This area has been a fruitful, if challenging, one for statisticians. Pilat (2004) provides a history of effort in this area, including the increasing use of official statistics for such studies in recent years. Firm level studies of ICT impacts are based on data linkage from different statistical sources, including statistics on firm performance, ICT use, innovation and organisational factors. There is a variety of approaches to analysis of firm level data including labour productivity regressions, multivariate analysis and growth accounting. Economic impacts studied also vary and include labour productivity, MFP and value added. While this diversity of approach has some benefits, it also limits cross-country comparisons.

The United Kingdom has been prominent in this area and has used firm level data as follows to test impacts (Clayton, 2006):

- Hardware and software investment.
- Employee use of computers and networks (including broadband).
- Use of electronic commerce and e-business processes.
- Employee skills associated with IT investment; and
- Quality/speed of communications links.

Some findings

Firm level studies (OECD, 2005a) suggest that use of ICT has positive impacts on firm performance and productivity, but that benefits occur primarily, or only, when accompanied by other changes and investments (for example, where skills have been improved and organisational changes have been introduced). Firm-level evidence also suggests that the uptake and impact of ICT differ across firms, varying according to size of firm, age of the firm and activity.

Results for the United Kingdom (Clayton, 2006) include the following:

- Productivity effects from hardware and software investment are significant, and higher in services than in manufacturing.

- The effect of IT investment on productivity is much larger in US subsidiaries in the United Kingdom than in domestic firms or in other multi-national enterprises; the difference is big enough to explain most of the productivity advantage of US firms operating in the United Kingdom. This is assumed to be due to 'US management practices' which are thought to make better use of the information which ICT generates.

- Having employees use IT has a significant additional productivity impact, after taking account of IT investment effects, and after allowing for industry differences; it suggests that part of the impact is due to the changing nature of work. The effects on labour productivity are substantially bigger where employees are broadband-enabled (see OECD, 2006b for a detailed analysis of the broadband effect).

- There is evidence that e-commerce makes markets more price competitive, by opening up e-supply to more firms and reducing transaction costs (but benefiting most those firms which use e-procurement).

- The benefit from use of integrated or multiple electronic business processes is different between manufacturing and services firms; manufacturing gains come most strongly from procurement and supply chain management; services gains come most strongly from links to customers.

- IT productivity benefits are greatest in younger firms, irrespective of industry; and

- IT productivity gains are greatest in firms with more qualified (degree level) employees.

Eurostat project on analysis of ICT, productivity and growth[7]

This project, funded by Eurostat, aims to assess ICT impacts by linking (firm level) micro-data from different sources, with a major objective being to identify how ICT adoption affects business behaviour and performance. The major data sources are:

- The enterprise ICT community survey (business ICT use survey).

- SBS (structural business statistics).

- CIS (innovation surveys).

- The business register in each country; and,

- Where available, firm level data on investment/capital stock and ICT investment/capital stock.

The strength of the project lies in a common approach across the European Union, with one NSO (the United Kingdom's Office for National Statistics) taking the lead and co-ordinating the project on behalf of

7. The information in this section was provided by Tony Clayton of the Office for National Statistics (ONS) and Hartmut Buchow of Eurostat. A later update incorporated the findings of an October 2007 Eurostat report (Eurostat, 2007).

12 European NSOs, with academic input from Eric Bartelsman, who has pioneered this type of work for OECD in other areas.

A project workshop was held in October 2006, hosted by Statistics Sweden. Key issues covered at the workshop included:

- Definition of 'core' analysis which can be undertaken by all participants.
- Additional modules which some NSOs can implement, to help extend the scope of analysis.
- How to take account of key issues: worker engagement with ICT, quality of communications, innovation, international value chains and multi-national enterprises; and
- How to link firm level analysis with industry/macro analysis.

The project has already designed common code which has been used by eight NSOs to produce analytical outputs and indicators from linked firm level data. A review of results to date was presented to the WPIIS/WPIE joint workshop on 22 May 2007. The project is scheduled to end by March 2008, with delivery of analysis and recommendations for indicators.

Eurostat and the ONS will use the framework to consult on this work with other countries such as Australia, Canada, Japan, Korea and the United States, and benchmark their methodology and results as widely as possible. Where possible, non-EU NSOs will be encouraged to apply the methodology to produce comparable results.

Longitudinal/integrated collection strategy of Australia

The ABS has initiated a major statistical program – the Integrated Business Characteristics Strategy (IBCS) – designed to improve measures of Science and Technology business statistics (especially use of IT and innovation). The IBCS combines the collection, processing and output of a range of characteristics and financial data for longitudinal and cross-sectional purposes. The 'Business Characteristics Survey' component of the IBCS includes questions on business characteristics, use of IT and innovative activities. Figure 4 outlines the strategy which is also described below.

