TECHNICAL REPORT SERIES

The Future of the Information Society in Europe: Contributions to the Debate

EUR 22353 EN

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Institute for Prospective Technological Studies

The mission of the IPTS is to provide customer-driven support to the EU policy-making process by researching science-based responses to policy challenges that have both a socio-economic as well as a scientific/technological dimension.

The Future of the Information Society in Europe: Contributions to the Debate

Editors:
R. Compañó, C. Pascu, A. Bianchi,
J-C. Burgelman, S. Barrios,
M. Ulbrich and I. Maghiros
(IPTS-DG JRC)

2006

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

EUR 22353 EN

European Commission
Directorate-General Joint Research Centre
Institute for Prospective Technological Studies

Contact information
Address: Edificio Expo. c/ Inca Garcilaso, s/n. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300
http://www.jrc.es
http://www.jrc.cec.eu.int

EUR 22353 EN
Catalogue number: LF-NA-22353-EN-C
ISBN 92-79-02984-3
ISSN 1018-5593

Luxembourg: Office for Official Publications of the European Communities

Printed in Spain

Acknowledgements

The Institute for Prospective Technological Studies (IPTS), one of the seven research institutes that make up DG Joint research centre, supports the overall formulation and implementation of appropriate Information Society strategies, policies, regulations and actions contributing to a competitive, innovative and inclusive European Information Society.

The flagship project 'Foresight on Information Society Technologies in the European Research Area' (FISTERA), has produced many results over the past few years (2002–2005) focusing on future and emerging information society technologies (IST), the specificities of the European IST research community and the future social contexts of the use of IST.[1]

FISTERA attempted to link these results to the wider issues concerning the economic dimension of ICTs; first to achieve a more complete and comprehensive view of IST implications and second to relate FISTERA conclusions to the existing economic concerns and body of thought that characterise much of the policy debate on ISTs. It is this dimension that will play an important role in generating value, and creating more and better jobs involving IST. This applies both to direct economic impacts of IST sectors themselves, and to the more general implications of the use of IST across all sectors of the economy.

To this end, DG JRC-IPTS hosted a thematic workshop on the "Socio-Economic Aspects of the Knowledge-based Europe: The Role of Information Society Technologies (ISTs)" in March 2005. This workshop set out to diagnose the main problems for Europe in achieving the Lisbon 2010 objectives. It also aimed to elaborate on possible new initiatives which would go beyond conventional wisdom and which would contribute to defining Europe's future role in a globalised society, taking into account the socio-economic drivers for better quality of life. After the Workshop, a number of well known economists were commissioned by FISTERA to write papers suggesting possible lines of analysis that were not included in the core FISTERA design, but which can be seen as crucial elements for a holistic view of the future of ISTs.

This report brings together the workshop's most thought-provoking contributions to the debate on the future of IST in Europe. It suggests ideas that may evolve into possible policy options to increase Europe's economic growth.

The FISTERA network was supported by the European Community under the FP5 specific programme for 'research, technological development and demonstration on a user-friendly Information Society' (1998-2002). The FISTERA team and the editors would like to thank Mr. **Pierre Marro** and Mr. **Khalil Rouhana** (DG INFSO) for their continuous support, Ms. **Patricia Farrer** for her invaluable contribution in proof reading the final draft, and also the contributors to this report:

Mr. **Emilio Fontela** (Universidad Nebrija Madrid, Spain), Mr. **Jeremy Millard** (Danish Technological Institute, Denmark), Ms. **Carlota Pérez** (Universities of Cambridge and Sussex, United Kingdom), Mr**. Luc Soete** (United Nations University (INTECH) and University of Maastricht (MERIT), The Netherlands), Mr. **Erik Reinert** (Talinn University of Technology, Estonia and Norwegian Institute of Strategic Studies, Oslo, NORWAY), Mr. **Ilkka Tuomi** (Oy Meaning Processing, Finland) and Mr. **John Zysman** and Mr. **Tobias Schulze–Cleven** (BRIE Berkeley Roundtable on the International Economy, USA).

