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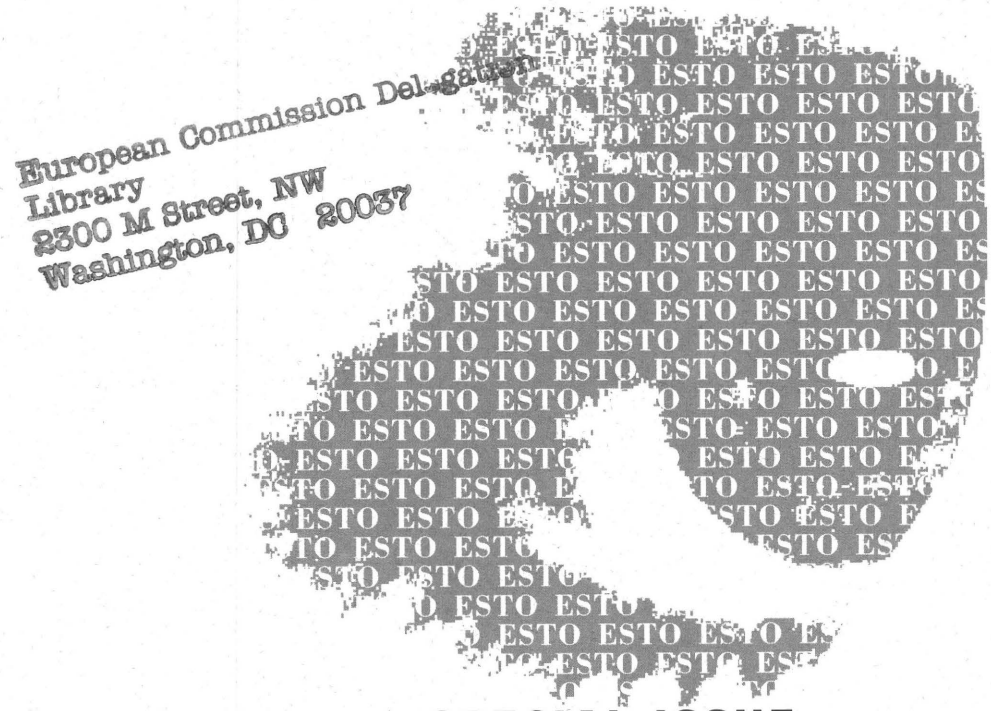

SPECIAL ISSUE: BUILDING THE INFORMATION SOCIETY IN EUROPE: THE CONTRIBUTION OF SOCIO-ECONOMIC RESEARCH

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

ENGLISH VERSION

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The IPTS Report is published in four languages. All editing and reviewing takes place in English and translated versions are produced in French, German and Spanish. It publishes articles it deems "prospectively relevant" in a number of areas, including information and communications technologies, regional development, innovation and technology policy, skills and training, biotechnology and the life sciences, methods and foresight, etc.

The focus of the IPTS Report is on articles that explore issues that are either not yet on the policy-maker's agenda (but are likely to be there at some point in the future) or are underappreciated aspects of issues that have already come to policy-makers' notice. Quality assurance is provided through our multi-stage drafting and redrafting process, based on a series of interactive consultations with outside experts.

In addition to the limited-circulation print run of the IPTS Report, all current and past articles are available on-line from the IPTS website at http://www.jrc.es/home/report/report_main.html. We also produce and distribute an electronic newsletter to inform readers whenever a new issue of the IPTS Report is published (to subscribe, visit the subscriptions section of the IPTS Report website, or send an email to listserv@listserv.jrc.es with the words "subscribe IPTS-REPORT" in the body of the message).

PREFACE

Dear Readers,

This is the final edition of the "IPTS Report".

Since its launching at the end of 1995, it has built up a faithful readership and has attracted contributions from many prestigious authors.

As the mission of the Joint Research Centre has changed - and with it the mission of the IPTS – the regular production of the "IPTS Report" could no longer be justified. However, taking into account the positive feedback we have received related to thematic issues of the "IPTS Report", we plan to issue periodic reports along the line of "JRC Reports" on specific issues.

I would like to thank all of those who have contributed to making this journal such an interesting platform for the exchange of ideas on so many diverse issues. I would also like to thank our readers for accompanying us throughout these years.

Barry Mc Sweeney

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Special issue: Building the information Society in Europe: the contribution of socio-economic research

EDITORIAL

Building the Information Society in Europe: the contribution of socio-economic research

Bernard Clements, Gérard Comyn, Khalil Rouhana and Jean-Claude Burgelman[1]

Early Community policy in telecommunications, electronic media and information markets was driven by the need to put the sector on a competitive footing with Europe's major trading partners in the face of rapid technological change and increasing convergence between related fields. As such it had a decidedly supply-side focus. It was not until the Bangemann Report of 1994,[2] followed not long afterwards by the launch of the eEurope initiative,[3] that the emphasis of policy-making shifted to the wider impact of the sector on the economy and society as a whole. Since then the concept of the Information Society has been a major source of inspiration for European Union policymaking on both regulation and research.

More than a decade later, concern for European competitiveness remains the single most important driver of much EU policy-making. But that concern is now tempered by the need to ensure that economic growth is not accompanied by unacceptable social costs. Quite the contrary; the EU has launched the Lisbon strategy precisely with a view to making Europe into a competitive, but socially inclusive and sustainable knowledge-based economy by 2010.[4] And the so-called 'European model of the Information Society' is one in which social factors form an integral part of its construction.

The concept of the Information Society therefore goes beyond sectoral considerations and is based on how information and communications systems are used in practice. As such it requires policymakers to focus on the social and economic aspects rather than just the technologies themselves. Indeed, there is an increasing realisation today that the successful take-up of emerging technologies depends on their ability to be accommodated into social practice, whether in the workplace or at home.

One of the merits of socio-economic research in Information Society Technologies (ISTs) lies precisely in demonstrating that there is no mono-causal relationship between technological capacity and societal implications. ICTs have a broad impact on processes that are fundamental for social coordination, collaboration, and knowledge creation. Their impact, therefore, should be viewed in a context of socio-economic development. At a social and economic level, ICTs enable new ways to organize production, coordinate economic activity, and create and mobilise competences and resources. The impact of ICTs is clearly visible in the new global distribution of labour, new innovation-based competition, regional concentration of knowledge-based activities, and the increased volume of financial flows. Although technical developments in ICTs do not determine the ongoing processes of socio-economic change, they do facilitate the rapid transformation of society resulting from those processes.[5] There is much that still needs to be discovered about the mechanisms involved, and in relating them to the European reality. That the information age should be modelled on the structures and aspirations of society is a natural ambition of any region. Indeed, Europe is not the

The views expressed here are the authors' and do not necessarily reflect those of the European Commission.

only one seeking such a model.[6] In Europe's case those aspirations are based on common values and societal goals developed over decades, particularly since World War II. Those values, shaped by historical and social context, transcend political differences and provide a framework within which policy choices can be made. Their absorption into Information Society policy can be seen in the following areas of wider social policy:[7,8]

- ***Economic growth***: ISTs make an important if not essential contribution to growth and employment, not only by constituting a significant growth sector themselves but also providing a platform for growth in other sectors of economic activity, whether industry- or service-based.
- ***Social inclusion***: they make a similarly important contribution to ensuring social inclusion through better governance, smarter healthcare and equal opportunities. eHealth, for example, promises to transform healthcare by empowering the patient while keeping costs under control.
- ***Sustainable development***: Because they are perceived as inherently 'clean' substitutes for industrial processes or transport, the notion of ISTs as a facilitator of sustainable development has emerged since the 1990s.

However, these upbeat descriptions need to be balanced by the sort of understanding that can only come from exhaustive research. We know that in many cases the technology is a double-edged sword, introducing as many ills as it does goods – digital divides as well as virtual communities, unexpected secondary effects ('rebound' effects) as well as benefits from use. So while it is possible to regard ISTs as a generic set of technologies affecting all aspects of everyday life, there is still much to be done to establish the dynamics of the interaction between these technologies and society.

Parallels have often been made between the Information Age and the earlier industrial and agricultural paradigms of human development. Looking through the prism of history suggests that we are still very much in the infancy of a new knowledge society based on the massive application of information and communication technologies, despite nearly a half-century's experience of their use. Not only would such a perspective put into context the odd glitch in the development of the Information Society – the downturn, the burst of the dot.com bubble, etc. – but it would also tell us that the Internet has just reached first base in terms of its use and application to lifestyle problems. Comparative research suggests that it is probably at the same stage of development as television was in the late fifties.[9] Taking Internet from the bottom of the S-curve to saturation needs more than mere technological progress. While such progress is of course essential, it needs to be complemented by a deeper understanding of the potential underlying impact for society as a whole.

It was largely in recognition of this new way of looking at Information Society policy that the European Commissioner responsible for this area (Erkki Liikanen) set up a High Level Socio-Economic Expert Group (HLSEG) to reflect on key aspects of the societal dimension of ISTs. The predominant industry advisory group up to that time, ISTAG,[10] has been moving from its technological starting point towards an applications-oriented approach to IST research policy. The HLSEG, made up of leading European social scientists, helps develop a complementary demand-side analysis of the same problem.

The Group met three times over the period 2003 to early 2004. Each meeting considered one or two topics, and specialists in their fields were subsequently asked to write summary reports, both reflecting the discussions which took place and highlighting what they considered to be the important policy issues arising.

The various papers of this Special Issue take some of the topics discussed by the HLSEG as their point of departure:

- In the first paper, ***Millard*** deliberately uses the less well-known term eGovernance, rather than eGovernment or ePublic Services, to illustrate a wider view of the potential role of ISTs in the processes of government. He describes ways in

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Bernard Clements is Head of the Information and Communications Technologies Unit at the IPTS. He was previously with DG XIII in Brussels where he worked on the regulatory aspects of EU telecommunications markets. He has also contributed to EC technical assistance programmes on regulatory matters in Latin America and Eastern Europe. Prior to joining the European Commission, he spent 25 years in the telecommunications industry in the Americas, Europe, and Asia. He has a degree in Electrical Engineering from Manchester University, is a Fellow of the IEE, and a former member of the Order of Engineers of Quebec.

which technology can enhance the democratic process by providing new and effective vehicles for citizen participation.

- ***Tuomi*** takes a hard look at what has become the perennial conundrum and pastime of academic economists – how to establish a cause-and-effect relationship between investment in ISTs and productivity and wider economic growth. This was famously enunciated by Nobel Laureate Robert Solow (incidentally a member of IPTS' High-level Economists Group). Tuomi suggests that we may need to look beyond traditional neoclassical growth-accounting models to resolve the so-called 'Solow paradox'.
- ***Forge's*** paper is altogether upbeat on the potential of Open Source as a future paradigm for software development and production in Europe, and has no hesitation in recommending strong public policy action in its support. He goes on to define the aims of such policy and to identify precise areas where it could be applied to effect.
- ***Van Bavel, Punie*** and ***Tuomi*** explore the effect that widespread use of ISTs has on social capital, a notion which has become popular in recent years to cover the intangible resources embedded in the many different kinds of networks - social, civic or business. In particular the paper examines civic engagement and knowledge transfer within and across communities of practice.
- ***Leyten*** presents the results of an important study financed by IPTS in support of the work of the HLSEG and aimed at mapping the knowledge base in Europe on socio-economics of ISTs.[11] Topics covered include innovation, organisational change, societal dimensions and policy instruments.

The writers of this editorial had the task of defining the scope of the High-level Group's work and of organising its meetings. We wish to acknowledge the contribution of the authors to the Group's work and to thank them for taking the time out to prepare the papers published in this issue.

Notes

1. Clements and Burgelman are with the ICT Unit at IPTS; Comyn until recently was, and Rouhana is with the Strategy Directorate of DG INFSO, European Commission, Brussels.
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10. ISTAG – Information Society Technologies Advisory Group.
11. EKB-SEIS – European Knowledge Base on Socio-economic research on the Information Society.

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ICTs and Governance

Jeremy Millard, *Danish Technological Institute*

Issue: Over the past few years the concepts of government and governance have been dramatically transformed. Not only is this due to increasing pressures and expectations that the way we are governed should reflect modern methods of efficiency and effectiveness, but also that government should be more open to democratic accountability. Information and communication technologies (ICTs) have considerable potential to make government more transparent and to open new channels for participation, but the incorporation of new technology into democratic processes can also be fraught with difficulty and controversy.

Relevance: It is clear that eGovernance is not just about putting government services online and improving their delivery. Rather, it also constitutes a set of technology-mediated processes that could change the broader interactions between citizens and government, as well as improve the overall quality of decision-making. ICTs are opening up new opportunities, but they also entail new risks with profound consequences for the way we understand and exercise citizenship.

Governance and eGovernance

Governance is not just about services but also about the management and institutions of society and the distribution of power between all legitimate actors and stakeholders. The current European Union, and in particular an enlarged EU with 25 Member States, needs to be more open, more accountable and more legitimate. Achieving these three goals will require greater efforts are made to ensure citizens' involvement, especially since citizens' participation in formal decision making, such as at the voting booth, seems to be falling in many Member States. Increased involvement in democratic processes is therefore a critical challenge for European democracy over the next 10 to 15 years.

Participation is a multilateral relationship between stakeholders of the political triangle (state, market, civil society), each attempting to influence the political agenda at various stages of the political cycle and at different levels of government. In order to enhance participation, citizens (as well as governments and political bodies) need increased and improved access to politically relevant information, as well as improved capabilities for managing knowledge. In the EU, the subsidiarity principle applies, i.e. that a given issue should be dealt with at the most appropriate level —no higher

Governance is not just about services but also about the management and institutions of society and the distribution of power between all legitimate actors and stakeholders

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than necessary, but high enough for the political decision to be effective. The specific articulation of how this should work in practice in the context of EU enlargement is currently being re-considered, *inter alia* through the drafting of a European constitution.