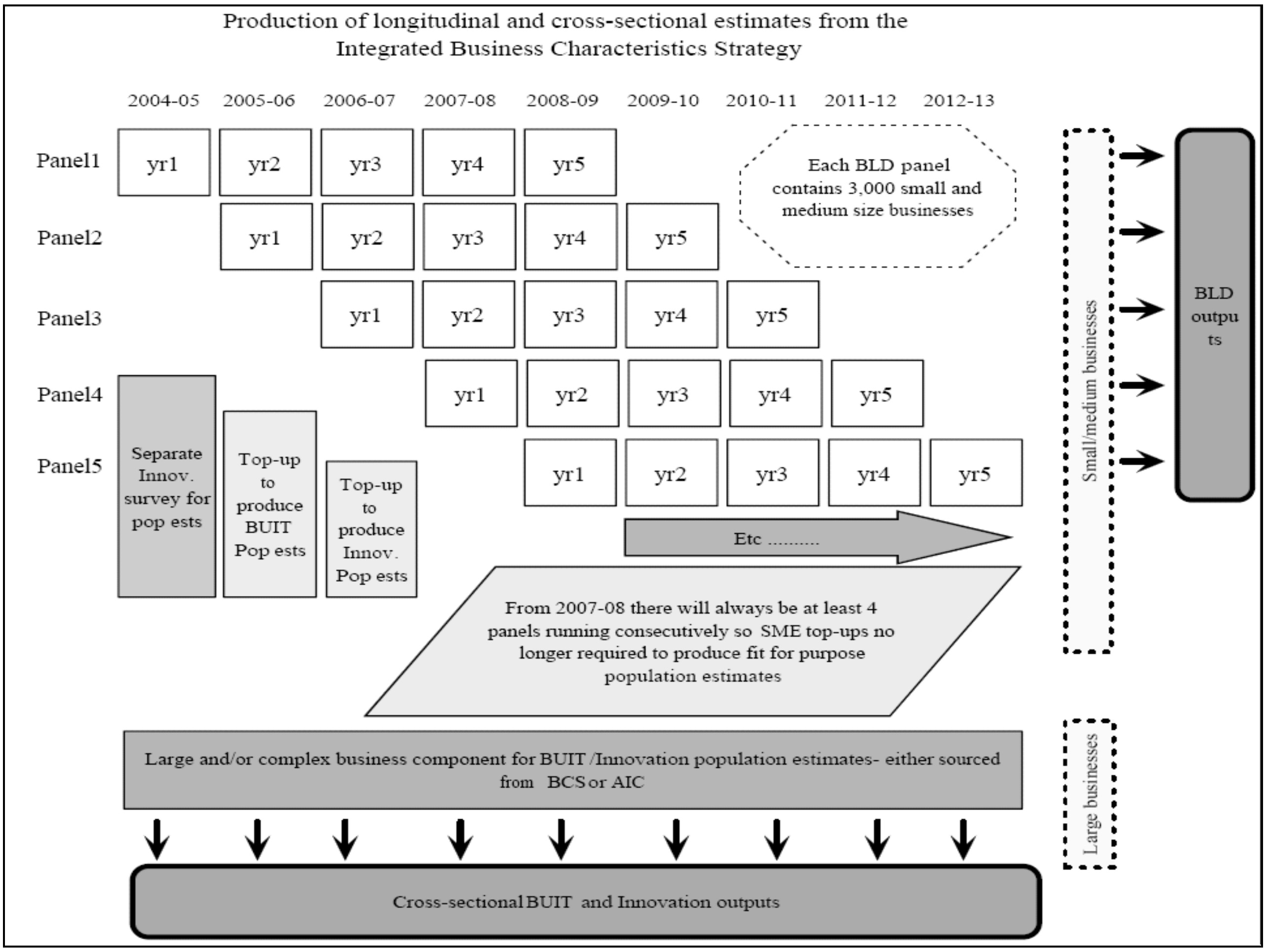
Small and medium-sized enterprises (SMEs) are selected in a series of panels, each of which remains in the survey for five years, thus giving a longitudinal series at firm level. Panels overlap over time (panel 1 starts in year t, panel 2 year t+1 etc). Taxation data are used for financial data (turnover, wages and salaries, and value added) and to extend the time series available at firm level. Trade data can also be linked to survey data to provide information about exporters.

Business characteristics (*e.g.* whether the business sells via the Internet) can be matched with performance indicators (*e.g.* change in turnover) to infer impacts.

Large businesses will be added to the panels each year to enable the production of cross-sectional data. Other ABS survey data will be used to populate the financial information for these large businesses.

Some productivity analysis should be possible as value added is available for each business and measures of labour input such as wages and employment are also available. Measures of capital services inputs are also being developed.

Figure 4. The Australian Integrated Business Characteristics Strategy



Source: ABS.

Note on acronyms: BLD – Business Longitudinal Database; BUIT – Business Use of Information Technology; BCS – Business Characteristics Survey; AIC – Annual Integrated Collection.

In May 2007, first experimental estimates from the Business Longitudinal Database were released in respect of SMEs for the periods 2003-04 (t1), 2004-05 (t2) and 2005-06 (t3). See ABS (2007) for a full description of the topics included in the Business Characteristics Survey and a discussion of the production of cross-sectional estimates from the IBCS. Table 1 below shows an example of the output data which are available. Similar information is potentially available for a range of business characteristics, including use of the Internet and nature of its use, labour force composition, business structure, time the business has been owned/controlled by the present owner, business operations and innovation. ABS (2007) contains some initial results denoted as ‘experimental estimates’ and designed to illustrate the range of data in the BLD. Due to the small sample of businesses included, initial results are not useable in a policy context.

Table 1. BLD output example, comparison of businesses by web presence

Web presence? Yes/No	Median sales			Median wages			Median value added (VA)			Median VA to wages ratio		
	t2 value	% change t1 to t2	% change t2 to t3	t2 value	% change t1 to t2	% change t2 to t3	t2 value	% change t1 to t2	% change t2 to t3	t2 value	% change t1 to t2	% change t2 to t3
non-employers												
1-4 employees												
5-19 employees												
20-199 employees												

ICT satellite accounts

Satellite account methodology is articulated in the international *System of National Accounts 1993* (SNA93). It allows for an expansion of the national accounts for selected areas of interest while maintaining links to the basic concepts and structures of the core national accounts and enabling comparability to, and consistency with, key economic aggregates such as GDP.

An ICT satellite account provides very good information on the impact of ICT on the economy. It typically uses (and confronts) a number of data sources to produce a range of outputs including the contribution of ICT to GDP.

The only countries known to have compiled an ICT satellite account are Australia and Chile (ABS, 2006a; Digital Action Group, 2006) though other countries have expressed interest in the concept.

The basic compilation framework for the Australian ICT satellite account (reference year, 2002-03) was the national accounts 'supply and use' system, adapted to focus on ICT products and ICT industries. ICT products included computer hardware, computer software, telecommunication assets, computer services and telecommunication services. ICT industries went beyond the recognised ‘ICT sector’, for example, they included own account investment in ICT by government and non-ICT businesses. ‘Demand’ included demand by businesses, government organisations and the household sector. ‘ICT GDP’ represents the total market value of ICT products produced in Australia after deducting the cost of goods and services used up in the process of production.

The methodologies and data sources used by the Australian and Chilean accounts differed slightly, with the Chilean account using a broader set of ICT products than Australia (which excluded audio-visual equipment) but having data gaps in the area of own account investment in ICT (overcoming this gap was recognised as a future challenge).