1 For more details, see FISTERA website http://fistera.jrc.es

Finally we thank all those who attended the FISTERA workshop on "Socio-Economic Aspects of the Knowledge-based Europe: The role of Information Society Technologies (ISTs)" held on 10 -11 March 2005 in Seville, Spain, for their active participation during the workshop, and and who contributed to the draft version of the synthesis report of this workshop:

Mr. E. **Bohlin** (Chalmers University, Göteborg, Sweden), Mr. C. **Buhigas Schubert** (European Policy Centre, Brussels, Belgium), Mr. G. **Coomans** (Institut de Sciences Mathématiques et Economiques Appliquees, Belgium), Mr. W. **Drechsler** (Praxis, Centre for Policy Studies, Estonia), Mr. P. **Duguid** (University of California, Berkeley, USA), Mr. E. **Fontela** (Universidad A Nebrija, Madrid, Spain), Mr. N. **Garnham** (Westminster University, United Kingdom), Mr. P. **Gaspar** (International Center for Economic Growth, and Budapest University of Economics, Hungary), Mr. K. **Guy** (Wise Guys, Brighton, United Kingdom), Mr. P. **Havlik** (Vienna Institute of International Economy, Austria), Mr. P. **Jarvis** (University of Surrey, United Kingdom), Mr. M. **Piatkowski** (International Monetary Fund, Washington, USA), Mr. E. **Reinert** (Tallinn University of Technology, Estonia), Mr. R. **Smits** (Utrecht University, the Netherlands), Mr. L **Soete** (UNU-INTECH and MERIT, and University of Maastricht, the Netherlands), Ms. A. **Szalavetz** (Institute for World Economics of the Hungarian Academy of Sciences, Budapest, Hungary), Ms. L. **Tsipouri** (University of Athens, Greece), Mr. L. Van **Langenhoven** (UNU Comparative Regional Integration Studies, Ghent, Belgium), Ms. R **Veugelers** (Katholieke Universiteit, Leuven, Belgium), Mr. M **Weber** (ARC-Systems, Seibersdorf, Austria), and Mr. J **Zysman** (Berkeley Roundtable on the International Economy, University of California, USA).

Table of contents

Summary

In March 2000, the heads of state and governments of the European Union (EU) agreed on the goal of making the EU the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. This overall goal has been widely accepted by European stakeholders. Recent analyses, however, have pointed out that the implementation of the Lisbon vision has been only partially successful. The Lisbon strategy needs fresh impetus and the pace of reform needs to be accelerated. Chapter 1 details some of the policy problems the EU has to face in this respect. Where will the EU go in the next decade and how will information and communication technologies (ICTs) contribute? How can information society technologies and knowledge (in the broader sense including education, science and research, innovation) contribute to growth and hence to welfare? ICTs are systemic technologies, enabling change at all levels of society and business: they are everywhere, in every job, every business, in all aspects of our lives and organisation of society. To address the challenges and to realise the full potential of a knowledge-based Europe in a global context, ICTs are therefore essential.

However, knowledge society policies need to be holistic, i.e. encompassing technical, economic and social issues. Only as part of a broader strategy based on knowledge, sustainability and participation does it make sense. Europe needs to identify the key focus areas for the future to construct its "dream world", building upon and going beyond the pillars of the industrial society. New actions would have to go beyond conventional wisdom, taking into account Europe's future role in a globalised society and the socio-economic drivers for better quality of life in Europe. In order to shed light on possible new actions, FISTERA asked a number of prominent economists and experts to indicate their personal opinion, they include, Mrs. Carlota Pérez,[2] Mr. Luc Soete,[3] Mr. John Zysman,[4] Mr. Tobias Schulze-Cleven,[5] Mr. Emilio Fontela,[6] Mr. Erik Reinert,[7] Mr. Jeremy Millard,[8] and Mr. Ilkka Tuomi.[9]

History suggests that there is a parallel between the techno-economic paradigm led by ICTs in a global context and that of the previous industrial revolutions. Past revolutions are therefore worth studying to understand how ICTs are reshaping the economy and society. In Chapter 2, Pérez sees the current globalization process as the inevitable consequence of the power of ICTs and their techno-economic paradigm. But, she adds, in order to avoid further polarisation or serious backlashes from job losses, a set of adequate policies need to be put in place to guarantee that the full potential benefits are reaped and that social well being is maximised in all the countries involved.