In order to ensure that ICTs are applied to governance issues successfully, many countries have adopted an approach based on a strong leadership role for central government

In order to ensure that ICTs are applied to governance issues successfully, many countries have adopted an approach based on a strong leadership role for central government, working top-down from an overall vision, with strategies, roadmaps, resources and a specification of standard solutions and frameworks. However, this needs to be pro-actively complemented by local and regional initiatives, close to their social and business communities, driven forward by local champions who are able to find the appropriate balance between, on the one hand, undermining special vested interests and undemocratic fiefdoms ('breaking down silos'), and, on the other, the need to preserve local autonomy and freedom to act in response to specific local needs. A difficult balancing act indeed, but an essential one and one that is not confined to eGovernment initiatives alone. Different countries across Europe need to develop their own paths as each has unique identities, cultures, legal systems and institutional structures, but all can learn from the experiences of others.

ICTs have important potential roles to play in each of the above.

Re-examining governance

It is important to be clear about, and control, what we wish to do in Europe. For example, eGovernance raises the potential to re-engineer representative democracy, but is this a choice we wish to make, or is it more simply a question of supporting our existing democratic processes and enabling them to function better?

A re-examination of democracy demands an articulation of European democratic principles. These could encompass (Council of Europe, 2003):

- universal and equal suffrage – equal rights for all adults with only legally-based exclusions, for example in relation to nationality or place of residence;
- free suffrage – the right of association, participation and expression, as well as the need for transparency and openness;
- secret, direct and frequent elections – shielding voters from undue pressures, providing direct election of representatives, and periodic ballots (normally no more than five years apart).

Based upon such principles, new models are needed to point developments in desirable directions. Two such models are shown in Figures 1 and 2.

Ancient-Greek-style direct democracy has tended to be replaced by representative democracy in modern societies. However, ICTs could enable a synthesis of the two traditions

The ancient Greek democratic tradition of direct decision making in the city forum (*agora*) has

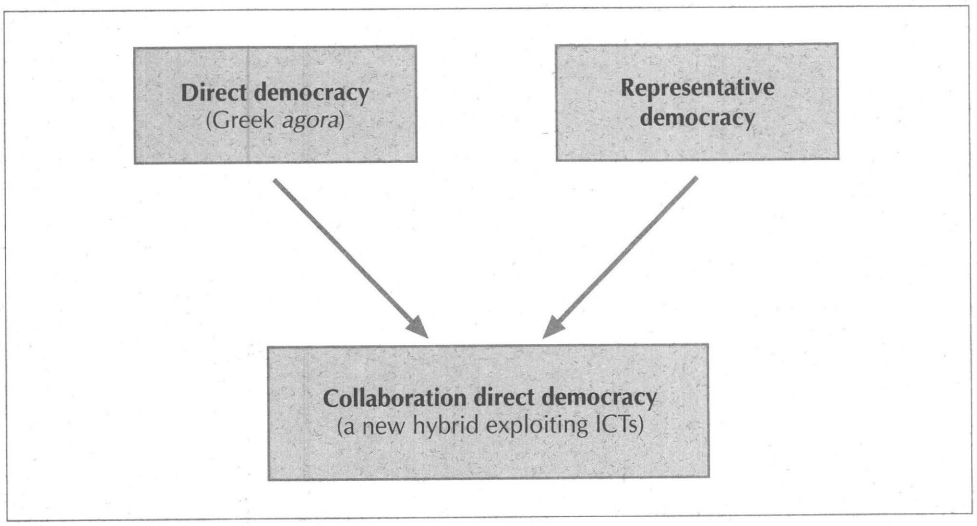
Table 1. Implementing eGovernance

Implementing eGovernance requires that we re-examine our basic notions of governance itself, for example by seeking to move:

- from regulation for control to regulation for facilitation
- from administration to service
- from bureaucracy to accountability
- from a top-down arbitrary approach to bottom-up citizen empowerment
- towards a new citizen-centred public service ethic, built on the solid foundations of what already exists
- from formal Politics to participation by all
- from a focus on rights and more rights to a focus on a balance between rights and responsibilities
- from the rule of the majority to space for minorities

Source: Millard, 2003

Figure 1. a new hybrid: collaborative direct democracy



Source: after an idea by Stephen Coleman[1]

long been seen as impractical in mass societies, and was replaced by the election of representatives in modern democracies. Figure 1 shows how, in principle, ICTs could lead to a synthesis of the best aspects of these two traditions in the form of 'collaborative direct democracy' which both re-engages citizens through on-line participation and retains professional legislators.

Figure 2 shows how ICTs could, in principle, lead to a re-balancing of traditional, top-down, institutionally-controlled participation with new bottom-up, informal and non-institutional forms of participation based upon experimental new digital technologies.

There is, however, also a 'digital danger' in applying ICTs to democracy. Despite the present democratic deficit experienced at many levels across Europe (for example, the loss of trust in politicians and the political process, and falling participation rates in elections), there is arguably still a need to continue representative democracy complemented by new forms (such as those illustrated in Figures 1 and 2). The wholesale or unthinking introduction of direct eVoting on too large a number of issues could undermine voters' sense of being accountable for their decisions if voting becomes too routine and too divorced from the process of policy assessment.

There is a risk that the wholesale introduction of direct eVoting could undermine voters' sense of responsibility and lead to decisions that are too remote from policy assessment

However, everyone can probably agree that government does need to be democratic, transparent, open and accessible, and ICTs can add significant impetus to each of these goals. Engaging citizens through policy design, implementation and evaluation can evolve through the eDemocracy cycle (see Box 1).

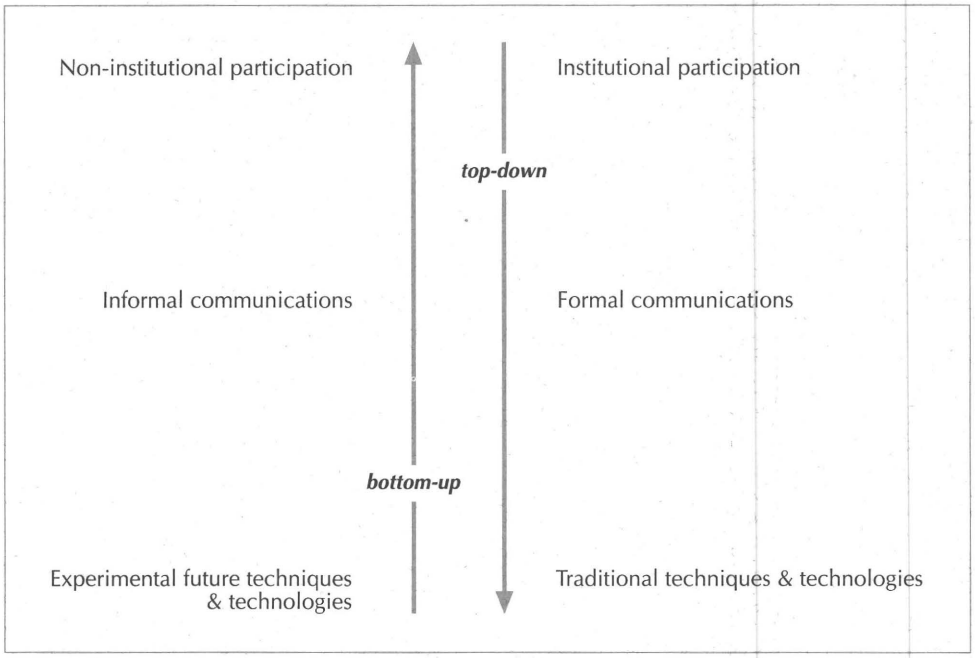
The OECD (2003) has also recently considered the impact of ICTs on efforts to enhance citizen engagement in policy decision-making, and highlights five main challenges for e-democracy (see Box 2).

eGovernance in practice

The practical implementation of eGovernance has started within the last few years and many examples are already serving to shape our understanding of the opportunities and challenges involved.

The European Commission provides a set of online Interactive Policy Making (IPM) tools for businesses and citizens to make inputs into European policy development and implementation

Figure 2. top-down and bottom-up eParticipation



Source: after an idea by Kim Viborg Andersen[2]

One of the biggest barriers to eServices generally is the need for identity management and complicated technical solutions like digital signatures tend to be applied in most cases, thereby reducing take-up

The European Commission provides a set of online Interactive Policy Making (IPM) tools for businesses and citizens to make inputs into European policy development and implementation. These include the 'Your Voice in Europe' web-site, on-line consultation, feedback mechanisms through structured online questionnaires (with 12,000 items in 2003), and a European Business Test Panel with participation by up to 3,000 businesses providing a statistically valid, permanent and simple method of eliciting the views of business. The IPM tools are used at all stages of European policy-making: agenda setting, policy creation, implementation and monitoring.

Also at the European level, the eVote web-site, introduced during the Greek Presidency in the first half of 2003, was a very successful experiment aimed at giving European citizens an active voice in European and indeed global issues, ranging from the Iraq War to European Heads of State Summit policies such as EU enlargement, immigration and drugs policy. Over 550,000 unique visitors used the site during the Greek Presidency, making it the largest ever experiment in international eDemocracy.

Switzerland has long used referenda (requiring a yes-no answer to a specific policy proposal) as a supplement to the election of representatives. In 1991, postal voting was introduced followed by Internet voting in 2001, both of which have significantly increased voter turnout. For example, in Communes that used Internet voting, turnout was 43% compared to 28% elsewhere. Internet voting is not intended to replace traditional forms, but rather to act as a third channel and it has already raised some interesting issues.

One of the biggest barriers to eServices generally is the need for identity management and complicated technical solutions like digital signatures tend to be applied in most cases, thereby reducing take-up. In Switzerland's eVoting

Box 1. The OECD's eDemocracy cycle (OECD, 2001)

- Information (eEnabling) – a one-way relation in which government produces and delivers information for use by citizens. It covers 'passive' access to information on demand by citizens as well as 'active' measures by government to disseminate information to citizens.
- Consultation (eEngaging) – a two-way relationship in which citizens provide feedback to government, based on the prior definition by government of the issue on which citizens' views are being sought. This requires the provision of information as well as feedback mechanisms.
- Active participation (eEmpowerment) – a relation based on partnership with government, in which citizens actively engage in the policy-making process. It acknowledges a role for citizens in proposing policy options and shaping the policy dialogue, although the responsibility for the final decision or policy formulation rests with government. This step of online public engagement in policy deliberation is undoubtedly the most difficult to generate and sustain.
- Online elections – on single issues or for representatives. Experiments in many European countries have shown that on-line voting can raise participation especially at a time when it otherwise seems to be falling.

experiments, however, lower security levels were set, but which were still greater than the security achieved with traditional voting. Promising results were achieved based on the use of citizens security card numbers, their date of birth and specific information about the Commune in which they live. Because there is no need for manual ballot processing, it is easier to ensure that votes are valid, and a receipt is given automatically. The back-office processes are also simplified as there is, in effect, only one ballot box to count rather than many. Overall, 28% of the Internet votes were cast by people who do not normally vote. Interestingly, citizens over 60 years voted online more than other age groups, and in the future there technology may be used to increase democratic participation among groups that otherwise might have to overcome difficulties of access (e.g. a voice-interface is being introduced for blind voters).

Conclusions

Introducing ICTs to democracy (however defined), poses profound political, ethical and practical problems, especially in relation to the digital divide, i.e. how can the technology 'have-nots' participate? Just as serious, however, is the danger of trivialisation and short-termism which could result if direct voting by Internet were to be widely introduced. These already bedevil the political system and could be made worse by the introduction of eVoting without educational and informational support structures. For example, a situation could arise where frequent eVoting reduces complex issues to over simplified yes-no questions and sacrifices the long-term view with pressures for immediate gain and quick ill-thought out populist panaceas. It is questionable whether simply adding ICTs to existing governance structures will *de facto* produce more open and accountable

Box 2. The OECD's five eDemocracy challenges (OECD, 2003)

- Challenge of scale: how can technology enable an individual to get heard in public mass debates; how can technology support governments to listen and respond to citizens' comments?
- Building capacity and active citizenship: designing technology to encourage deliberative debates on public issues among citizens.
- Ensuring coherence – allowing a holistic view of policy-making: there is a need to ensure that knowledge that is input at each stage is made available appropriately at other stages of the process so as to enable more informed decision making by governments and citizens.
- Evaluating e-engagement: there is a need to understand how to assess the benefits and impacts of eDemocracy tools on political decision-making.
- Ensuring commitment: governments need to adapt structures and decision-making processes to ensure that the results gathered with eDemocracy tools are analysed, disseminated and used.

Box 3. The Demos Project, Hamburg

The Demos project in Hamburg addresses the issue of eParticipation based upon three key elements: information provision, public will formation, and decision-making through three discussion phases:

1. Broadening the discussion – where online discussion is initiated and information about the problem situation and the interests, positions and ideas of the stakeholders are gathered from as many sources as possible. Electronic tools enable moderators to structure online discussion and cluster inputs into the major issues.
2. Deepening the discussion – where the main task is to address major issues in more depth through electronic tools which assist participants to break into sub-groups, to conduct online surveys, and to collaborate on preparing joint position statements.
3. Consolidating the discussion – which collates the results from the sub-groups into a document summarising and visualising the main points of the discussion. Ideally, this structured discussion process leads to political consensus. In practice, participants may continue to disagree, but the reasons for the disagreement will have been made transparent and comprehensible.

government, even assuming that the digital divide can be overcome. We need to re-examine the whole notion of governance and democracy, both supported by and independent of ICTs, and this will take time, especially as the rapid ICT-adoption curve is racing ahead of our ability to cope with and understand the processes unfolding. Despite these dangers, however, experience has already shown the immense benefits eGovernance can bring in extending participation, widening and enriching the political debate and increasing voter turnout. As in most societal arenas, new technology is a double-edged sword requiring real policy choices and deliberate implementation strategies designed to maximise benefits and minimise negative outcomes. The march of history has been ever thus.