Some findings

The Australian ICT satellite account experimental estimates found that ICT accounted for 4.6% of total GDP in 2002-03 (ABS, 2006a). In Chile, ICT accounted for 3.4% of total GDP in 2004 (Digital Action Group, 2006).

In Australia, of the ICT contribution to total gross value added of 4.9%, telecommunication services contributed 2.2 percentage points (that is, 45% of the total). In Chile, telecommunications was the largest component of ICT value-added, at 61% of the total.

Perceptions measures

One way of measuring the impact of ICT on firm performance is to ask firms directly. While this approach provides direct causal information, it is often criticised for its subjectivity. The 2005 OECD model survey of ICT use by businesses includes a question on business perceptions of the benefits of Internet selling (OECD, 2005a). Response categories for the question include: ‘reduced transaction time’, ‘increased quality of customer service’ and ‘lower business costs’.

Eurostat’s 2008 enterprise ICT use model questionnaire includes an optional question about improvements attributable to ICT projects, as follows:

To what degree have ICT projects implemented in the last 2 years caused improvements compared to the previous task handling, in the following areas? *If your enterprise has not had any ICT projects, please check all boxes 'not applicable'.*	Minor / None	Moderate	Significant	Don't know / Not applicable
a) Reorganisation and simplification of work routines				
b) Release of resources from the tasks envisaged by the ICT projects				
c) Higher earnings for the enterprise				
d) Development of new products and services				

In its surveys of business technology use, the ABS has asked various impacts questions of businesses relating to Internet commerce. The 2004-05 survey asked those businesses which had received orders via the Internet or web to specify what benefits, if any, they had gained by receiving orders in this fashion. Businesses could identify more than one benefit of receiving orders via the Internet or web (ABS, 2006b).

Some findings

In Australia, businesses receiving orders via the Internet or web in 2004-05, reported being able to achieve ‘faster business processes’ and ‘improved quality of customer service’ as the two most commonly reported benefits of receiving orders in this fashion (51% and 44% of businesses respectively). Only about one fifth of businesses receiving orders via the Internet or web indicated that they did not achieve any benefits. Larger businesses (those with 100 or more employees) were more likely to report benefits from Internet/web selling, with 98% reporting some benefit (ABS, 2006b).

Measurement of the social impacts of ICT

Introduction

The measurement of the social impacts of ICT has received less attention from official statisticians than the measurement of economic impacts. This is despite the fact that the use of ICT by households has obvious impacts on economic performance (for instance, by stimulating demand for ICT and content products, and by encouraging the acquisition of ICT skills). Nevertheless, measures of ICT are increasingly appearing in social surveys, including those based on the OECD’s model surveys of ICT use (2002 and 2005) (OECD, 2005a).

Such surveys are revealing that ICT is changing how people do things such as:

- How – and where – they work.
- What kinds of things they study and what jobs they do.
- How they do everyday activities such as shopping, banking and dealing with government.
- How they spend their income.
- How they spend their time.
- How they obtain information on a variety of subjects including current affairs and health; and
- How they communicate with family and community.

As an example of how people are increasingly using ICT (especially the Internet) to do things in new ways, in Finland, 37% of Internet users did electronic banking in 1998 and 78% in 2005; 12% of Internet users did online shopping in 1998 and 34% in 2005 (Statistics Finland, 2006a).

ICT also has broader impacts on society, for instance, in the areas of health, crime and education. Methods used and some of the available data are presented below.

Challenges of measuring social impacts of ICT

For economic impacts, arguably the important questions of micro- and macro-economic impact are being addressed and are reasonably measurable. The questions in respect of society are less well defined and are likely to be harder to measure.

Looking at the final rather than intermediate impacts on society, how can a question like “Is ICT, on balance, beneficial for this society?” be addressed? Such a question is more subjective and multi-faceted than the ultimate economic questions of productivity and economic growth. At the ‘micro’ level, questions such as whether the use of ICT in education benefits individuals are also essentially unanswered.

Statistics on social impacts of ICT tend to be of an intermediate nature, for instance, impact on patterns of work or changes in how people do their shopping, rather than whether this has a positive or negative outcome for individuals, communities or the broader society. A possible exception is the link between ICT and social capital where some work has been done, particularly by Statistics Finland.

It should also be noted that there is not a simple division between social and economic impacts. Most of the topics which have been included here as ‘social’ also have economic implications – even ‘social capital’, which is embedded in an economic framework (DCITA, 2005a).

Work

ICT changes the way people work and what types of jobs are available. It can also change where people work, with home-based work enabled by ICT having potentially beneficial impacts for individuals and their employers. Clearly, the impact of such changes could be significant for economies and societies.

OECD (2005a) has used labour force statistics to analyse changes in employment of ICT-skilled personnel by industry. The aim of the project was to measure ICT skills using occupational data. Skills were defined at two levels:

- Narrow level – *ICT specialists* who have the ability to develop, operate and maintain ICT systems and for whom ICT is the main part of their job.

- Broad level – includes *ICT specialists* as well as *basic* and *advanced* ICT users for whom ICT is a tool for their job.

Occupations were classified (to one of the above categories or to neither of them) on the basis of an assessment of the degree to which workers are expected to use ICT for their own output. Labour force data on employment by occupation by industry were then used to calculate the share of ICT-skilled employment in total employment, and by industry. Industries were grouped according to the ICT-skills specialisation of their workforce, or the industry's share of ICT-skilled employment.

The United Kingdom's Office for National Statistics has used labour force surveys to collect information on home based work – and how it is enabled by the use of ICT (a telephone and a computer) (ONS, 2005).

Some findings

ICT is undoubtedly affecting how and where people work and what kinds of jobs they do. Fortunately, there is useful statistical data on these changes.

In OECD countries, in 2004, between 2% and 5% of employees were estimated to be ICT specialists (OECD, 2006c). For countries with comparable 1995 data, the proportion of ICT specialists had risen (modestly in most cases) between the two years. The proportion of employees who were **either** ICT specialists **or** ICT users was between 20% and 30% in OECD countries in 2004.

Work patterns appear to be undergoing technology-driven changes. From questions asked in its labour force survey, the ONS found that in Spring 2005, 2.1 million people in the United Kingdom working mainly from home (or using home as a base) were **only** able to do so because they used **both** a telephone **and** a computer. The proportion of the workforce who 'tele-worked' using both a telephone and a computer rose from 3% of the total workforce in 1997 to 7% in 2005 (ONS, 2005).