According to Tuomi (Chapter 8), the emerging meaning-processing paradigm would be more appropriate than the current techno-economic paradigm (following Pérez's terminology) in that

2 Visiting Senior Research Fellow at CERF, Cambridge University, UK, and Honorary Research Fellow at SPRU (Science and Technology Policy Research), University of Sussex, United Kingdom.
3 Professor of International Economics and Director of United Nations University (INTECH) and University of Maastricht (MERIT), The Netherlands.
4 Co-director of Berkeley Roundtable on the International Economy (BRIE), United States.
5 Research associate at BRIE, Berkeley, United States.
6 University Antonio Nebrija Madrid, Spain.
7 Professor at Tallinn University of Technology, Estonia and Norwegian Institute of Strategic Studies, Oslo, Norway.
8 Senior Consultant for Danish Technological Institute (DTI), Copenhagen, Denmark.
9 Currently Chief Scientist at Meaning Processing Ltd., Finland.

it explicitly recognises that human beings create information and knowledge based on different interpretations of reality, which depend on cultural, social and even biological factors and contexts. The new emerging paradigm would be, in Tuomi's view, more adapted to tackle the challenges of the information society because meaning and semantics are increasingly located at the core of computing, communication and knowledge.

The nature of the ICT revolution entails profound changes and has direct policy implications for the EU. The role of technology in economic growth can be analysed following the 'supply-pushed' model, where new technologies and related innovations emerge from science and are available to entrepreneurs in a pool of technological opportunities. Technological revolutions can also be considered through the demand-pulled model, where technological improvements emerge from the activity of profit-oriented entrepreneurs looking for temporary monopolistic positions. A crucial issue, according to Fontela (Chapter 5), is to know when and where the technological clusters are most likely to be located in the future.

Europe has recognized the emergence of the new paradigm for economy and society and consequently focused its policy actions on research and innovation, but has not yet developed an integrated policy approach. As a consequence, Soete argues in Chapter 3 that Europe does not use all the leverages for supporting growth and for stimulating innovation. Additionally, and more importantly, European policy-makers do not pay enough attention to institutional constraints/ barriers which limit the full deployment of knowledge and innovation potential for growth. Europe should reinforce its investment in quality and quantity of knowledge, by implementing macroeconomic and fiscal policies supporting knowledge and innovation. Such an adjustment would encourage innovative and risk-taking attitudes, which then might contribute to growth. Finally, he concludes that the only input factor that could bring about long-term sustainable growth is knowledge accumulation. Knowledge cannot be fully appropriated, but ICT increases the codification and transferability of knowledge world-wide. In ICT-based innovation systems, knowledge has to be considered as a capital good, because it can be employed for producing other goods, for producing additional knowledge, it can be accumulated, and it is globally accessible.

ICTs also change the nature of labour and employment by increasing their content in knowledge, so that education becomes the main factor of production. Education is in fact at the heart of the growth process, given its link to innovative capability and R&D activities. Millard's analysis, in Chapter 7, suggests that ICTs can lead simultaneously to de-skilling and re-skilling, depending on the initial skills and market conditions. De-skilling occurs when activities can be automated, while re-skilling concerns the acquisition of tacit knowledge, which is very resistant to automation and grows rapidly due to the ICT-induced speed of change.