Keywords

eGovernance, eDemocracy, eVoting, eParticipation, citizens, digital divide.

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Notes

1. Stephen Coleman, Professor Oxford Internet Institute at the European Commission's eDemocracy Seminar, 12-13 February 2004, Brussels.

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Realising the Productivity Potential of ICTs

Ilkka Tuomi, *IPTS*

Issue: Our current understanding of ICT productivity and growth effects is based on models that are not well suited to knowledge- and innovation-based economies.

Relevance: Although it is widely believed that ICT productivity impacts became clearly visible in the second half of the 1990s in many developed countries, and that EU has been lagging the US in appropriating ICTs, such beliefs may be unsubstantiated. Effective policy-making may require new frameworks that link growth and development in order to conceptually grasp and foster productivity.

Introduction

In recent years numerous influential studies have focused on the importance of ICTs for economic growth and improvements in productivity. These studies often started out from Robert Solow's famous observation, known as the Solow paradox, that despite the extensive use of ICTs, up until the mid-1990s they do not seem to have made a noticeable impact on productivity. Recent studies have claimed that the paradox has now been solved. According to these studies, ICTs started to become visible in the second half of the 1990s, and ICT was the most important source of productivity growth in many developed countries. It has also been argued that in comparison with the U.S., Europe has been slow to appropriate the productivity benefits associated with ICTs.

For policy-makers, the central role of ICT in the modern economy means that it is important to understand the links between ICT, productivity growth, and economic development. It is therefore important to have a clear picture of what, exactly, we know about ICT productivity impacts.

A closer look at the assumptions of the econometric models that underlie our current knowledge about ICT productivity impacts reveals some interesting open issues. Below we discuss these, and argue that a broader focus on ICTs as enablers of economic development is needed to understand their growth and productivity impacts.

Information and Communication Technology in the neoclassical productivity framework

ICTs can influence productivity through three different mechanisms. Firstly, when ICT producers learn to create more output without increasing their inputs, the efficiency of the ICT producing sector increases. This improvement may appear as an increase in overall economic efficiency and so

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ICTs can potentially influence productivity in three different ways: improved manufacturing techniques in the ICT sector; labour productivity improvements in other sectors investing in ICTs; and efficiency gains in other industries

According to the growth accounting framework the growth rate of total output is a weighted sum of the growth rates of the inputs, plus a residual factor that equals the growth rate of total factor productivity

be recorded as total factor productivity growth. Secondly, when ICT using sectors invest in ICT, their labour productivity typically increases. This is because of "capital deepening" which lowers the relative amount of labour needed to produce a given output. Thirdly, the use of ICTs can make the user industries more efficient, thus increasing their total factor productivity.

In the 1990s, ICTs started to become visible in economic statistics. ICT investments increased rapidly and ICTs became a substantial part of total fixed investment in many countries. In industries that were heavy users of ICTs, capital deepening increased labour productivity, and much of labour productivity growth could be associated with these investments. In ICT producing industries, rapid technical advances become recorded as increases in total factor productivity, and much of the overall total factor productivity growth can be traced back to these advances. In this sense, ICTs become the drivers of productivity growth in the 1990s, with the U.S. leading the way.

This interpretation may, however, produce a rather misleading picture of the role of ICTs in productivity improvements and economic growth.

Conceptually, most influential studies on ICT growth and productivity impacts start from the neoclassical growth accounting framework.[1] In this framework, the growth rate of total output is shown to be a weighted sum of the growth rates of the inputs, plus a residual factor that equals the growth rate of total factor productivity. In ICT productivity studies the inputs are typically decomposed into labour, ICT-related capital, and non-ICT capital. The residual factor is often called the Solow residual. It represents growth that remains unexplained after the impact of labour and capital inputs on growth are taken into account.

To understand the essence of the neoclassical growth accounting framework, it is useful first to clarify the nature of the residual.

Technical advance, the Solow residual, and total factor productivity

Historically, the Solow residual has been associated with technical progress. The famous "productivity paradox" was associated with the fact that despite the rapid diffusion of ICTs in the 1980s, the Solow residual more or less disappeared after 1973 in the observed growth data. In other words, since the early 1970s, ICTs did not seem to have any noticeable impact on economic efficiency. In the second half of the 1990s the paradox, however, seemed to go away. To understand why this happened, we have to understand what the Solow residual actually measures.

In the neoclassical productivity framework the Solow residual is directly associated with the rate of total factor productivity growth. Total factor productivity—also known as multi-factor productivity—gives the overall efficiency of using productive inputs, most importantly labour and capital services, and—depending on the exact formulation used—land, energy and intermediate inputs.

It would be natural to expect that ICTs would reveal their productivity impact on the overall economic efficiency, and become visible in the Solow residual. The rapid measured growth in total factor productivity and its concentration in the ICT-producing sectors in the second half of the 1990s, indeed, has often been interpreted this way. Whereas the productivity paradox of the 1980s demonstrated itself in the dismal improvements in total factor productivity and the disappearance of the Solow residual, in the second half of the 1990s total factor productivity grew rapidly in the U.S. and in some other ICT-intensive economies, and

the residual became visible again. This was often interpreted as the impact of ICTs.

Strictly speaking, this interpretation is not correct. When total factor productivity is consistently measured using the neoclassical productivity framework, total factor productivity improvements by definition remain unexplained "manna from heaven." In the neoclassical productivity framework, total factor productivity is not due to improvements that are paid for; instead, in this framework "technological advances" are unplanned costless improvements that are exogenous to the economic system. It is therefore important to realise that total factor productivity does not measure technical progress in any normal sense. Instead, total factor productivity measures unknown factors exogenous to the economic system, but which inherently remain beyond policy-implications-oriented frameworks used to understand growth and productivity.

In fact, in the 1950s, Abramowitz famously called the total factor productivity residual "our measure of ignorance." In the standard growth accounting framework, total factor productivity can measure earthquakes, good weather, wars, changing terms of international trade and global outsourcing, firm-level and inter-industry competition, stock-based labour compensation schemes, mismeasured working hours, fluctuations in capacity utilisation, changes in tax structure, and all other factors that are not explicitly measured. For example, in ICT industries where labour has extensively been compensated with employee stock option grants, total factor productivity will noticeably diminish in the next couple of years, as the new international accounting rules make options accountable as normal labour costs.

"Technical advance" in neoclassical productivity studies, in other words, typically means "everything that is not measured as labour and capital services." If all productive factors were to be included accurately in the neoclassical equations that describe how economic inputs are translated into economic output, total factor productivity would become a constant and its growth rate, the Solow residual, would become a stochastic error term in those equations. The policy implications of studies that show that some countries have slower total factor productivity growth than other countries, therefore, are not conceptually clear.

At present we know, however, that the measured total factor productivity growth has been strongly concentrated in ICT equipment manufacturing sectors. As total factor productivity growth has been slow outside these sectors, many researchers have argued that ICT use has not increased economic efficiency. In this sense, as Robert Gordon[2] puts it, "the Solow computer paradox survives intact for most of the economy." Others[3] have argued that industries that invest in ICTs extensively, in fact, have shown total factor productivity improvements in recent years. Such conflicting views typically reflect differences in the data used, adjustments for cyclical factors, and variations in research methodology. In general, these conflicting interpretations, however, build on shared basic assumptions of the growth accounting framework (an issue which cannot be explored further here for space reasons).

Total factor productivity does not measure technical progress in any normal sense. Instead, total factor productivity measures unknown factors exogenous to the economic system

The sources of productivity growth in the 1990s

Assuming, as ICT productivity studies normally do, that the neoclassical framework works, it is interesting to understand why, exactly, ICT in these studies seems to be a key source of growth and productivity improvement. Why did ICTs become such an important factor in the 1990s? To understand the reasons for this, we have to find the mechanisms that produce growth in these

The way total factor productivity is measured could mean it will diminish in the short term as stock options start being entered on the accounts as normal labour costs

productivity studies. A somewhat surprising result is that most of the ICT-related growth is produced by researchers who put growth were they believe it should be found.

The growth accounting framework separates the contributions made by labour, ICT capital and non-ICT capital to economic output growth by generating time-series data of these different inputs. It then weights the growth rates of the inputs to derive the overall growth rate of the economy, typically measured as total value added. Using this procedure, productivity researchers can say how much the different potential growth sources actually contributed to growth. In a similar way, researchers can separate different industries and study productivity developments within industries and economic sectors.

Choosing appropriate weights for the different inputs in the growth accounting model means assuming economic actors allocate their resources rationally, the economy is in equilibrium, and that producers use different inputs in ratios that reflect the marginal productivities of these inputs

A central question in growth accounting is how to choose the appropriate weights for the different inputs. This is the point where the neoclassical theoretical assumptions enter the picture. Theoretically, if all economic actors allocate their resources rationally and the economy is in equilibrium, producers use different inputs in ratios that reflect the marginal productivities of these inputs. Furthermore, if the economy is perfectly competitive, in theory the prices of the different inputs also equal their marginal productivities.[4] For labour, the price for labour services equals the wage, and for capital it equals the market rental price. One possible way to weight the different inputs to the production process is therefore to multiply the working hours by the wage rate and the amount of capital services by their current market price. In this way, the economic value of inputs can be added to get a number that represents the total value of inputs.

In practice, producers often own most of the capital goods that they use in production. Capital services generated by these goods therefore do not necessarily have market prices, and productivity researchers have to estimate them. This is done using the concept of "user costs." The cost to the user is the "rental cost" that the capital owner "pays" for using the capital good.

The user cost consists of gross rate of return multiplied by the current remaining value of the invested amount. One factor in the gross rate of return is the net rate of return that the invested amount would earn if it were producing income in the overall economy. In ICT productivity studies, this net rate of return is often assumed to be about 4 percent. In addition, the gross rate of return includes depreciation that accounts for wear, tear, and other losses of productive efficiency, and a factor that accounts for the revaluation of the price of the invested capital good. Although different studies use different methods to calculate these different components of gross rate of return, for computers the annual depreciation is often calculated to be about 30 percent, and the price decline is estimated to be in the same range, leading to gross rate of return of some 65 percent.

The neoclassical productivity framework develops time series data that describe the evolution of productive stocks of different types of capital assets and labour, multiplies these with user costs and wages, and compares the time series of economic output with the inputs

The neoclassical productivity framework proceeds from these starting points in a relatively straightforward way. It develops time series data that describe the evolution of productive stocks of different types of capital assets and labour, multiplies these with user costs and wages, and compares the time series of economic output with the inputs. By looking at the unexplained difference between output growth and the growth of combined labour and capital inputs, it arrives at numbers that represent total factor productivity growth. By comparing the growth rate of output with growth rate of labour inputs, it arrives at numbers that represent labour productivity growth.

One particularly interesting theoretical issue has been underlying most of the results of ICT

productivity studies, however. This is the way that ICT output, investments and capital are measured. It seems possible that we have considerably overestimated the growth and productivity impacts of ICT in the 1990s.

Computer price indices as the source of growth

The basic problem in measuring computer productivity impacts is that we need a good estimate of the computing services generated by computers. To isolate the impact of computer production and investments, we have to multiply the user costs of computing investments by the volume of computing. But what could be the appropriate way to measure the "volume of computing?" How can we measure the flow of services generated by computers? Should we use cubic meters, tons, electricity consumed or the number of computer boxes shipped?

Productivity researchers typically solve this problem by measuring the economic value of accumulated investments and correcting for price changes across the different years when investments are accumulated. The current stock that generates services would then equal the accumulated investments, corrected for price changes, minus depreciation of assets through wear, tear, and obsolescence.

For computers, simple price changes, however, are not enough. A typical desktop PC may cost 5 percent less this year than last, but it may also have double the hard disk capacity and a processor that is twice as fast. Computer price indices, therefore, need to be "quality adjusted." In fact, in nominal terms the median desktop computer prices have been quite stable during the last three decades, although in recent years they have dropped from about 2000 USD to about 1000 USD in the U.S.

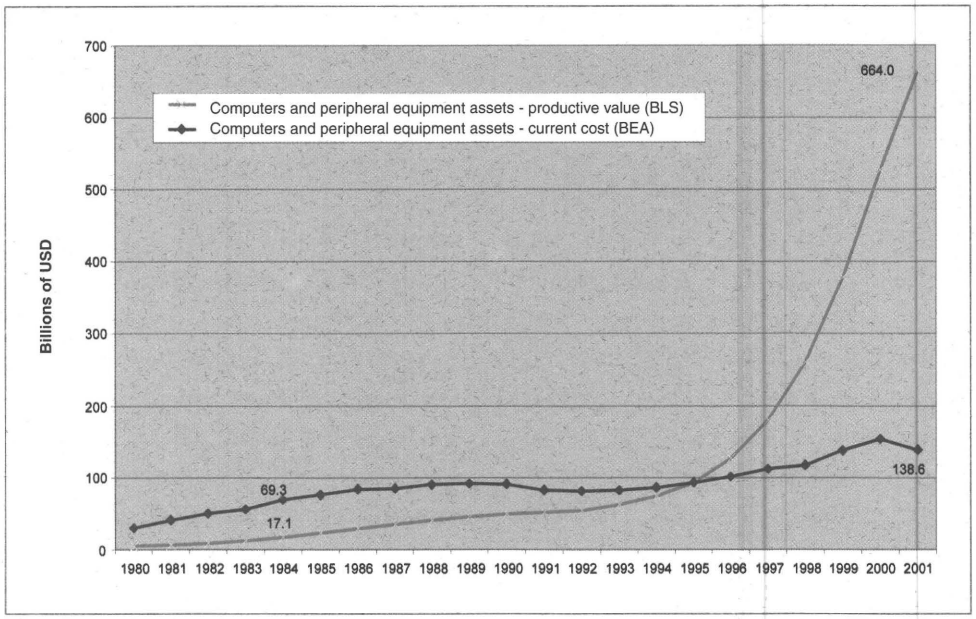
The "volume" of computing services is calculated by accumulating "productive stocks" of computing, and assuming that the stream of computing services is proportional to the size of the productive asset. Whereas national accounts and business firms normally calculate their assets based on their current market value or historical investment value after depreciation, productivity researchers are interested in productive assets that reflect their ability to produce services.