Household expenditure

Household expenditure surveys shed light on how people are spending their income and how expenditure patterns are changing over time. Useful information in respect of ICT relies on the product classifications used to classify household expenditure, for instance, how internationally comparable and how current they are.

A potential area for standardisation amongst OECD countries is the ICT dimension of classifications used for household expenditure surveys. Ideally, these should be based on an international standard, for example, the UN's COICOP classification (Classification of Individual Consumption According to Purpose) (UNSD, 1999).[8]

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8. In the case of Australia, at least, the product classification used for the Household Expenditure Survey is not based on the COICOP – though it is likely to be better aligned for the 2009-10 survey (personal communication, ABS).

Some findings

People are spending more of their income on ICT products. In Canada, average household spending on ICT increased from 4.2% to 4.5% of total spending between 1997 and 2003 despite falling ICT costs (Statistics Canada, 2006). In France, between 1960 and 2005, household expenditure on ICT increased from 1.3% to 4.2% of the household budget (INSEE, 2006). Average weekly expenditure on ICT products by Australian households in 2003-04 is shown in Table 2 below. The proportion of total household expenditure was 4.2% excluding audio-visual equipment (and just under 6% if it is included). This is higher than the result for France (where audio-visual equipment is included).

Table 2. Average weekly household expenditure on ICT[9] goods and services, Australia, 2003-04 (USD)[10]

Home computer equipment (including pre-packaged software)	4.40
Blank and pre-recorded media (excluding pre-packaged computer software)	4.01
Internet charges	2.10
Repair and maintenance of audiovisual equipment and personal computers (incl. insurance)	0.81
Mobile phones	0.82
Telephone handset (purchase)	0.29
Answering machines	0.01
Telephone and facsimile charges (of which mobile phones were USD 6.59)	20.01
TOTAL ICT GOODS AND SERVICES EXPENDITURE, 2003-04	**28.04**
TOTAL GOODS AND SERVICES EXPENDITURE, 2003-04	**659.89**

Source: ABS (2006c).

Time use

Time use surveys reveal how much time people spend on different activities and how patterns of time use are changing. Internationally comparable information on time spent on ICT-related activities is likely to be particularly reliant on common methodologies and classifications being adopted by statistical offices.

The Australian time use survey of 2006 had two components, each capturing ICT-related information. The **interview** covered ICT access and use; the **diary** asked what people are doing. If the respondent only said that s/he was using a computer or the Internet then the activity was coded to 'Audio/visual media n.e.c.'. If further information was provided, such as paying bills, then the activity was coded to the relevant classification for that activity. In both these cases, a technology code was recorded, and this was 'Internet' or 'personal computer'. Similarly, if a respondent reported that they were using a mobile phone for an activity, then a communication code of 'mobile phone' was recorded. The ICT information that will be available from the diaries is dependent on what the respondent records in the booklet. Some information will be available using a combination of the activity, communication and technology classifications. First results from the survey are due to be released in late 2007 (ABS, personal communication).

The United Kingdom time use survey of 2005 (ONS, 2006) also collected information on time spent using ICT. The diary for the 2005 survey recorded what the computer was being used for (as the primary activity) and the fact that a computer was used (as the secondary activity). As the primary activity may not indicate use of ICT, the secondary activity is important in ascertaining that ICT is being used. By treating

9. Excluding purchase, repair and hire of audio-visual equipment, and pay TV, the expenditure on which was estimated at USD 8.65 per week.

10. Exchange rate as at December 2003 (1.353 Australian dollars to 1 US dollar).

all mentions of computer use as if they were primary activities, the ONS was able to ascertain time spent on using ICT. It should be noted that workplace use of computers was not recorded, so data relate to use at home and other non-work locations.

Up until 2004, relatively few OECD countries had conducted a time use survey.[11] The UN has compiled a manual on time use statistics, including a proposed activity classification, ICATUS, the *International Classification of Activities for Time-Use Statistics* (UNSD, 2003).[12]

Some findings

People in the United Kingdom are spending more of their time using ICT. A comparison of results from ONS' 2000 and 2005 time use surveys, found considerable growth in both the number of people aged 16+ using computers and the time they spent doing it. On a given day in 2000, an estimated 12% of the population used a computer outside their workplace. By 2005, this had increased to 16% of the population. The time which users spent on a computer outside work increased from an average of 96 minutes a day in 2000 to 120 minutes in 2005. The two hours a day difference between computer users and non-users is accounted for by less time spent on a variety of activities including housework (33 minutes), watching TV (25 minutes difference), social life (23 minutes), resting (18 minutes) and study time (11 minutes). A breakdown of these figures by age and gender would be of interest – though the ONS publication does reveal that women are less likely to use a computer outside work and it is likely that students of both sexes spend more time using computers.

Crime

ICT related crime ('e-crime') is both a social and an economic problem. The impact of ICT on crime rates could theoretically be examined by looking at statistics on ICT-specific crimes, for instance, identity theft and Internet fraud. It would be of interest to know also whether the advent of ICT-specific crimes substitutes for earlier forms of crime or represents a higher level of criminal activity in terms of number of offences and the damage caused. Of particular interest in an economic sense is the cost of such crime – which accrues to individuals as well as organisations – and includes things like goods which are purchased online not being delivered, 'advance fee fraud' type scams and phishing incidents (US National Consumers League, 2006) as well as the costs of prevention.

The OECD 2005 model questionnaires of business and household/individual ICT use include questions on IT security measures in place and security experiences resulting in loss of data or time, or damage to software (OECD, 2005a). Eurostat has also asked such questions in its community surveys of ICT use.

Several years ago, the Australian Bureau of Statistics established the National Centre for Crime and Justice Statistics (NCCJS). Current projects relating to 'e-crime'(ABS, personal communication) include:

- A 2007 household survey on personal fraud victimisation is collecting information on identity theft and a range of scams, including: the prevalence of scams, the types of scams, how many scams were received and instances where people responded; prevalence of credit/debit card use without permission; use of personal details without permission; reporting of these incidents and mode (including whether by phone or Internet); and cost of these types of frauds to the

11. UNSD website: http://unstats.un.org/unsd/demographic/sconcerns/tuse/default.aspx.

12. The classification used by the Australian survey, at least, is reasonably consistent with the ICATUS (except for details about paid work).

community and economy. Data collection is occurring from July to December 2007 and results are expected to be released from March 2008.