Soete points at one particular area in need of fundamental rethinking: the European social security system, which is still deeply rooted in the requirements of the former industrial society. Europe should actively consider revising the current social security system and adapting it to new ways of working, increasingly rooted in a new balance between labour and pleasure at work. A knowledge-based Europe needs to fully mobilise its available labour, by creating flexible working environments and realistic life-long learning schemes. ICTs will be a key enabler here. Technical and societal innovation should therefore become an intrinsic part of our culture and the European value system. It should be encouraged at all levels in order to augment the economic and social value which can come from it. Social policies in Europe need, according to Zysman and Schulze-Cleven (Chapter 4), to encourage "social flexibility", but not necessarily by means of a reduction of social security. On the contrary, the provision of the right kind of social security will not only allow people to feel more secure, but also enable them – and production

systems in general - to be more adaptable. In this context, one must distinguish the question of "how much" social security costs, as measured in financial transfers, from the "how", i.e. the mechanism of providing social security.

New players, such as China and India, have turned the market upside down. The challenge for Europe is how to stay "wealthy" in a rapidly evolving and ever more competitive global economy. Zysman and Cleven-Schulze argue that, in this new digital era, the key to success is "experimentation". Globalisation, pushed by the cross-national productions networks, requires a constant change of production systems, business models and strategic decisions.

Turning to the question of what consequences these evolutions have for policy-making, there is a need for a systemic approach to the economic institutions (labour market, product market), resulting in a full set of structural reforms. All these should be implemented as a systemic policy for better political governance. In order to encourage growth, Europe should increase its efforts to identify growth sectors, and re-allocate resources to growing firms and sectors with more growth potential. The knowledge society will rely upon a different weighting of factors (i.e. innovation, growth, and learning amongst others). As the composition of these factors changes, priority setting gets difficult. Thus, for Europe to be successful in innovation, growth, productivity and learning, trade-offs need to be made more explicit, so that informed choices can be made and a feasible path set.

Policy-makers and the public sphere have an important role to play in the new growth paradigm. Fontela identifies four important dimensions to improving the design of public interventions. These involve:

- taking into account the specific socio-economic contexts in which ICT-related policies are implemented,
- promoting research (both basic and market-oriented) at all levels,
- promoting cooperative processes in particular through the intertwining between competition and cooperation, and
- improving measurement of economic performance in the knowledge society in particular by taking into account the changing nature of the economic, social and environment accounting framework.

How can governments intervene in a globalised world? Pérez singles out three areas for intervention. The first is the regulation of globalised finance to favour long-term investment rather than short-term financial gain through –for instance- rapid movements of capital. Second, a shared vision accompanied by consensus policies should be promoted. This would guide market action towards a win-win process of regional re-specialisation so that full employment –or earning-generating activity– can once more become a reality in the advanced world and an attainable goal in developing countries. Finally, the social safety net, previously provided by the welfare state, should be "reinvented" in a manner consistent with the current globalising paradigm. It should be capable of reopening the ample upward mobility routes that until recently gave strong cohesion to more developed societies.

On a more conceptual level, Reinert argues in Chapter 6 that a long-term solution for Europe will have to be based on an understanding of why economic development is such an uneven process. The selection of good policy options should be based on much more profound and differentiated analyses of technology and innovations and their economic consequences on both wages and employment at company, national and community levels. Reinert believes that new models should be developed which better describe phenomena such as economic differences (beyond the framework of equilibrium theory).

Moreover, though Europe has accepted the importance of the ICT techno-revolution for the economy and society, an integrated policy approach, employing all economic and social

levers to stimulate innovation and maximise its benefits, is still missing. So far, policy makers have picked up the most obvious challenges of the knowledge economy, but, arguably, they have not yet grasped the whole range of implications. As the knowledge society will bring profound change in our economies and societies, these implications must be well understood and placed at the core of EU policy making in the coming years.

If digital technology affects the whole of society, then all of society's existing norms and laws should be re-assessed to check whether they are adapted to the new reality or not. Rather than trying to adapt the application of existing rules to the knowledge society, one should investigate how far the rules themselves need to be adapted for all sectors. One example with policy implications is how the shift towards more knowledge-based activities will affect the future social security system.[10] Changes in type of work, blurring of borders between work and leisure, and the increasing variety of jobs (from hard physical labour to intellectual activities) should be taken into account when redesigning the foundations of national social security systems.