Productive assets, therefore, become different from conventional economic assets. When researchers make adjustments that change the economic market value of computers into productive value, they actually generate most of the growth that appears in productivity statistics in the 1990s. This is illustrated in Figure 1, which shows the evolution of computer assets in the U.S., both for their current cost value that is supposed to measure the replacement value of these stocks, and for productive value, which is supposed to measure the volume of computing assets.

As can be seen in Figure 1, the value of U.S. computing assets has roughly doubled over the two decades since the 1980s, while growth in the 1990s was relatively modest. The estimated value of productive assets that generate computing services, however, grew extremely rapidly in the second half of the 1990s. This rapid growth, in fact, has been the main source of research results that show that ICTs became important for economic growth and productivity improvements in the 1990s. As the neoclassical growth accounting framework multiplies the growth rate of productive stocks with their corresponding user costs, which for computers are extremely high due to the rapid decay of computer investments, studies which include a separate ICT-capital term (i.e. breaking capital down into ICT and non-ICT) point to computer investments as the main source of growth.

Calculating the value of computing assets is made difficult by their rapid obsolescence and the continual performance improvements offered by newer models

Figure 1. Computer assets in the U.S. Market value vs. value used in productivity studies



One may, however, wonder whether the market really measures the value of computing as badly as implied by Figure 1. If we used the market value of computing assets instead of the estimated productive value, the neoclassical growth accounting framework would show that ICTs had a negligible impact on economic growth and productivity improvements in the 1990s.

Whereas in the case of software and telecommunications equipment the productive stocks have grown almost exactly at the speed of net investments, in that of computing equipment the rates of growth have diverged radically

To understand this issue, one needs to note that the difference between the two curves in Figure 1 is created mainly by price index adjustments that try to account for technical improvements in computing. The U.S. Bureau of Economic Advisors calculates these quality adjusted price indices, which are also widely used in European and international productivity studies. These price indices are "hedonic" indices that estimate price changes across time for constant quality computing products. In effect, they statistically fit dollar values for different technical characteristics of computers, such as processor speed, bus bandwidth, and hard disk size, and use these estimated parameters to calculate the price change of a bundle of technical characteristics from one year to the next. These indices are then used to adjust the market value of computers so that today's prices become comparable with yesterday's prices and can be added to get an estimate of the volume of accumulated productive stocks of computing.

Computers have been important for measured growth because computer prices have been aggressively adjusted for quality improvements. In other ICT products and services the adjustments have been much less prominent. This can be seen in Figure 2, which shows the price indices for computers, communications, software, and other products using the year 1996 as the base year. Whereas in the case of software and telecommunications equipment the productive stocks have grown almost exactly at the speed of net investments, in that of computing equipment the rates of growth have diverged radically. The reason for the rapid growth of productive computing stocks is the rapid decline in computer price indices. In neoclassical productivity studies, this decline becomes doubly influential as it affects

both the size of productive assets and the user costs that multiply the growth speed of these assets.

Most European countries do not use hedonic price indices in their national accounts. As a consequence, their computer price indices decline much more slowly, in some cases showing price increases instead of declines. International studies therefore typically use the U.S. hedonic price indices to derive estimates of productive ICT assets in different countries, assuming that national statistics do not give a correct picture. These studies, however, typically do not correct the output, which usually is taken to be the GDP or industry value added as it is recorded in national accounts.

A fundamental question is whether the quality adjusted price indices lead to correct estimates of "computing volume." One may argue both from theoretical and empirical points of view that this is not the case. Theoretically correct price indices have to be "chained" within product categories across time, leading to product specific valuations of economic services, at the same time splitting the economy into numerous incommensurable "economies" where money can no longer be added. In this world, car money and computer money have different colours. This has profound implications for the economic theory of value.

Hedonic price adjustments also make the value of money dependent on technical change and rapidly changing technical characteristics. This blurs the boundaries between technical and economic worlds. This is a fundamental challenge, as economic theory was supposed to generate a theoretical system that can be studied autonomously, treating considerations about social, mental, ethical, or technical sources of values as exogenous. Such external considerations appear in Figure 1 as the difference between those productive assets whose value the analyst imputes , and the assets that the market perceives and values. Furthermore, the extremely rapid technical change in computing in effect means that these products live in a world of hyper-deflation, where conventional growth accounting methods are known to break down.

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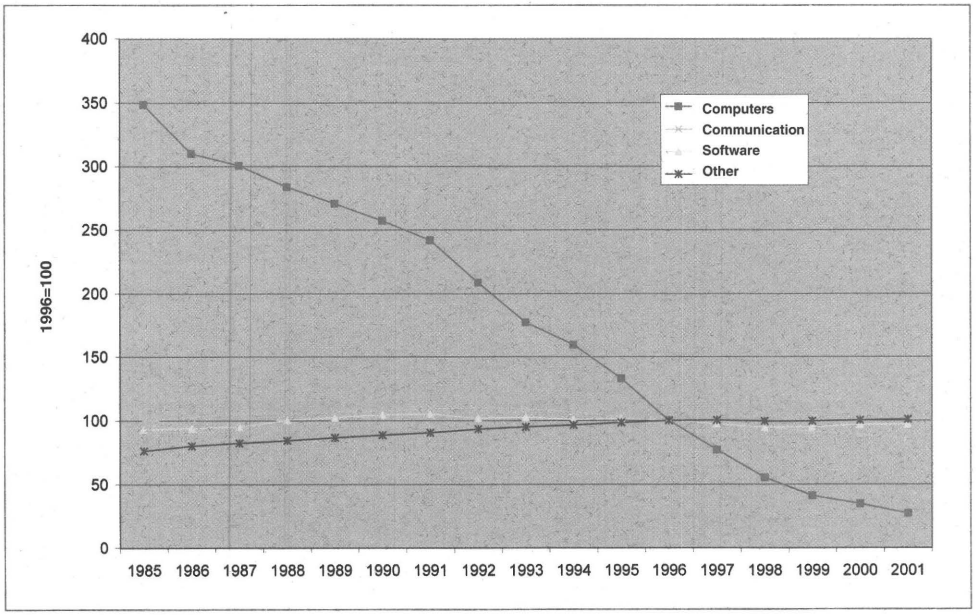
Figure 2. Price indices used to adjust the value of different products



Firewalls, virus protection software and spam filters create growth and drive computer users towards faster computers, but it is not clear that these advances should be interpreted as growth of productive ICT stocks

Empirically, the hedonic computer price indices most probably exaggerate the growth of computing assets. This is because they assume that improvements in technical parameters directly translate into increased computing services. This logic would mean, for example, that we are now roughly a thousand times more effective word processors than twenty years ago. An alternative explanation is that a considerable part of the decay in computer prices is in fact generated by decay. As ICT industry people sometimes say, they are in a fish business where goods start to stink if they stay on the shelves. The value of old technologies is creatively destroyed in a somewhat similar way as the latest fashion products destroy the value of yesterday's fashion. In this sense, modern ICTs are products that can simultaneously be described as durable goods and consumption goods.

Although computers have become technically much more advanced over the years, much of this progress has been consumed by increasingly complex software, and it is not clear what the net effect has been. In the networked computing world, all computing does not necessarily represent productive use. Firewalls, virus protection software and spam filters create growth and drive computer users towards faster computers, but it is not clear that these advances should be interpreted as growth of productive ICT stocks. The situation is analogous to the problems of GDP measurement, where crime, pollution, and other defensive costs become recorded as economic growth. It therefore appears that we need more research on the actual productivity impacts of ICTs.

Conclusion

ICTs are composite goods that consist of hardware, software, skills, systems integration, operational support, and infrastructure. The productive use of ICTs often requires organisational and working practice changes, and depends on contextual factors, such as transport infrastructure, cultural values, and the routines organising everyday life. It is therefore difficult to isolate ICT productivity impacts using the traditional productivity frameworks that allocate productivity improvements to specific investments. ICT investments become productive in combination with other investments and often through recombination of existing assets for new uses. This does not mean that ICTs would be irrelevant for economic growth and productivity. ICTs became a fundamental element of the economy and society in the 1990s. However, a closer study of ICT productivity impacts also reveals that our current concepts of economic growth and productivity perhaps address the economic impact of ICTs only in a somewhat limited sense. We therefore may need to rethink why productivity was understood to be such a central concept for policy and what, exactly, we mean by productivity and growth in the knowledge economy.

One way to move towards a new paradigm of productivity could be found, for example, by studying the growth impacts of ICT using Amartya Sen's capability-based model of economic development. This framework could help policy-markers to describe what types of technical change could reasonably be called development. It could also allow us to describe how ICTs augment and enhance those basic capabilities that are fundamental for economic development.[5]

Keywords

ICT, productivity, Solow paradox, growth accounting, classical model

Notes

1. Cf., Schreyer, 2001.
2. Gordon, 2000:57.
3. E.g. Van Ark, Melka, et al., 2002.
4. For a clear and compact elaboration of these mathematical relations, see Schreyer, Bignon, & Dupont, 2003.
5. This possibility has been discussed in more detail in Tuomi, 2004.

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Towards an EU Policy for Open Source software

Simon Forge, *SCF ASSOCIATES Ltd*

Issue: The importance of open source software arises from its role in preserving choice in a market characterised by growing monopolisation in crucial areas. It may also offer cost savings for public bodies in terms of both the initial outlay and total cost of ownership.

Relevance: Fostering an environment in which open source software can flourish could encourage innovation and a more pluralistic software market at a time when software has become a critical factor in the economy and society as a whole.

Introduction[1]

To date the European Commission's approach to the open-source software (OSS) debate has largely been passive, although some attention has been given to tacit support for OSS, especially in information and communication technology (ICT) research projects and policy in the Framework Programmes. In contrast the European Parliament has already taken a position on certain freedoms in software with an active stance, specifically with the vote against software patents of 24 September 2003. The essential question that needs to be addressed is whether the EC should merely lend passive support (i.e. take a laissez-faire approach, or whether it should be more proactive in its promotion of OSS). Reasons for taking a proactive approach include:

- dependence for the EU's economic development on quality software at the right price, available under non-limiting conditions - interoperability and advantages of public standards
- the need for creativity and openness in software, in order to develop a more advanced form of economy, an information society, which will be based on very large scale, open and secure platforms at low cost, that is, the information society's infrastructure

A proactive policy approach to open source software could bring benefits such as encouraging competition and a flourishing European software industry

A pro-active OSS policy initiative could offer the following benefits:

- protection of strong competition in the software sector, as our economic dependence on it increases each year;
- ensuring the benefits of products coming from the software industry are passed on to users —which will require a rebalancing of market power;
- encouragement of education and training in OSS to help promote a flourishing European software industry.

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These would all require some form of explicit support for OSS in EU policy. However, it is first necessary to define the aims of policy in this area.

The goals of OSS support

To date, most of the debate so far on why OSS is important has been in three areas:

- preserving an open choice in software against a growing monopolisation of the market in crucial segments, winning power back for the users, while giving more freedom of development;
- possible savings for government by admitting OSS as a contender for public procurement;
- reducing total cost of ownership, by eliminating the commercial software industry's externalities from its practices.

It may be useful for policy to go further. At the most general level, the goal is to support a better business model for software creation, as our dependency on software is already high and will continue to increase. OSS will have an increasingly important role in this new model of software creation, and so will play an increasingly crucial part in our economic destiny over the next 50 years. So the EU policy for OSS can be viewed as having two main goals:

- ensuring the freedom for OSS to prosper and be successful, that is by protecting competition;
- positively supporting OSS development and take-up with active measures to encourage new avenues while creating employment inside the EU, and possibly elsewhere.

The strategy for OSS: competition vs. regulation

Taking the first goal, policy instruments will be necessary to restore real competition in software, for a society ever more dependent on it, in a market situation of polarising oligopoly. Until recently, software was not perceived as being important enough to deserve such attention. However, as we become increasingly dependent on it, there is an argument that the economic consequences of the commercial software industry's failures and inefficiencies are so high that we should regulate it closely, to protect its users - far more closely than the considerable efforts that go into protecting the intellectual property rights (IPRs) of its publishers - because it is now as fundamental in our hierarchy of dependence as food, energy, transport and telecommunications. It is notable that in these other essential areas, anti-trust measures have been applied, and regulation continues to be strong.