- The Australian Institute of Criminology is investigating the feasibility of conducting a national survey of the business sector to examine the extent and impact of cyber crime or "attacks on the confidentiality, integrity or availability of network data". They are expecting to survey approximately 16 000 businesses and wish to measure the prevalence and types of computer security incidents, where systems are vulnerable and the costs and types of technologies used for protection. Results from the survey for the 2006-07 reference period are expected to be released in early 2008.

- The NCCJS started developing an e-crime statistics framework about two years ago, in conjunction with the Australian High Tech Crime Centre, but this work is not complete.

- The Australian Standard Offence Classification (ASOC) is currently being reviewed and, while the concept of e-crime is considered an important area of crime to be able to represent clearly in statistics, it is proving difficult to distinguish methods/modes of crimes (*e.g.* those committed using electronic media). Such distinctions are likely to be developed in the longer term using an additional flag or view, in conjunction with the ASOC, to ascertain those incidents that were committed electronically versus traditional methods.

Some findings

Findings from Eurostat's surveys of household and individual ICT use show that, for most European countries, there was an increase between 2003 and 2005 in the proportion of Internet users suffering from virus attacks which resulted in loss of information or time. For most countries, the proportion was between 20% and 40% of Internet users. In 2005, the proportion of Internet users who were the victim of fraudulent credit or debit card use in the last year (as a percentage of those ordering goods or services online) was also relatively high – with the EU average just under 4% (OECD, 2007b).

Health

Advanced ICTs are important tools in a number of areas of health and include: sophisticated medical equipment enabled by ICT; remote health applications such as telemedicine; and use of large databases of patients to enable better information about, and co-ordination of, treatment. From an individual's point of view, the Internet can be an important source of information about health. Arguably, ICT has had negative effects on health as well, for instance, occupational overuse injuries associated with computer use. Unfortunately, there are very few statistics on ICT's impact on health, positive or negative.

Some findings

In relation to health, Pew (2006a) reported that 26% of adult Internet users who had dealt with the issue in the previous two years said that the Internet played a crucial or important role as they helped another person cope with a major illness; the equivalent figure for themselves as they coped with a major illness was 28% (Pew, 2006b). The December 2005 Pew survey (2006a) found that one in five adult Internet users reported that the Internet had greatly improved the way they get information about health care, with a variety of web-based information sources used.

Education and training

Arguably, there are various positive and negative impacts of ICT on learning outcomes. The former could include improvements attributed to the use of ICT in the classroom and the latter the more general influence of intensive ICT use on pupils' cognitive and language skills (OECD, 2006d). Despite the importance of the topic, there appear to be few statistics which show such impacts at a country or international level. In discussing the implications of ICT on learning expectations and educational performance, the OECD/CERI expert meeting of March 2007 report (OECD, 2007c) stated that "… it is not surprising that the results, as shown by a number of research reviews, if not contradictory, are at least inconclusive."

The OECD's Programme for International Student Assessment (PISA) surveys were conducted in 2000, 2003 and 2006. They are surveys of 15-year olds in the principal industrialised countries and assess how far students near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society (OECD, 2003).

The International Association for the Evaluation of Educational Achievement (IEA) has conducted surveys and case studies on the association between ICT and education. Its SITES (Second Information Technology in Education Study) project consists of three modules: a school survey (last conducted in 1998 and involving 26 countries); a set of case studies on innovative practices involving ICT (174 studies involving 28 countries); and, a planned third module consisting of a school/teacher survey and possibly an optional student survey (IEA, 2003).

Some findings

Analysis of results from the 2003 PISA surveys (OECD, 2005b) shows that the mathematics performance of students without access to computers at home was significantly below that of those with home access. The gap was significant for all countries in the study. In 23 out of the 31 countries in the study, a performance advantage (albeit a lower one) persisted even after accounting for different socio-economic backgrounds of students. The performance difference associated with school access to computers is less marked, although it is high in the United States, Canada and the Czech Republic. Other findings were that students with shorter experience in using computers and those who use them least at home scored below average in mathematics. The highest performances in both mathematics and reading tended to be from students with a medium level of computer use. The last finding suggests that excessive computer use could have a negative impact on school performance.

An analysis of the 174 SITES cases studies referred to above found that "technology is supporting significant changes in classroom teaching and learning. They paint a very different picture than the traditional classroom where the teacher lectures in front of the classroom and students take notes or do worksheets. They show important similarities in how technology is being used in many countries around the world." (IEA, 2003).

Social capital

Social capital has been defined by the OECD as "…networks together with shared norms, values and understandings that facilitate co-operation within or among groups." (OECD, 2001b).

The Australian Department of Communications, Information Technology and the Arts published a discussion paper on the topic of ICT and social capital in 2005 (DCITA, 2005a). The paper reviewed the literature on social capital and described several experiments and case studies on communities linked by

ICT. It described the norms referred to in the OECD definition as including trust and reciprocity,[13] and discussed two forms of trust (social and transactional), three forms of social capital (bonding, bridging and linking capital) as well as different types of communities (for instance, geographic and virtual). The paper recognised that not all social capital is inherently good for a community (or society). For instance, strong bonding capital (within groups) can act to exclude others. It also recognised that ICT may have a negative relationship with social capital, because of an isolating effect. The experiments and case studies described in the paper indicate how complicated this area of measurement is.

An Australian social capital framework (ABS, 2004) includes indicators on frequency of contact with friends and relatives using ICT and contacting government using the Internet. It is suggested that contact with others is positive and provides individuals with identity, social roles and social support mechanisms. Based on case study evidence, the ABS further suggests that ICT facilitates such contact.

Finland (Statistics Finland, 2006b) went further than this and looked at the relationship between social capital and ICT use.

Some findings

There is strong evidence from the United States and Canada that people are communicating more using ICT – fixed and mobile phones, as well as e-mail. For instance, in the United States, minutes per capita per day spent on mobile phone calls increased from 0.3 to 6.7 between 1993 and 2002, while between 1980 and 2001, minutes per capita per day on fixed phones increased from 21 to 47 minutes (Statistics Canada, 2006).