The implications of Europe's ageing population are a related challenge. When today's forty-year-olds (the 'baby-boom' generation) reach retirement age, the dependency ratio[11] will drastically increase and current social security systems will be in danger of becoming unaffordable. ICTs can make a contribution towards maintaining social welfare in an ageing society by increasing productivity, stabilizing costs and keeping older citizens socially and economically active. For this to happen, effective ICT implementation will first imply profound changes in processes, in organizations and in the ways all actors operate in our society, whether private businesses or public institutions. In addition, if Europe wants to have a world-class ICT industry despite a shrinking workforce and a high dependency rate, policy makers need to make every effort to put the right framework conditions in place before the baby-boom generation reaches retirement age.

10 "Knowledge workers" –as opposed to those dealing with physical labour- will be predominant and drive the economy.
11 Ratio between contributors to non-contributors to the pension system.

1. A Competitive Knowledge Society

by A Bianchi, C Pascu, R Compañó, J-C Burgelman[12]

This chapter builds upon the discussion that took place at the FISTERA workshop on socio-economic aspects of a knowledge-based Europe.[13] The workshop aimed to investigate how far Europe has progressed towards a knowledge society. The discussion focused on (a) the status and adequacy of the vision, objectives and values that inspire European Union policies and (b) the proposed components of a systemic approach, and the necessary actions and implementation. The challenge was to analyse the objectives, deliver a diagnosis of Europe's current status and offer new insights into possible new ways to achieve these objectives. The table below summarises workshop participants' views, grouped by diagnoses, with regard to Europe's situation on a number of key factors - namely vision, innovation, productivity, work, globalisation, learning, risk, society, state/public sector, diversity - and possible ways ahead.

Table 1: Some key aspects towards a Knowledge-based Economy in the European Union

	Diagnosis	Forward-looking considerations
Vision	The rationale of the Lisbon Objectives is not uncontested. Some economists argue in favour of a longer-term vision, because they believe that more time (>2010) is necessary to achieve a knowledge-based economy. Others argue that Europe should 'jump beyond Triade thinking (EU/US/Japan)' and learn from the emerging world's 'hot spots', particularly in (south-east) Asia. This vision should contribute to two distinct (but complementary) aims: to foster political, social and economic unity within the EU AND encourage growth in a global context.	The Lisbon Strategy largely followed a top-down approach. However, in order to achieve more effective political, social and economic convergence, Europe would need to broaden the ownership of the vision, by making more use of bottom-up approaches.
Innovation	The Schumpeterian understanding of technological change, and its activity-specific growth potential are still valid. Future knowledge-based economics will take root in a techno-economic paradigm shift and decision makers need to reassess the new balance between social and business benefit.	Short term. In order to take full advantage of ICT, governments should take adequate policy actions to re-engineer core organisations of the innovation system. To boost the economy, current policies on intellectual property, including copyright and trademark regulation should be updated to conform to the 'digital era'. Mid-term. It may be possible to redirect this new techno-economic shift to solve grand challenges. For instance, the innovation should aim to combat poverty world-wide. This could combine social solidarity with economic prospects, as the "bottom of the pyramid" is a huge market. Long-term. The current IT revolution is likely to prolong its cycle through possible applications arising from the so-called 'converging technologies (CT)' paradigm. Europe should not miss this emerging CT trend and look for opportunities in these sectors (e.g. giving priority to cognitive sciences).

12 European Commission (EC), Joint Research Centre, Institute for Prospective Technological Studies, Sevilla (Spain). The opinions of the authors do not necessarily represent those of the EC. Neither the EC nor the authors are responsible for the use which might be made of the following article.

13 "Towards a European Knowledge Society: New ICT Solutions to Old Challenges five years after Lisbon", FISTERA workshop, Sevilla 10-11 March, 2005.

Table 1: Some key aspects towards a Knowledge-based Economy in the European Union (Cont.)