Regulation could be mooted for software for similar reasons to those in other areas where it already exists. The three key factors it would need to cover, especially in cases where one software publisher dominates the market to the point of having market power, are:

- Backward compatibility legislation – making backward compatibility mandatory so that the new and old versions of an application dominating more than 30% of its market continue to work with earlier versions of software and document and data formats. The exact market share at which this mechanism shoudl be triggered needs to be decided, but the lower end of the scale for the threshold would be a market share of around 30%). If the product itself cannot be made backward compatible, then filters and adaptors must always be provided by the supplier for agreed common open formats.
- Open access – the software package or module's interfaces, especially application program interfaces (APIs), must be made public, for any product with more than 30% of its market.
- Legal limits on market share and use of the network effect – for basic platforms like operating systems and utilities such as browsers and databases, when dominating more than

The debate on the importance of open-sources software has so far focused on the need to prevent monopolisation of the software market and enable cost reductions, particularly in the public sector

Until recently, software was not perceived as being important enough to deserve such attention. This attitude is now changing

Possible areas for regulation in the software market include mandating backward compatibility, open access to program interfaces, and separation between operating systems and applications

The Internet is an example of how policy was able to protect and encourage growth despite the resistance from incumbent telecommunications operators

30% of their market, stricter controls apply, to avoid abuse of the dominant position:

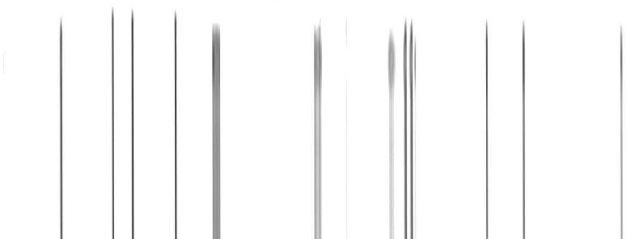
- applications produced by the same software publisher can only be released one year after all competitors have received the same information and support material as the internal division – documentation and test software – and this transfer must be audited as to time and content;
- applications supplied by the company that developed the operating system may not use special platform features not open to all competitors;
- operating systems or added basic utilities such as browsers must never treat rival utilities covering the same functions in a degraded fashion nor act maliciously or reject their inputs and accesses - for instance, the dominant supplier could place software updates or news from rivals in junk mail, or produce error messages during normal operations to deliberately sow uncertainty in the minds of customers.

An alternative to these examples of specific legislation is to follow what the US FCC chose in the case of the Internet, encouraging and protecting its growth, between 1970 and 1995 against the incumbent telecommunications operators – a policy of defending competition. In the case with which we are concerned here, competition would come from OSS. Real competition in software will ensure that the dependence on software is a healthy relationship, thus enabling our economy to thrive.

Allowing software patents raises a number of issues for open source software, particularly regarding

At this point on policy, we come to the question of software patents. A public debate has recently arisen over the legality of the 30,000 software innovation and they also tend to result in legal uncertainties that could endanger OSS (Perchaud, 2003; Probst, 2001; Commissariat Général, 2002; Bessen, 2003; Hall, 2001). Commercial practices such as a nebulous description and a tactic of "patent thicketing" can delay innovation for the lifetime of the patent. Consequently, for software, they tend to reduce competition, raise prices, slow down innovation, and encourage cartel behaviour (for example, patent pools) so that even licensing periods are relatively short (three years for example), the idea of a software licence is untenable. As well as there being a risk that the negative aspects of proprietary software patent rights might spill over into OSS, there is a risk to commercial software companies if their code is shown to contain OSS concepts (inadvertently or otherwise) and the copyleft principle in the open source licence is being infringed. In the event of infringement, software patent law would provide the instrument for punishing the company concerned, which is not at all the intention of OSS licences. Refusal to endorse software patents is one key to open source expansion of creativity and for widespread OSS usage, as the fears of patent misuse are avoided. Europe should perhaps avoid going down the same road as the US, as many people now regret that allowing software patenting might have been a mistake.

Far more is at stake than the fate of particular software publishers, and their attendant semiconductor manufacturers and PC vendors. The risk, if competition in software is not preserved, is that the continuing evolution of the information society might be jeopardised. We should maintain the opportunity for users, interested industry groups and individuals to contribute to OSS works in open communities of



These would all require some form of explicit support for OSS in EU policy. However, it is first necessary to define the aims of policy in this area.

The goals of OSS support

To date, most of the debate so far on why OSS is important has been in three areas:

- preserving an open choice in software against a growing monopolisation of the market in crucial segments, winning power back for the users, while giving more freedom of development;
- possible savings for government by admitting OSS as a contender for public procurement;
- reducing total cost of ownership, by eliminating the commercial software industry's externalities from its practices.

It may be useful for policy to go further. At the most general level, the goal is to support a better business model for software creation, as our dependency on software is already high and will continue to increase. OSS will have an increasingly important role in this new model of software creation, and so will play an increasingly crucial part in our economic destiny over the next 50 years. So the EU policy for OSS can be viewed as having two main goals:

- ensuring the freedom for OSS to prosper and be successful, that is by protecting competition;
- positively supporting OSS development and take-up with active measures to encourage new avenues while creating employment inside the EU, and possibly elsewhere.

The strategy for OSS: competition vs. regulation

Taking the first goal, policy instruments will be necessary to restore real competition in software, for a society ever more dependent on it, in a market situation of polarising oligopoly. Until recently, software was not perceived as being important enough to deserve such attention. However, as we become increasingly dependent on it, there is an argument that the economic consequences of the commercial software industry's failures and inefficiencies are so high that we should regulate it closely, to protect its users - far more closely than the considerable efforts that go into protecting the intellectual property rights (IPRs) of its publishers - because it is now as fundamental in our hierarchy of dependence as food, energy, transport and telecommunications. It is notable that in these other essential areas, anti-trust measures have been applied, and regulation continues to be strong.

Regulation could be mooted for software for similar reasons to those in other areas where it already exists. The three key factors it would need to cover, especially in cases where one software publisher dominates the market to the point of having market power, are:

- Backward compatibility legislation – making backward compatibility mandatory so that the new and old versions of an application dominating more than 30% of its market continue to work with earlier versions of software and document and data formats. The exact market share at which this mechanism shoudl be triggered needs to be decided, but the lower end of the scale for the threshold would be a market share of around 30%). If the product itself cannot be made backward compatible, then filters and adaptors must always be provided by the supplier for agreed common open formats.
- Open access – the software package or module's interfaces, especially application program interfaces (APIs), must be made public, for any product with more than 30% of its market.
- Legal limits on market share and use of the network effect – for basic platforms like operating systems and utilities such as browsers and databases, when dominating more than

The debate on the importance of open-sources software has so far focused on the need to prevent monopolisation of the software market and enable cost reductions, particularly in the public sector

Until recently, software was not perceived as being important enough to deserve such attention. This attitude is now changing

Possible areas for regulation in the software market include mandating backward compatibility, open access to program interfaces, and separation between operating systems and applications

The Internet is an example of how policy was able to protect and encourage growth despite the resistance from incumbent telecommunications operators

30% of their market, stricter controls apply, to avoid abuse of the dominant position:

- applications produced by the same software publisher can only be released one year after all competitors have received the same information and support material as the internal division – documentation and test software – and this transfer must be audited as to time and content;
- applications supplied by the company that developed the operating system may not use special platform features not open to all competitors;
- operating systems or added basic utilities such as browsers must never treat rival utilities covering the same functions in a degraded fashion nor act maliciously or reject their inputs and accesses - for instance, the dominant supplier could place software updates or news from rivals in junk mail, or produce error messages during normal operations to deliberately sow uncertainty in the minds of customers.

An alternative to these examples of specific legislation is to follow what the US FCC chose in the case of the Internet, encouraging and protecting its growth, between 1970 and 1995 against the incumbent telecommunications operators – a policy of defending competition. In the case with which we are concerned here, competition would come from OSS. Real competition in software will ensure that the dependence on software is a healthy relationship, thus enabling our economy to thrive.

Allowing software patents raises a number of issues for open source software, particularly regarding the risk of OSS being strangled by patent infringement litigation

At this point on policy, we come to the question of software patents. A public debate has recently arisen over the legality of the 30,000 software patents issued by the European Patent Office (Roffel, 2004) Patents are monopoly rights granted by the state. Their overall effect on software is a tendency to inhibit rather than encourage innovation and they also tend to result in legal uncertainties that could endanger OSS (Perchaud, 2003; Probst, 2001; Commissariat Général, 2002; Bessen, 2003; Hall, 2001). Commercial practices such as a nebulous description and a tactic of "patent thicketing" can delay innovation for the lifetime of the patent. Consequently, for software, they tend to reduce competition, raise prices, slow down innovation, and encourage cartel behaviour (for example, patent pools) so that even licensing periods are relatively short (three years for example), the idea of a software licence is untenable. As well as there being a risk that the negative aspects of proprietary software patent rights might spill over into OSS, there is a risk to commercial software companies if their code is shown to contain OSS concepts (inadvertently or otherwise) and the copyleft principle in the open source licence is being infringed. In the event of infringement, software patent law would provide the instrument for punishing the company concerned, which is not at all the intention of OSS licences. Refusal to endorse software patents is one key to open source expansion of creativity and for widespread OSS usage, as the fears of patent misuse are avoided. Europe should perhaps avoid going down the same road as the US, as many people now regret that allowing software patenting might have been a mistake.

Far more is at stake than the fate of particular software publishers, and their attendant semiconductor manufacturers and PC vendors. The risk, if competition in software is not preserved, is that the continuing evolution of the information society might be jeopardised. We should maintain the opportunity for users, interested industry groups and individuals to contribute to OSS works in open communities of development. That is, open access to source code should be assured in a key part of the software industry, as the resulting products are often so superior in many ways.

Is there justification for the EU to actively support freely distributed open-source software?

Is there an economic justification for providing financial support to OSS projects in certain areas, not just creating a level playing field by suitable legislation to protect competition? Does it makes economic sense for governments to subsidise work that becomes publicly accessible and which may be diverted into proprietary software? Some economists have tried to show that government subsidies are at best an inefficient use of public funds. But do these calculations take into account the benefits of giving access to OSS as a result of subsidies, rather than leaving the initiative to chance in the hands of a commercial concern? This is particularly so given that the unique character of OSS development leads to products that might never be produced by the commercial software model. Without OSS, we would have no large-scale shared environments at all, as no single commercial concern could foresee the results and predict success, or create sound business models for profits. The commercial risk of such an enterprise, dependent on a wide public take-up is too high.

However, it is quite possible, within the bounds of commercial risk, for a software company to take what is already an OSS success, such as Linux, and create a sustainable business supporting packaged version of that OSS or commercialising an application for it. In this way OSS has the capability to seed a new software model, as technical risk is reduced for the publisher and support service provider.

If there is a policy to support OSS, what should its key aims be?

Taking OSS as analogous to free speech–as a way of communicating software freely–sets the scene for an OSS policy to drive European excellence in software while creating wealth and employment. The policy's key aims are to produce major programmes with a perspective over at least 20 - 30 years:

- Ensure dependence on software occurs in a way that is safe and sustainable for the economy through general policy initiatives across all actions the EU takes, which will:
  - form a large stable OSS community;
  - facilitate employment creation through OSS;
  - protect competition and the use of open standards for inter-operability.
- Advance research in OSS and create OSS applications that can be harnessed widely by business and by the EU software industry, in its support and systems integration roles.
- Ensure competition between a number of business models – exploiting synergies between OSS and other models on the basis of "co-opetition" (i.e. combining features of both competition and cooperation) to provide more choice.
- Support new software usage directions which are simply not possible under the commercial banner. We may need to establish large-scale shared commons projects at the level of the Internet - cross-industry and cross-society infrasructures - for instance, a next generation of internet which is secure and free from malicious software and criminal exploitation
- Ensure the provision of the software, data repositories and document formats needed in the public sector in an unfettered manner with long-term support
- Build a software industry based on a mix of OSS and commercial enterprise through positive encouragement of OSS as well as its open design methods:
  - encourage the development of self-organising creative communities for OSS, involving the users as much as the developers. Furthermore, OSS provides an

The risk, if competition in software is not preserved, is that the continuing evolution of the information society might be jeopardised

Open source software is potentially able to develop products that would not be possible for developers working according to a purely commercial business model

innovation model for other fields of high technology, where a shared approach may yield common benefits;

- education from an early stage on OSS utilities and products, to raise knowledge levels in all types of software, via OSS itself;
- create employment in OSS, via vocational training and university level courses, and move to an inclusive mode of software employment, whereby retraining can help mop up unemployment and increase the knowledge value of work in the EU;

- Stimulate the private sector - the aim would be to drive an SME-based software industry comprising:
  - system integrators - a new set of common platforms, which come with more robustness and experience of interfacing with alien applications and environments;
  - value-added resellers (VARs) , representing a source of functional modules at low cost plus an educated market;
  - support and maintenance companies, representing a whole new source of revenues and employment;
  - independent software vendors (ISVs) - the chance to build on OSS wherever the OSS licence allows it, adding high functionality at low cost or to build products designed specifically for the OSS operating systems and database markets.

The way forward must give balanced support that preserves the creative spirit of OSS and fosters innovation

Possible policy approaches

Several options can be entertained, but each requires some deliberation, and some may be rejected as possibly doing more harm than good. A balanced approach to support is needed.

- One approach would be to mandate OSS in all software open to government influence. This range would cover public sector or private finance initiatives (PFI) for government projects, or for those private sector projects receiving public funds, including corporate venture support. However this could undermine the idea that policy should support *competition* in software – not replace one monopoly by another.
- Another approach would be strong official support for the OSS movement in the form of large, closely managed, OSS projects. Again this is undesirable, as the close management would destroy the *ad hoc* creative community approach, the key ingredient for success and sustainability, especially with commercial participants. A series of measures that are too heavy and monolithic could kill off spontaneous fast reaction, motivation and creativity by a bureaucratic stranglehold with its overheads of inefficiency.