In Finland, in 2004, about 70% of respondents agreed fully or to some extent with the statement "With e-mail you contact people that you otherwise wouldn't" (Statistics Finland, 2006a). Statistics Finland (2006b) found significant correlations between ICT use and components of social capital, with the most significant being with community involvement (participation in voluntary or leisure activities). They also found significant correlations between use of ICT (especially number of phone calls and SMS messages) and several components of social capital (*e.g.* size of the social network, community involvement).

A 2000 Pew study (cited in DCITA, 2005a) found that e-mail use by women contributes to the building of bonding social capital by "…. reinforcing the users' social connectedness to family and friends."

In Australia, in 2002, a large proportion of people had contact with relatives or friends (living elsewhere) in the previous week using ICT (phone, e-mail); the ABS speculated that "the increased use of communication technologies such as mobile phones, e-mails and web-based chat rooms may also have helped extend interaction as people substitute these more convenient and wider-reaching forms of contact for time spent together." (ABS, 2006d).

The case studies described in DCITA (2005a) indicate that the role of ICT in building social capital within communities is dependent on several factors, including the context in which the community was originally established, the nature of the community and the extent of facilitation. The report suggested that the nature of ICT is also likely to be important, for instance, broadband connectivity and ease of use are factors that could encourage the use of ICT.

13. In respect of trust, the paper points out that online interaction also raises challenges in relation to trust in the forms of malicious threats, authentication and privacy etc. They suggest that online threats may reduce the willingness of individuals to engage with others online.

Retrospective examination of expected impacts of ICT

In 2006, Statistics Canada published *Our Lives in Digital Times* (written by George Sciadas). The study used official and non-official statistics to examine the extent to which **past** predictions about the impacts of ICT had eventuated. The predictions tested included:

- Reduction in physical mail as the incidence of e-mail increases.
- Increase in e-commerce at the expense of 'bricks and mortar' retailing.
- Reduction of fixed line phones and their use in favour of mobile phones; and
- Increase in Internet use and reduction in time spent on other activities.

Some findings

Reduction in physical mail. While communication by ICTs in Canada (in the form of faxes, e-mail, text messages etc) is increasing greatly, the volume of physical mail moved is also increasing (albeit much more slowly) (Statistics Canada, 2006).

E-commerce versus 'bricks and mortar' retailing. 'E-tailing' in Canada is growing fast but is still very small; normal retailing is growing as well (Statistics Canada, 2006).

Reduction of fixed line phones and their use in favour of mobile phones. In the United States and Canada, both are growing strongly (though in Finland there is a trend towards households having only a mobile phone) (Statistics Canada, 2006; Statistics Finland, 2006a).

Increase in Internet use and reduction in time spent on other activities. Among Canadian Internet users, time spent watching TV has decreased slightly but is not offset by the increase in time spent on the Internet (Statistics Canada, 2006). In Finland, in 2005, slightly fewer than half of medium to high Internet users reported a decrease in TV watching; about two thirds reported no change in time spent reading or talking on the phone; 90% reported no change in time spent with friends (Statistics Finland, 2006a). Time use data for the United Kingdom are presented earlier in this paper and indicate that time spent using the computer at home is accounted for by less time spent on a variety of activities, including watching TV (ONS, 2006).

Statistics Canada makes the point that the reasons for such predictions not coming true are diverse and complex, involving changes in patterns of human behaviour as well as other factors such as price changes.

The digital divide

The term 'digital divide' refers to a divide (between individuals or countries) based on unequal access to ICT. While arguably, a digital divide *per se* is not an impact of ICT, unequal access to ICT will have an impact on individuals and economies. For individuals, this will range from inconvenience (for instance, needing to pay bills in person rather than via the Internet) to more serious outcomes (for instance, disadvantage in the labour market due to lack of familiarity with ICT). For economies, lack of ICT infrastructure and use is likely to make existing economic divides greater, as the global economy relies increasingly on ICT to function efficiently and effectively. To date, statistics on the digital divide have mainly focused on its measurement rather than the impact of 'digital disadvantage'. Exceptions are the studies, described below, from Hong Kong, China and Macao which ask non-Internet users to assess the impact on them of not using the Internet (CNNIC, 2006).

Perceptions measures

It should first be noted that, while perceptions measures are not mutually exclusive of the areas outlined above (particularly social capital), they use a distinct methodology which is worthy of separate consideration.

There are few known instances of NSOs including subjective measures of impacts of ICT in household surveys. One instance is a small set of questions in the international Adult Literacy and Life Skills (ALLS) surveys of 2003 and 2006[14] which probed respondents' attitudes to computers. The questions[15] for 2006 are shown in Table 3 and indicate a possible approach to subjective questions.

Table 3. ALLS questions on ICT impacts

DATA ITEM	PROPOSED OUTPUT CATEGORIES
Computers allow respondent to do more in less time	1. Strongly agree
	2. Agree
	3. Disagree
	4. Strongly disagree
	5. Has never used a computer
Computers have made it easier for respondent to get useful information	1. Strongly agree
	2. Agree
	3. Disagree
	4. Strongly disagree
	5. Has never used a computer
Computers have helped respondent to learn new skills other than computer skills	1. Strongly agree
	2. Agree
	3. Disagree
	4. Strongly disagree
	5. Has never used a computer
Computers have helped respondent to communicate with people	1. Strongly agree
	2. Agree
	3. Disagree
	4. Strongly disagree
	5. Has never used a computer
Computers have helped respondent to reach career goals	1. Strongly agree
	2. Agree
	3. Disagree
	4. Strongly disagree
	5. Has never used a computer

14. ALLS is a survey run periodically by several countries in conjunction with the OECD.

15. Taken from the Australian ALLS questionnaire.

The 2006 National Internet Development Agency of Korea (NIDA) survey on household/individual computer and Internet usage asked about the perceived positive and negative impacts of ICT. The approach was to ask both Internet users and non-users whether they agreed or disagreed with a number of positive and negative propositions concerning the ‘impact of informatization’ (NIDA, 2007).