The way forward must give *balanced support* that preserves the creative spirit of OSS, makes real progress in encouraging its use, and gives effective support to its development and creates opportunities for innovation in discontinuities in technology and business models.

Concrete measures for policy

Firstly, concrete measures should focus on competition - the intention of basic policy should be to foster competition through open applications access and an open architecture, with published document formats and interfaces such as APIs. Policy should preclude closed access - which would limit competition, experimentation, and innovation. Policy should also clarify the legal status of OSS, so that users and participating developer companies know where they stand. A selection of carefully constructed conditions for driving open competition will be needed, including measures such as:

- **not endorsing software patents** for the reasons stated above, Europe should maintain its position, and refuse to allow software patents;

- **support for OSS in public procurement policy**, with support for mixed solutions as well as purely OSS and purely proprietary environments;
- **responding to the need for a public proofing process** to assure that the OSS source is not contaminated by lines of commercial source code, perhaps with a public certification of "cleanliness";
- **re-examination of the role of trade-related IPR for software in the WTO agreements** (TRIPs) and the place of OSS, to encourage free interchange for developing countries to participate in global software markets, and form part of the OSS community;
- **examining the role for a body to hold OSS IPR in a commons at a European level**, so that any subsequent recourse is to that body. The body might be financed by the software industry itself and its associated partners such as the embedded systems suppliers.
- **considering support for an OSS source code and documentation repository** for Europe, with a set of template OSS licences acceptable in courts across Europe.

Secondly support a range of funded programmes (or simple policy support) in the following areas:

- ***Shared business platforms*** - The application of OSS to engender sector and cross-sector *use* of software for shared business activities such as trading, open innovation, and in embedded software within products. The policy must ensure that the commons model does really deliver what the commercial model can never provide – additional wealth and employment across many sectors from a common platform without commercial property restrictions, specifically from *being one open* platform. Key areas for such common generic platforms and their basic utilities could include:
  - trading networks and secure financial transactions, both business and retail;
  - health systems and networks for operation and management of health services;
  - education from pre-school – primary, secondary and tertiary, including academic research;
  - mobile communications for secure, ubiquitous environments;
  - embedded systems for consumer appliances and industrial controls;
  - vertical shared innovation environments – pharmaceuticals, oil and gas, central banking and insurance;
  - energy management and distribution;
  - grid computing and e-Science platforms and databases.
- ***Industrial OSS research*** - Create an industrial research programme of ten projects per year for *ad hoc* development communities, which can be seeded by the EC – for instance in:
  - IT security and commercial transactions, including personal privacy, and protection of identity;
  - robust, networked, open architectures for mobile and mesh (*ad hoc*) networking for pervasive and ambient computing, for the next generation of mobile multimedia Web;
  - middleware for distributed applications, including grid computing.
- ***Education and training*** - Encourage education and vocational training in OSS software, at all levels, to form a new generation of students well versed in OSS and to harness their creativity and ideas for the EU community:
  - a specific programme aimed at vocational training in OSS to help tackle unemployment among the under 25s, and to quickly create an energetic, well-educated pool of OSS programmers at a European level. OSS technology is particularly apt here in its culture, working practices and appeal.
  - support OSS with educational programmes at all levels of the education system:
    - for schools – distribution of OSS

Shared business platforms, industrial research, and education and training are areas where policy could possibly play a useful role in promoting OSS

Measures to support the open source software industry in the EU could include creating a body to manage OSS licences

environments and applications as the basis of educational infrastructure within the school;

- in university courses - where OSS can play an important role in computer science courses;
- in vocational software apprenticeship courses - for vertical markets and for support technicians, to create youth employment.
  - Form an open university of OSS - a "Web university" (there will be a need to pay attention to culture) with course materials published electronically, openly, at no charge. It may be spread across many existing universities as a virtual department that collectively works together, over the net across Europe and the world with:
    - formal undergraduate studies in software with degree qualifications, including OSS software development management (software engineering) and legal aspects of OSS, with narrowcast Web conferencing tutorials;
    - a post-graduate research faculty, including testing labs and licence approvals for close industrial collaboration on joint European projects;
    - the ability to support those taking ad hoc courses at will and informally – for example, in a specific (Linux) or a more generic subject (middleware and application servers) full-time or part-time or on-demand, with Web tutorials;
- ***Support the EU software industry in using and participating in OSS*** to form a new European software industry segment around OSS and ensure long-term employment opportunities – this would be closely linked to the previous education initiative, and will be based on funded support activities for:
  - legal clarification of the status of OSS licences, with the creation of a holding body for OSS licences, rather than a series of not-for-profit companies in concert with the main European software publishers, and the embedded systems suppliers in Europe;
  - large systems integration projects using OSS platforms, probably first in government and military segments, and for the generic vertical platforms mentioned above, in health, mobile multimedia and so on;
- ***Leverage public procurement*** – endorse use of OSS in the public sector, with support in key areas, such as document processing, for formats which must last over 50 years.

Choices for implementing the measures

Each policy area requires the right choice for implementation. A selection of the possible tools that may be used to implement policy, and the application of each, is given in Table 1.

Table 1. Selection of policy tools

Policy tool	Application
1. Legislation - areas for legislative tools are those concerned with protection of competition and restrictive practices, which could include refusal and reversal of software patents	• Mandate open document formats for public records and documents. • Inclusion of OSS in public tenders, in competition with commercial software packages • International trade – protection of OSS in TRIPS related discussions to assure the TRIPS agreements are not used as weapon • Control of monopoly in software markets with anti-trust law • Force interfaces to be revealed, where they harm competition and act as a restrictive practice under EC law, Article 82 • Ban software patents and reverse those given already
2. Supporting funds – a suitable tool for furthering OSS technology and encouraging vocational and general education in OSS, in hand with funded R&D	• Software infrastructure, as development and implementation projects • Programmes of Innovation- research, development and implementation • Education, at all levels of schooling, plus an OSS administrative environment, university courses, and also an open Web university of OSS, with course materials published electronically, at no charge • Vocational training in the technical and legal aspects • A centre for OSS: an institute for encouraging and co-ordinating OSS, centrally holding licences and the OSS source code repository
3. Directives – require common agreement across all EU members on aims and content. OSS is likely to be more acceptable as it offers direct cost savings.	• Inclusion of OSS in public tenders, in competition with commercial software packages • Legal status of OSS and acceptance of its 'template' licences within local courts
4. Recommendations - show local and central government how and where to use OSS	• Guidelines for procurement of OSS in public sector tenders • Recommendations to local and central government on where, when and how to use OSS and the various licences
5. Information campaigns	• Promote OSS in all sectors • Promote education in OSS

Note

1. This paper is based on a position paper prepared for IPTS/JRC, delivered January 2004, Open Source Software: Importance for Europe.

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ICT-Enabled Changes in Social Capital

René van Bavel, Yves Punie and Ilkka Tuomi, *IPTS*

Issue: ICTs are playing an increasingly significant role in the creation and appropriation of social capital. In terms of civic engagement, they are transforming and supplementing social capital. In terms of social contact, when social capital is understood as the capability to mobilise material and knowledge resources, further developments in ICTs (particularly ambient intelligence) can overcome the challenge of transferring tacit knowledge across communities of practice.

Relevance: As interactive and mobile ICT infrastructures become widely available, they transform the ways social capital is generated and appropriated. This has profound impacts on society and the economy. There is the potential for ICTs to play an increasingly significant role in social learning and the exchange of knowledge and knowledge-related resources across communities of practice, particularly now that network infrastructure and network access are becoming ubiquitous. But this will not be realised automatically. There is a need to go beyond the current development and design paradigm focused on functionality and external appearance.

Introduction[1]

Social capital is defined as 'features of social organisation, such as civic participation, norms of reciprocity and trust in others, that facilitate cooperation for mutual benefit'

Social capital has been defined as 'features of social organisation, such as civic participation, norms of reciprocity and trust in others, that facilitate cooperation for mutual benefit' (Putnam, 1993). It is a notion that has caught the attention of researchers and policy-makers alike. Significant relationships exist between levels of social capital in a society and positive indicators for health, education, economic growth, crime, and effectiveness of government institutions, to name a few (Performance and Innovation Unit, 2002; Grootaert & van Bastelaer, 2001). Therefore, from a policy perspective, awareness of social capital offers a number of opportunities across a range of EU policy areas.

Viewed from the perspective of Information Society policies, there is evidence to suggest that the widespread diffusion of information and communication technologies (ICTs), no longer restricted to early adopters, is having an impact on social capital. ICTs are increasingly becoming an integral part of people's everyday lives and of the everyday business of organisations (whether profit-seeking or not). ICTs are transformative, giving rise to new ways of living and organising which would not exist without them. The use of ICTs in social practice and their challenge to traditional

The views expressed here are the authors' and do not necessarily reflect those of the European Commission.

conceptions of time and space present new challenges to social organisation, re-organising those structures and processes that make up social capital. A prospective glimpse suggests that this influence of ICTs will only increase.

Today we are at the early stages of social change enabled by ICT. The Internet is still in its infancy, just as television was in the early 1960s. Interactive and online communication channels are no longer restricted to PCs, but are increasingly available through multiple devices. Access to fixed-line and wireless broadband is providing always-on multimedia connectivity. As a result, ICTs are starting to penetrate everyday life in new ways, transforming space and time, and reorganising the basis of social interaction.

Putnam (2000) argued that social capital has been declining consistently in the post-war period in the US, and concerns over the reasons and consequences of this decline have fuelled interest in social capital as a topic of research. Among many others, one of the factors associated with this decline, according to Putnam, is the increase in the amount of time people spend watching television. The assumption is that time spent in front of the television is time taken away from participation in civil society. By extension, according to this view, widespread ICT use may lead to a decline in civic engagement. The image which emerges from such a view is one of users (particularly young computer whizz-kids) increasingly interacting with their computers, but having little if any contact with the outside physical world. The implication, according to this perspective, is that ICTs may lead to an overall impoverishment of social relations and social cohesion, as suggested by Putnam's image of people 'bowling alone'. Moreover, such a development might contribute to an increasingly fragmented and individualised civil society, characterised by lower voter turnout and lower participation in public affairs.

However, such a pessimistic vision can easily be put into doubt. Recent research suggests that ICTs act as a catalyst for alternative ways in which people can relate to one another, and so lead to the emergence of 'new' forms of civil society. The importance of traditional institutions is declining while informal social collaboration is becoming more important. This observation gives rise to two different ways of understanding the impact of ICTs on social capital. One perspective sees ICTs as *transforming* social capital and the other as *supplementing* it (Quan Haase and Wellman, 2004).

In order to emphasise the fact that certain aspects of social capital are specifically shaped by ICTs, *networked social capital* emerges as a useful term (Van Bavel *et al.*, 2004). Such a notion enables discussion of the implications, with regard to social capital, of living in an increasingly networked society. Moreover, as noted earlier, the reliance on ICTs will only increase through time, making the notion of networked social capital more relevant in the future.

In order to consider the ways in which this trend towards the pervasiveness of ICTs is impacting social capital, a further refinement is required. Quan Haase and Wellman (2004) suggest that social capital can refer to, on the one hand, *civic engagement* (organised social networks and relationships) and, on the other, *social contact* (interpersonal communication patterns). Communication technologies enable social contact and they also underlie more institutionalised forms of social and civic engagement. This article will attempt to look at both.

Transforming social capital

Networked social capital emphasises interconnections between people with shared interests. Yet as interests become increasingly

Viewed from the perspective of Information Society policies, there is evidence to suggest that the widespread diffusion of information and communication technologies is having an impact on social capital

Television has been accused of being responsible for the decline in social capital in recent decades, on the assumption that time spent in front of the television is time taken away from participation in civil society

It may be that ICTs act as a the catalyst for alternative ways in which people can relate to one another and so lead to the emergence of 'new' forms of civil society

global and independent of physical proximity, interconnections between people from the surrounding (physical) environment, such as neighbours, are potentially neglected. This shift echoes the ongoing debate in the social sciences, dating back to the 19th century, regarding the changes in community life due to economic and technological advances. Some feel community life has been 'lost' due to the emergence of industrial society, while others, by looking beyond locality as a defining characteristic of community, point to transformations in social life and the emergence of a 'liberated' community (Quan Haase and Wellman, 2004).

One concern is that by freeing social connections from constraints of time and space, ICTs could create a society dominated by self-referential interest groups, leading to the so-called "balkanisation of public interest."

Along these lines, some authors have been worried that by facilitating social connections independent of time and space ICTs could create a society dominated by self-referential interest groups, with an associated decrease in society-wide participation. This possibility is sometimes characterised as the "balkanisation of public interest."

Moreover, the new forms of participation are thought to be different from the traditional ones where participants typically have to make compromises and need to commit to ideas or projects which they might not be entirely in agreement with. In fact, traditional representative democracy, where voters must yield to the will of the majority, is a prime example here. New forms of civic participation through ICT may require less commitment (i.e. they allow for less 'sticky' participation), and, for some authors, such a trend may also be a matter of concern.

From another perspective, ICTs offer a means of empowering civil society, giving new impetus to attempts at building a community that is connected simultaneously at global and local levels

Supplementing social capital

ICTs will, however, also create new ways to generate and appropriate social capital. From this point of view, ICTs offer another means of empowering civil society, giving new impetus to attempts at building a community, leading to greater social engagement, establishing different kinds of relationships between people, and helping provide the basis for a 'glocal' (i.e. simultaneously both global and local) civil society.

Frissen (2003) provides evidence of the active role of ICTs in stimulating civic participation, such as an on-line community project in response to local tragedies (Jongeren.volendam.nl), a website challenging ethnic stereotypes and promoting social integration between locals and immigrants (Maghreb.nl), and global web-based organisations opposed to globalisation (Indymedia.org). In a traditional political setting, the US presidential election campaign by Howard Dean used the Internet to enrol hundreds of thousands of supporters in just a few months, giving them a voice in setting the political agenda (Jett & Välikangas, 2004). More recently, the Internet and mobile phones enabled the coordination of last-minute protests, the night before the election, against the Spanish government in the wake of the March 2004 terrorist attack in Madrid.

Facilitating the exchange of knowledge

From the perspective of Information Society policies, it is particularly relevant to examine the role of networked social capital in the exchange of knowledge. A distinction is often made between explicit and tacit knowledge (see Duguid, 2003, for a review). Explicit knowledge is "de-contextualised" from its practical setting in a form that allows its representation and abstraction. As a result, it can be exchanged and diffused relatively easily, and here conventional information systems play a significant role. Tacit knowledge, on the other hand, is embedded in practice, difficult to represent as data in computer systems, and not easily diffused. The transfer of tacit components of knowing typically require social learning and socialisation into specific practices.

Generating and transferring tacit knowledge requires social interaction. Repeated interactions lead to social structures that are often described as communities of practice. These can be described as social entities that generate their specific world-views and interpretations, and which maintain the social learning processes that are required to make sense of the knowledge that is specific to the community in question.

Historically, communities of practice have been understood as relatively localised social structures (meaning that members are often located in proximity to one another). They require the existence of trust among members, which often requires frequent face-to-face contact in order to be established. It is possible, however, that ICTs replace this contact, establish trust, and lead to the creation of "virtual" communities of practice. While some research suggests that ICTs play a stronger role in *maintaining*, rather than *creating* social capital and communities (Steinmueller, 2003), there is also growing evidence against such a claim.

As computer networks increasingly become networks that facilitate computer-mediated communications, the characteristics of computer use change. Computers have traditionally been used as information processing machines that manipulate data. Now they are becoming a core element in social communication and knowledge exchange. The communicative use of computers, therefore, also facilitates their use in shared projects. They become embedded in social practices and thus allow for the transfer of tacit and practice-related knowledge within communities of practice. For example, Internet-based communities – such as those centring around open source software (e.g. Linux) – have increasingly become environments for social learning.

Communities of practice act as the loci of expertise. When social capital is understood as the capability to mobilise material and knowledge resources, access to communities of practice becomes a key source of social capital. By definition, community members have relatively good access to these resources. People who bridge several communities often play an important role in transferring socially embedded resources from one domain of application to another. In social capital literature, such persons are often said to have "bridging" social capital and they fill "structural holes" in social networks.

Knowledge can move within communities of practice by being codified into particular representations. A particular term, say 'digital territory', will be taken to mean something very specific within a community that specialises in the topic, and is interpreted in a similar fashion by those who share the same tacit knowledge. Members of a community of practice will know how to decode a representation and will also know about its limitations. However, knowledge exchange *across* communities of practice typically requires translation by persons who simultaneously participate in different communities and who bridge their structural holes.

Knowledge also moves across communities of practice in the form of 'boundary objects'. These can be documents, drawings, prototypes, information in computer databases, material artefacts and, for example, products. The boundary objects make some knowledge explicit by embedding it in the objects that move across different social practices. Such boundary objects, therefore, also structure and constrain the possibilities for mobilising social resources.

There is the potential for ICTs to play an increasingly significant role in social learning and the exchange of knowledge across communities of practice, particularly now that network infrastructure and network access are

Communities of practice are social entities that generate their specific world-views and interpretations, and which maintain the social learning processes that are required to make sense of the knowledge that is specific to the community in question

Knowledge can move within communities of practice by being codified into particular representations

Knowledge also moves across communities of practice in the form of 'boundary objects', which can be documents, drawings, prototypes, etc.

becoming ubiquitous. But this will not be realised automatically. There is a need to go beyond the current design paradigm that focuses on functionality and external appearance, and complement it with explicitly social considerations.

Future ICTs, as expressed in the vision of Ambient Intelligence (AmI), could prove to be relevant for such a purpose (ISTAG, 2001). AmI products and services will be, according to the vision, context-sensitive, intuitive and adaptive. Potentially, they will therefore be able to integrate and communicate tacit knowledge more easily than current-day technologies can. Social learning might be facilitated in such an environment since it can bring people from different backgrounds and different communities of practice closer together. The intelligent environment will take over the role of facilitator and make the necessary translations.

An illustrative example of the potential of AmI to support spontaneous learning and to establish a 'collective learning memory' is described in the so-called ISTAG *Scenarios for Ambient Intelligence in 2010*.[2] The scenarios that were developed and tested with over 35 experts describe possible futures for Ambient Intelligence environments and also identify major key technologies, socio-political issues and an S&T research agenda for realising AmI (ISTAG, 2001). One of the scenarios was "Annette and Solomon". It describes a meeting of an environmental studies group that is led by a human mentor but facilitated by an "Ambient" knowing the personal preferences and characteristics of the participants (real and virtual). The scenario implies significant technical developments such as high 'emotional bandwidth' for shared presence and visualisation technologies, and breakthroughs in computer supported pedagogic techniques. But it also presents a challenging social vision of AmI in the service of fostering community life through shared interests.

Conclusions

The increasing pervasiveness of ICTs invites an examination of its impact on social capital. In terms of civic engagement, and contrary to monocausal explanations, ICTs appear to both transform and supplement social capital. In terms of social contact, ICTs can play a prominent role in creating and maintaining a community of practice and facilitating the exchange of knowledge within it. However, ICTs face the challenge of bridging across communities of practice and transferring knowledge which is embedded and created in social practice – a field in which Ambient Intelligence holds particular promise.

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Keywords
Social capital, information and communications technology, communities of practice, civil society, tacit knowledge

Notes

1. This article is based on insights from the workshop 'ICTs and Social Capital in the Knowledge Society', held in Seville on 3-4 November 2003 (see Van Bavel *et al.*, 2004, for a full report).
2. See **http://www.cordis.lu/ist/istag.htm**

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Directions for Future Socio-Economic Research on ICTs

Jos Leyten, *TNO-STB, The Netherlands*

Issue: Policies to open up markets to competition and maximise access to information society products and services on a global scale and in Europe have by and large been successful. However, in many information society product and service areas Europe is finding it hard to keep up the pace of innovation and maintain the entrepreneurial spirit that drives the development of the sector.

Relevance: We do not have a set of more or less agreed theories about how the Information Society is developing. This can result in policies that are often somewhat reliant on an intuitive approach. As well as being a useful tool in assessing the effectiveness of policies and strategies, socio-economic research can provide the necessary insights to understand the dynamics of the Information Society and identify where it is possible to act with adequate policies and strategies.

Introduction: the relevance of socio-economic research

There is one important long-term trend which makes the development of ICTs more than merely a matter of high quality technological research and development. Modern information technology is extremely flexible and versatile in terms of its applications. The trend toward mass-customisation, in which the potential of ICT is exploited to build flexible systems that ultimately can deliver individually tailored products and services, has been recognised for a number of years. The growth of the Web, e-commerce and a drive towards one-to-one marketing and peer-to-peer applications strongly favours and reinforces the possibilities of companies and individuals to choose and even build their own preferred application arrangements. The development of ICTs in the near future promises personal assistants and agents incorporating adaptive learning programmes that are capable of adjusting themselves to the needs and habits of their users. Some of these features are already built into existing software. The somewhat longer term vision is reflected in ideas such as 'ubiquitous computing and networking', 'intelligence enhanced objects' or 'ambient intelligence', which foresee an information environment that adapts so well to our needs and preferences that we will hardly notice the technology on which it is based.

The longer term view of the information society envisages an information environment that adapts so well to our needs and preferences that we will hardly notice the technology on which it is based

The views expressed here are the authors' and do not necessarily reflect those of the European Commission.

For both individuals and companies in ICT-based sectors the number and range of choices about what products or services to produce, buy or use has grown enormously. Making such choices is becoming increasingly difficult and making the wrong choices has become very costly. It has become very clear that the development of ICTs, and more particularly of software based services, increases the need to make economic, social and cultural choices. Which services are we going to produce? How secure do we want our systems to be? How private are our personal lives? It seems that in a highly competitive and innovative world economy the ability to make such choices is an essential factor for success.

There are many different ways in which we could describe the relevance of socio-economic research for such choices, but starting from the policy-driven perspective given above, we have distinguished four important areas of socio-economic research relating to ICTs:

- The conditions for innovation in ICTs: understanding the essential relationships between technological development, economic growth, productivity and competitiveness.
- Organisational change, work processes and the use of ICTs: understanding the conditions and consequences of innovation at firm level, and the organisational and behavioural aspects of the design, diffusion and use of ICT innovations.
- Social dimensions of ICTs: understanding the longer term social transformations and problems related to the widespread use of ICTs in all sectors of society.
- ICT-related policy instruments: understanding the effectiveness of public intervention aimed at regulating, coordinating, supporting, and stimulating ICT-based developments.

A great deal could be said about these categories, so for reasons of space we take a pragmatic position and we accept the inevitable overlaps between them (as was done in the EKB-SEIS project, see Box 1). We also recognise that there is a lot of socio-economic research that deals with specific sectors of society (e.g. education, health care, social services, etc.). This kind of research by and large mirrors the more general state of socio-economic research on the information society, with the difference that it usually can be more context-specific. This could be an advantage. However, this article will not examine the state of this sector-specific research.

The sections below give a short discussion of the main open questions or gaps in the research in the four areas. They focus on the problems which European researchers are addressing and will

Box 1. The EKB-SEIS project

This article is based upon the results of the ESTO-project "*Mapping the European Knowledge Base of Socio-Economic Impact Studies on IST*" (EKB-SEIS).
The EKB-SEIS project has shown that socio-economic researchers in Europe are aware of the fact that their impact on policy-making is limited. But the project has also shown that this is partly dependent on rather specific European weaknesses. There hardly exists a European community of socio-economic information society researchers. In particular policy related research is very much organised and funded along national lines, addressing problems within the national context. Since this is usually published in the national languages, the accessibility of this research for building European perspectives is low. The overall picture is one of fragmentation, language barriers and a north-south division which probably goes even deeper. The successive framework programmes and research contracts from the European Commission have not changed this picture.
The goal of EKB-SEIS was to make socio-economic research on ICTs more accessible and thus increase its usability and potential contribution to technology development and application, and to policies that aim at making Europe a competitive knowledge society. EKB-SEIS primarily aimed at mapping the European knowledge base of research on social and economic aspects of ICTs. It focused on identifying the most important lines of research.

identify a number of critical issues and/or divergent viewpoints in relation to policy-making.

Conditions for Innovation in ICTs

Over the past 10 years research in this area has been growing and many important questions are being addressed, even when researchers have to leave traditional analytical frameworks behind, e.g. in order to understand the growing role of services or the disappearance of classical boundaries between economic sectors and professions. But there still are important gaps, open questions, areas of strong disagreement and other uncertainties that need to be addressed in socio-economic research.

Understanding of the conditions needed for innovation has been improving over recent years, although there are still gaps and areas of disagreement that need to be addressed in socio-economic research

The first set of open questions addresses innovation financing – who, when, why and how much? There are at least two important future research areas with respect to ICT investments. The first is further analysis of the mechanisms by which some firms receive high returns from IT use, and in particular, the returns from investments in complementary assets. The second is explaining why some IT-intensive industries have not seen gains in labour productivity in spite of large investments. These insights are necessary if policy-makers are to be able to finance R&D in ways that best complements private innovation funding.

Public intervention is frequently justified by the perception of a system failure. Identifying failures in the innovation system requires a better understanding of how it works

A second set of questions arises from the wide agreement on the use of the concept of systems failure as a reason for public intervention, in conjunction with a lack of understanding of the concept. Different types of system failures call for different action, and different remedies. To be able to improve an innovation system's performance requires an improved conceptualisation of such a system and a deeper understanding of its dynamics. To what degree are various successful innovation systems particular and to what degree can their "critical constituents" - whatever they are - be copied (see for example the current popularity of the 'Finnish model')?

A better understanding is also needed of the relationship between innovation and competitiveness

The relationship between innovation and competitiveness is also not completely understood. The role of R&D as an engine of economic growth is far from clear. Some researchers appear to have found that R&D subsidies have an effect on growth when they support broad imitative R&D, others that support has a more powerful impact when it focuses on innovative R&D that yields new products. But what is the basis for choosing between the two? There is also a need to better understand the problem of knowledge diffusion in innovation systems. With the spread of the Information Society a new knowledge infrastructure is emerging which combines many private and public agents generating and distributing knowledge. What kind of cooperation and network formation will take place, and what skills and competencies are needed?

A final set of open questions concerning innovation relates to the manageability of dynamism in the information society. There is no doubt that entrepreneurs have a key role to play in processes of creating and diffusing new paths of techno-economic development. But besides entrepreneurship, there are many other forces that contribute to the unlocking of the existing and the creation of new development paths, such as new technological paradigms, heterogeneity among agents, the co-evolutionary nature of socio-economic adaptation, and the invasion of new organisational forms from other contexts, for example. Still not fully answered is the question how entrepreneurial activities could be enhanced in Europe.

Organisational change, work processes and the use of ICTs

In general this is a well-researched field, most likely because of its direct relevance for

introduction and application of ICTs in firms' internal and external processes (collaboration, B2B e-commerce and marketing). In this area many questions can also be addressed in the European Framework Programme. With increased networking and versatility of applications it is to be expected that socio-economic research in this broad area will grow in importance. A few critical gaps exist, however.