While NSOs have not been particularly active in the area of subjective measurement, some other organisations have been. Even though the resulting statistics are generally not considered to be ‘official’, they suggest further impacts questions which official surveys could include.

A 2005 survey by the Centre for Communication Research, City University of Hong Kong, China, asked Internet users and non-users about their perceptions of the impact of Internet use. The survey also asked non-users to assess the impact on them of not using the Internet (CNNIC, 2006). A 2005 survey in Macao conducted by the University of Macau asked similar questions (CNNIC, 2006).

The *Pew Internet and American Life Project* (2006c) asked American Internet users in 2001 and 2005 whether the Internet had improved specified aspects of their lives (shop, perform their jobs, pursue hobbies and get health information).

Another *Pew* survey (2006b) asked about the impact of the Internet on ‘life’s major moments’. The survey was first conducted in 2002 and repeated in 2005. In the more recent survey, respondents were asked whether they had faced a decision about a particular topic in the last two years and, if so, what kind of role the Internet played in making that decision. The topics chosen were: buying a car, making a major financial decision, getting career-related additional education and training, choosing a school for oneself or a child, and helping someone deal with a major illness. From those five topics, eight decision events were specified.

A Nielsen/Net ratings survey of April 2005 measured Australians’ attitude to technology by asking whether they agreed with the statement that “technology makes life easier” (cited in DCITA, 2005b). The survey also asked about the impact of broadband on users, including such response items as ‘download material easily’, ‘spend more time online’, ‘e-commerce easier’ and ‘working from home easier’.

Some findings

Results from the international Adult Literacy and Life Skills (ALLS) survey of 2003 found that adults’ perceived usefulness of, and attitude towards, computers increases as prose, document, numeracy and problem solving levels increase (Statistics Canada and OECD, 2005).

The 2006 NIDA survey on household/individual computer and Internet usage found that the most frequent positive impacts of ‘informatization’ reported were: ‘convenience in life’ (78% of Internet users aged 12 and over), ‘promotion of national right to know’(60%) and ‘increase of leisure time’(48%). Quite high proportions also agreed with propositions on negative impacts, for instance, 55% of Internet users agreed that a negative impact was ‘invasion of privacy’, while 40% agreed about ‘feeling alienation’ (NIDA, 2007).

Studies in Hong Kong, China and Macao asked how both Internet users and non-users perceived the impact of Internet use and its importance in life, work and study. Some of the results were as follows:

- In Hong Kong, China, only a small proportion of non-users reported a negative impact, for instance, only 2% reported being sometimes or frequently excluded by their circle of friends and only 3% reported being sometimes or frequently disadvantaged in hiring, promotion etc.

Somewhat different response categories were used in the Macao survey, where 37% reported the ‘feeling of becoming old-fashioned’, 25% reported that they had the ‘feeling of knowing less news than others’, and 17% reported the ‘feeling of having less fun in life’.

- In Hong Kong, China, respondents’ (including both Internet users and non-users) perceptions of Internet use included the positive finding that 84% agreed somewhat or highly with the statement that “Internet use can help enhance the efficiency of work/study/life”. On the other hand, 60% agreed somewhat or highly with the statement that “Internet use can make one vulnerable to bad influences”. In Macao, 68% agreed somewhat or highly with the statement that “Internet use can help enhance the efficiency of life” and 57% with the statement that “Internet use can easily make one addicted”.

- When asked to evaluate the Internet generally, in Hong Kong, China, 30% of users thought it ‘highly important’ compared with 7% of non-users. Of the latter group, 12% found the Internet ‘highly unimportant’, compared with 1% of users.

A *Pew Internet and American Life Project* survey asked whether the Internet had improved certain aspects of individual users’ lives (Pew Internet and American Life Project, 2006c). The questions were asked in both 2001 and 2005, with the online Americans saying that the Internet had greatly improved their:

- Ability to shop – doubled from 16% in 2001 to 32% in 2005.

- The way they pursue hobbies and interests – grew from 20% in 2001 to 33% in 2005.

- Their ability to do their job – had grown to 35% in 2005, up from 24% in 2001.

- The way they get information about health care – grown to 20%, from 17% in 2001.

Another Pew study (2006b) asked about the impact of the Internet on major decisions made by individuals. The survey was first conducted in 2002 and repeated in 2005. Results showed significant increases in the number and proportion of American adults reporting that the Internet played a **crucial** or **important** role in specified aspects of their lives. Increases were as follows:

- 54% increase in the number of adults reporting that the Internet played a major role as they helped another person cope with a major illness.

- 50% increase in the number who said that the Internet played a major role as they pursued more training for their careers; and

- 45% increase in the number who said that the Internet played a major role as they made major investment or financial decisions.

The 2005 survey results showed that the Internet was most important for decisions on:

- Choosing a school or college for yourself or your child (42% of those who dealt with the issue in the previous two years reported that the Internet played a crucial or important role).

- Getting additional career training (39%); and

- Finding a new place to live (30%).

The Australian Nielsen/Net ratings survey of April 2005 found that the percentage of respondents who agreed with the statement that “technology makes life easier” was strongly influenced by age. While nearly 70% of respondents aged 14-24 agreed or strongly agreed with the statement, the proportion dropped as age increased, to just below 20% for those aged 65 and over (cited in DCITA, 2005b). When asked about the impact of broadband, a high proportion of respondents to the survey reported that broadband allowed them to become more efficient (for instance, ‘download material easily’; ‘it was easy/quick to send attachments’, ‘e-commerce easier’, ‘working from home easier’). Others reported spending more time online and being able to stream radio/TV and play interactive online games (DCITA, 2005b).

Suggestions for future work

It is clear that official statistics in the area of ICT impacts are generally not well developed. They tend to be fragmented both in their coverage of the topic (especially on the social side) and international comparability.

In an attempt to address these shortcomings, the following issues and suggestions are presented for consideration by member countries. They cover the role of classifications, positive versus negative impacts, conceptualisation of ICT impacts, use of terminology and some ideas for further development on standardisation of some of the measurement approaches described in this paper.

Classifications

Of particular importance is the role of classifications. While WPIIS has been active in defining sectoral and product ICT classifications (especially in the last year as they were revised to match ISIC Revision 4 and CPC Version 2 respectively), it has been less involved in ‘social’ classifications such as time-use activity and household expenditure classifications (relevant international classifications are the UN’s ICATUS and COICOP respectively).

An ICT occupations ‘thematic grouping’[16] based on the 2008 revision of the International Standard Classification of Occupations (ISCO-08) is nearly completed and will be helpful in analyses of changes in ICT occupations. The ‘thematic grouping’ of ICT occupations includes occupations whose main tasks involve the production of goods and services in ICT.

Positive versus negative impacts

Arguably, there has been more attention paid to measuring positive rather than negative impacts of ICT.[17] For instance, the subjective measures described in this paper appear to be based on the assumption that impacts of ICT will be positive (and, in the case of the Hong Kong, China, and Macao studies, that non users will suffer negative impacts). A consequence of the diversity of ICT impacts is that they may be positive at one level and negative or neutral at another. For instance, access to broadband is usually an advantage for individuals who may use it for various purposes, including some which have negative impacts for society (such as illegal downloading of music or movies).

16. This is being prepared by the International Labour Organization and is expected to be approved towards the end of 2007.

17. Exceptions on the social side are the Korean, Hong Kong, China and Macao studies which asked respondents about negative as well as positive perceptions of the Internet. Results can be found earlier in this paper. On the economic side, some negative impacts are measured in respect of IT security experiences.

Given that there are obvious negative impacts of ICT, especially in the social realm,[18] it is suggested that these be given more attention in official surveys.

Conceptualisation of ICT impacts

At the beginning of this paper, different ways of conceptualising ICT impacts measurement within a measurement framework are presented. They are:

- The S curve (Figure 1) – though this is likely to be restricted to impacts of ICT use.
- ICT impacts as integral to a general information society statistics conceptual model (Figure 2).
- ICT impacts as part of a general model but described in terms of their characteristics such as short- and long-term (with these characteristics grouped by likely difficulty of measurement) (Figure 3); and
- An *a priori* objectives model for ICT impacts (for instance, using the socio-economic objective classification used for R&D classification).

Standardisation of terminology

It is recommended that member countries consider the different terms which can be used to describe ICT impacts and use them appropriately. Policy makers and statisticians will tend to classify impacts as social, economic or environmental. Another particularly useful distinction is between 'intermediate' impacts (for example, how ICT changes the way something is done) and 'final' impacts (how that use of ICT has important effects on an entity, the economy or society). Other potentially useful ways of looking at impacts include:

- The degree of impact – whether it is strong or weak (in which case, it may be termed an influence rather than an impact).
- How localised the impact is – whether it is broad or narrow, micro (entity level), meso (community level) or macro (economy, society, international level).
- Whether it is positive or negative.
- Whether the impact is short or long term; and
- Whether it is direct or indirect.

Economic impacts: possible areas for standardisation

With the aim of achieving comparability of outputs, it is useful to look at the work of NSOs to see which approaches could be standardised for use by more countries. Possibilities include:

- The work of Australia and Chile on ICT satellite accounts. Though the models used by these countries differed in some respects, they both rely on the System of National Accounts (SNA93) which represents an international standard on which a methodology could be based. The recent

18. Some of the negative social impacts of the Internet have been documented in this 'running list' compiled by Roger Clarke http://www.anu.edu.au/people/Roger.Clarke/II/Netethiquettecases.

work by WPIIS in revising sector and product classifications offers the prospect of simpler and more consistent ICT satellite accounts (because it narrows the scope of ICT industries and products).

- Eurostat and others' work on firm level data. There is an attempt being made to include other countries (OECD and non-OECD) in this exercise.

- A longitudinal database approach, such as that taken by Australia. While the strategy adopted might not be possible for all countries, because of its cost and reliance on matched administrative data, it is a model worth monitoring as results start to emerge.

- Perceptions measures per the OECD 2005 model survey and Eurostat's 2008 enterprise ICT use survey. These might be particularly interesting on a sectoral basis, for instance, the impact on service industries compared with manufacturing. They could also potentially be further developed to indicate impacts of more sophisticated technologies.

- The work by Pilat (2004) lists a number of areas where there are measurement difficulties due to lack of data or lack of comparability (in data or methods). While these difficulties are reasonably well known to official statisticians working in this field, they are referred to here for completeness (summary details can be found earlier in this paper and in Pilat's paper).

Social impacts: possible areas for standardisation

With the aim of achieving comparability of outputs, the work of NSOs and other survey organisations examined in this paper leads to several possibilities for standardised approaches:

- The work on perceptions measures (for example, ALLS, Pew studies).

- Standardisation of time use and household expenditure survey methodologies and classifications in the area of ICT measurement.

- Standardisation of 'e-crime' statistics, with a useful start being the adoption of the OECD model survey of ICT use questions on the incidence of IT security breaches which resulted in loss of data or time, or damage to software.[19]

- Collection of statistics on 'teleworking' and other changes in work patterns which are driven by ICT. Such data can be collected from specific ICT use surveys (as Australia has done) or via labour force surveys (as the United Kingdom has done).

A note on the future

ICT is characterised by ongoing change – both in technologies and the ways that people and organisations use them. The challenges of measuring the impacts of ICT likewise expand in order to keep up with these changes. Therefore, as a final comment, it is worth bearing in mind some of the future changes in ICT which could have significant impacts (both positive and negative) on economies and societies. They include:

19. While IT security is an economic as well as social issue, it is included here for consistency with the structure of the paper.

- Further expansion of broadband technology and its uses, with expected social and productivity improvements from services in e-commerce, e-banking, e-government, e-education and e-health (DCITA, 2006).

- Further expansion of mobile phone and wireless technologies, offering the possibility of permanent connectivity via the Internet as well as further convergence of technologies – mobile phone/Internet; Internet/broadcasting, Internet/phone etc.

- Advances in malicious software ('malware') and other security threats, such as attacks on critical information infrastructure (OECD, 2007d).

- Radio frequency identification devices (RFID) and similar sensor technologies which have the potential to vastly improve tracking of goods, vehicles, livestock and people (OECD, 2007d); and

- Software advances in a number of areas, including: enhancement of IT security, improved interoperability, better data storage and matching, improved voice and pattern recognition capabilities, and improved expert systems and automation (DCITA, 2006).

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