Many software and technical research communities have difficulties integrating socio-economic dimensions in a constructive way in their innovation and development activities and in identifying ways to extend these competencies. The development of many applications which directly impact work processes has shown that such integration is almost becoming a necessity (e.g. teleworking and knowledge management). Given the differences between the technical and social-science communities and the problems experienced in integrating the two, this is a subject for research in itself. What are the necessary conditions for successful collaboration and integration of technologists and socio-economic scientists? Can the strong disciplinary organisation of universities in most European universities effectively cope with this demand?

On the whole there is a lack of systematic longitudinal user-oriented research which combines large-scale data collection with qualitative in-depth case studies of the specific the specific ways in which new applications are adopted. This kind of research should give us much greater understanding of what works and what does not. Generally we may conclude that socio-economic research tends to adhere to an 'either/or' approach. On the one hand there are many descriptive user-surveys which map patterns of adoption and diffusion of ICTs, but which fail to describe and explain the specific roles of users in innovation processes (beyond merely diffusion and adoption). On the other hand there is also a wealth of more qualitative material to be found in socio-economic research, particularly in 'social shaping of technology' approaches, which tends to be either too theoretical and difficult to apply, or too small scale, which makes it difficult to assess in terms of a more generic scope.

Finally, we recognise a growing need for systematic experimentation and experimental research under this heading. The versatility of modern ICTs in combination with specific European social, cultural and political traditions calls for new forms of user-producer interaction to accommodate the larger role of users in the process of technology and application development. To successfully develop and apply such an interactive innovation model which links industrial and services innovation with innovative user behaviour could in theory provide a strong alternative to the US-led innovation race, because it builds on the specifics of the home market. But it would also require a considerable research effort to find the best way of working and most effective models of interaction, to understand the opportunities and to get to know the limitations of such an approach.

Social dimensions of ICTs

This heading encompasses a wide range aspects of the information society on which a lot of socio-economic research has been done. The points that follow below are a selection of the most important ones taken from a longer list in the EKB-SEIS report (see Box 1).

A first aspect is public sector innovation and state reform. Application of ICTs in government (e-government) can be a major driver for change in policy-making and in policy implementation processes. It may lead to changes in the relations between citizens, businesses and governments. These potential changes have been described in

Entrepreneurship, and other factors in the process of creating and diffusing new paths of techno-economic development, are other areas where a full understanding is needed

On the whole there is a lack of systematic longitudinal user-oriented research which combines large-scale data collection with qualitative in-depth case studies of the specific ways in which new applications are adopted

the future-oriented socio-economic literature. However, we do not have comparative empirical analyses of the effectiveness of different policies and strategies on key requirements for e-government, such as universal access, sufficient benefits for the citizens, and sustainability of public services. Nor has research been carried out on cost-efficiency and other direct impacts of e-government. Research of this kind is necessary to develop adequate models for introduction and (public) financing of ICT-based services. This puts governments in weak negotiation positions vis-à-vis suppliers and does not provide the information that would be necessary for deciding on the merits of an *open source* strategy.

Little or no research been conducted to assess the cost-efficiency and other direct impacts of e-government. Research of this kind is necessary to develop adequate models for introduction and (public) financing of ICT-based services

ICT-related changes in the roles and perceptions of privacy, trust and security are rarely addressed as socio-economic and cultural problems. Most of the research on these issues is either implementation oriented or addresses individual attitudes. This, however, does not help strike the right balance between very sophisticated expensive technological solutions and solutions which build on changing societal structures and organisation. Nor does it help to find solutions based on essential social-cultural principles such as anonymity, reciprocity and transparency. In other words, with the growing pervasiveness of ICTs we need more and better studies about the sociology and the political economy of privacy, trust and security.

A third major topic for socio-economic research is the so called *Digital Divide*. Many researchers and politicians have warned –and continue to do so– of the danger of a split between 'information haves' and 'information have-nots' with severe consequences for the capabilities of certain groups and even countries to participate in the information age. Qualitative, case-study-based research has tended to support the argument. In the meantime quantitative analyses have shown that the problem of 'information have-nots' is directly related to the availability of appropriate infrastructures. Even if some countries and regions still have problems, basic access to information and communication services does not seem to solve other problems than those caused by a lack of the means to invest in infrastructures. The digital divide debate illustrates that a lack of sound empirical work can actually misinform the policy agenda by suggesting that basic access is the problem. At the same time it has become clear that the 'rules of the game' in the information society can put considerable demands on people's skills and literacy and on their ability and/or willingness to learn. Moreover, some authoritarian governments have a tendency to put limitations on what their citizens may learn and communicate. The impacts of all these factors need to be carefully monitored.

Studies of the digital divide, another major topic for socio-economic research, have shown that the problem is directly related to the availability of appropriate infrastructures

ICT-related policy instruments

It is often difficult to establish ICT-specificity of policy instruments. The tendency towards generic or technology-neutral instruments, which we know from market regulation and competition policy, seems to be a general trend. But the speed and nature of development in ICTs often causes a disruption of existing policies. Two of most important aspects are discussed below.

The growing awareness in political and policy-making circles of the importance of ICT-based innovation as a driver for growth and competitiveness has lead to increased expectations of results from lines of research that deal with these questions from a policy perspective. The analysis of policy instruments needs a stronger integration of different approaches to providing the necessary indicators and measurements for establishing the social costs and benefits or the 'additionality' of policies (what does a policy add to what the market or the innovation system fails to do?). What is often called the "neo-classical" school has a tradition of

formal analysis, but often does not take all the relevant historical or institutional realities of market developments into consideration. Other schools, such as the "regulation" and "innovation" schools include analyses of institutions in the markets and in the political sphere, but lack the rigour of traditional economic analysis. The growth of the information society is leading to increasing complexities and interdependencies in the economy and society. There has been a lot of discussion about the validity of the concept of the 'network society', but there is little doubt that the relationships between governments, citizens and businesses are changing. This calls for new policy concepts and new policies. Old concepts such as the clear distinction between government and the market on which traditional liberalisation policies were based are no longer tenable with the advent of independent public agencies and public-private collaboration. But the alternative ideals of direct democracy to be based on the widespread use of ICTs can easily lead to a paralysis of decision-making structures. Such concepts of the information society and its governance do have a direct impact on how we think about issues such as market power, Intellectual Property Rights, the role of the state in standardisation processes, and the right to control information. Many of these issues are analysed in fragmentary and often rigid economic or legalistic frameworks that were very often shaped in the US policy context. There is a serious lack of empirical research which combines the conceptual level with analysis of day-to-day practices on these issues in Europe. As a consequence it appears that policy-makers lack the arguments for innovative solutions and instead the power game of vested interests is left unchallenged.

Assessing the role of socio-economic research

Compared with American and Japanese ICT-related social science policy research, the corresponding European research is relatively broad-based in many academic disciplines, covering a larger variety of topics. It is also relatively independent, in the sense that it is not closely tied to specific economic or political interests. This gives the research a good point of departure and a high degree of credibility. In particular, media research has a strong tradition in Europe and, generally, has a broader orientation than the American equivalent, which is very much preoccupied with market issues. The other side of this argument is that European media research is relatively weak on the economics of the media. In the ICT-areas, policy research in the US has often been ahead, in particular the research that guided and supported the liberalisation policies of the past 25 years, and has been a strong source of inspiration for much analysis in Europe. However, during the past 10-15 years European research in this area has been catching up and has developed its own characteristics and qualities. In general European socio-economic research has been paying more attention to evolutionary economics, institutional aspects and the political economy of ICTs. The question is, however, if these rather fragmented lines of research are strong enough to point to competitive and sustainable trajectories which are different from the US models of markets, social and cultural development. Because following the US model of individuality, entrepreneurship and economic dynamism is likely to end in the same paradox as is currently experienced in the US. This so-called *American paradox* is described in Table 1.

European socio-economic research so far has not been able to provide a strong foundation for a strategy which combines strong performance on technological and economic dynamism related indicators with good performance on social cohesion related indicators. On the contrary, the very delicate balance between techno-economic dynamism and social cohesion that Europe

The tendency towards generic or technology-neutral instruments often makes it difficult to establish the ICT-specificity of policy instruments

The growth of the information society is leading to increasing complexities and interdependencies in the economy and society, giving rise to the need for new policy concepts and new policies

Best (in top three)	Worst (in bottom three)
Gross domestic product	Poverty
Productivity	Economic inequality
Business start-ups	Carbon-dioxide emissions
Long-term unemployment	Life expectancy
Expenditure on education	Infant mortality
University graduates	Homicide
R&D expenditure	Health-care coverage
High-tech exports	HIV infection
Movies exported	Teen pregnancy
Breath of stock ownership	Personal savings
Volunteerism	Voter participation
Charitable giving	Obesity

Table 1. The American paradox (Ted Halstead, in The Atlantic Monthly, January/February 2003, based on an OECD member countries comparison of performance on different public indicators)

European socio-economic research so far has not been able to provide a strong foundation for a strategy which combines a range of techno-economic and social indicators

nowadays has, might very well be threatened by a reduction of the Lisbon targets to increased economic and technological dynamism, under the influence of a growing sense of urgency in European politics.

The weaknesses of European socio-economic research on this point are related to the way the European Framework Programme is organised. Most opportunities for doing socio-economic research on the European level are now closely linked to technological projects and networks. This is an adequate answer to the need for more socio-economic knowledge in the processes of technology development. But it leaves very little room for the kind of independent socio-economic research which tries to build an understanding of the dynamics of the information society and which may point toward much needed new concepts, models and trajectories for policy-making.

Conclusion

European socio-economic research needs to be strengthened, especially in its European dimensions, to increase its role for policy-making in a period in which Europe will have to deal with a number of difficult policy choices which require a very good understanding of the forces that drive the development of the European (information) society. This will require the re-introduction of a separate socio-economic research programme, to support the willingness of researchers to build a stronger knowledge base for European strategies. In comparison to the former TSER (FP5) such a new socio-economic research programme must be clearly driven by strategic longer-term policy needs to increase its effectiveness. This also requires the development of mechanisms for closer interaction between policy makers and researchers. Policy-makers need to challenge researchers with their questions and researchers need to challenge policy-makers with their findings.

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Keywords

Information society, socio-economic research, policy, digital divide, impact assessment

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The Joint Research Centre (JRC), one of the Directorates General of the European Commission, carries out research and provides technical know-how in support of European Union (EU) policies. Its status as a Commission service, which guarantees independence from private or national interest, is crucial for pursuing this role.

The JRC implements its mission through specific research programmes decided by the Council upon advice from the European Parliament falling under the European Union Framework Programmes for research and technological development. The work is funded by the Budget of the European Union with additional funding from associated countries. The work of the JRC includes customer-driven scientific and technical services for specific Community policies, such as those on the environment, agriculture or nuclear safety. It is involved in competitive activities in order to validate its expertise and increase its know-how in core competencies. Its guiding line is that of "adding value" where appropriate, rather than competing directly with establishments in the Member States.

The JRC has seven institutes, located on five separate sites, in Belgium, Germany, Italy, the Netherlands and Spain. Each has its own focus of expertise.

The Institutes are:

- The Institute for Reference Materials and Measurements (IRMM)
- The Institute for Transuranium Elements (ITU)
- The Institute for Energy (IE)
- The Institute for the Protection and the Security of the Citizen (IPSC)
- The Institute for Environment and Sustainability (IES)
- The Institute for Health and Consumer Protection (IHCP)
- The Institute for Prospective Technological Studies (IPTS)

Further information can be found on the JRC web site:
www.jrc.cec.eu.int

ABOUT THE IPTS

The Institute for Prospective Technological Studies (IPTS) is one of the seven institutes making up the Joint Research Centre (JRC) of the European Commission. It was established in Seville, Spain, in September 1994.

The mission of the Institute is to provide techno-economic analysis support to European decision-makers, by monitoring and analysing Science & Technology related developments, their cross-sectoral impact, their inter-relationship in the socio-economic context and future policy implications and to present this information in a timely and integrated way.

The IPTS is a unique public advisory body, independent from special national or commercial interests, closely associated with the EU policy-making process. In fact, most of the work undertaken by the IPTS is in response to direct requests from (or takes the form of long-term policy support on behalf of) the European Commission Directorate Generals, or European Parliament Committees. The IPTS also does work for Member States' governmental, academic or industrial organizations, though this represents a minor share of its total activities.

Although particular emphasis is placed on key Science and Technology fields, especially those that have a driving role and even the potential to reshape our society, important efforts are devoted to improving the understanding of the complex interactions between technology, economy and society. Indeed, the impact of technology on society and, conversely, the way technological development is driven by societal changes, are highly relevant themes within the European decision-making context.

The inter-disciplinary prospective approach adopted by the Institute is intended to provide European decision-makers with a deeper understanding of the emerging S/T issues, and it complements the activities undertaken by other Joint Research Centres institutes.

The IPTS collects information about technological developments and their application in Europe and the world, analyses this information and transmits it in an accessible form to European decision-makers. This is implemented in four sectors of activity:

- Sustainability in Industry, Energy and Transport
- Support to the European Research Area
- Information and Communication Technologies
- Sustainability in Agriculture, Food and Health

In order to implement its mission, the Institute develops appropriate contacts, awareness and skills for anticipating and following the agenda of the policy decision-makers. In addition to its own resources, the IPTS makes use of external Advisory Groups and operates a Network of European Institutes working in similar areas. These networking activities enable the IPTS to draw on a large pool of available expertise, while allowing a continuous process of external peer-review of the in-house activities.

The IPTS Report is published in the first week of every month, except for the months of January and August.
It is edited in English and is additionally available in French, German and Spanish.

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