	Diagnosis	Forward-looking considerations
Productivity	How to apply the concept of productivity to a knowledge-based economy is debatable. For instance, how to measure the quality of (increasingly more) knowledge-intensive services is not obvious. New Member States have great economic potential and should avoid EU15 mistakes, by making the best out of the division of labour, and by reforming social security systems.	Having an overview of the financial boundary conditions before designing implementation measures is a strategic asset (otherwise illusory visions and wrong expectations may be created). The agreement and approval of the new financial perspective (2007-2013) allows for a foreseeable horizon. Economic progress should be carefully monitored and the transition to a knowledge-based economy urgently demands the development of commonly agreed indicators.
Work	In a knowledge-based society, production will shift to 'knowledge products'. Consequently, employment will be embedded in knowledge-as-a-product activities, whereby additional jobs will mostly be generated in services. Innovation will need to be accompanied by organizational change and social interaction	In a highly dynamic working environment, (human) talents have to adapt rapidly to changing environments. Therefore there is a need to explore new forms of life-long learning.
Globalization	In comparison to previous EU enlargements, the last one was more complicated, due to its magnitude, the large economic divergences and the unfavourable economic environment of several older Member States. The integration is not happening as quickly as expected and it appears that the economic and global political power of the enlarged Europe is still not fully recognized.	Europe is facing globalization and increasing regional protagonism at the same time. These tendencies have to be reconciled and the regionalism perspective, based on multiple dimensions of integration, must be taken into account as it also implies aspects of partnership and outsourcing (outside EU). European countries should interact together in global social networks, global innovation/knowledge networks.
Learning	There seems to be a mismatch (rather than a shortage) of highly educated ICT workers. How future needs will evolve, is arguable. All agree, however, that there is a risk of excessive focus on formal teaching and lack of interest in practice. Future actions must involve a range of concepts, including education and life-long learning. Share/transfer to the New Member States R&D and learning.	The objective is to enhance inter-personal and cultural skills of future workers rather than generating high-tech specialists. More emphasis should be put on research in education, innovative developments in life-long education, e-learning and support.
Risk	As a result of complex financial and legal rules and established cultural schemes, there is a reduced risk taking attitude in the European Union, hampering innovative research.	Promote Regional agreements, in order to implement economic and growth-related clauses successfully.
Society	There appears to be insufficient incentive to promote effective use of ICT. The ICT contribution to innovation, quality of life, and the benefits to the final user are still low.	Adverse perceptions of ICT may partially be overcome (a) by making sure that ICTs are taken up for useful purposes and match the demand side, (b) by integrating more social scientists in the innovation process with adequate resources and (c) by establishing platforms for early participation of users.
State/public sector	There is a need to reform public administrations, and particularly their back offices. This applies at all layers of the (nation, region, sub-regional local) governance of economic growth and development.	Public Administrations should promote more demand-pull innovation by involving citizens in policy formulation and distinguish responsibilities (rather than 'selling' policies to the people.) In view of changing demographics, specific programmes should be designed for services for elderly people.
Diversity	There are different development levels and income distribution throughout Member States. The trade-offs that arise when growth, stability and cohesion are pursued at the same time need to be discussed openly. Europe's economic and cultural diversity should not only be seen as problem but also be seen as a source for growth, provided that there is an honest assessment of different regional levels of development, and absorptive capacities and possibilities for action.	Europe should consider encouraging the establishment of some 'hot spots' and world class research nodes in the New Member States (as leading lights).

In the following pages, the authors present a number of issues of interest raised by participants in the March 2005 FISTERA workshop on socio-economic aspects of the knowledge-based Europe. The objective is to be selective rather than exhaustive.

A challenging starting point for Europe

In March 2000, the EU heads of state and government agreed on the goals of transforming the EU into the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion (i.e. the Lisbon objectives). They present a uniquely European view on the emerging knowledge society, combining innovation-driven economic dynamism with social and environmental sustainability.

One of the base lines of the Lisbon process is the comparison of EU and US economic performance. There have been examples in the past where defining European objectives with respect to a common 'external competitor' has mobilized efforts towards a unifying goal. Nowadays, Europe should not regard the US as a blueprint to copy, but as a model from which lessons can be learnt. Generally speaking, the accepted view is that the EU is losing ground in terms of productivity growth rate with respect to the USA. However, a number of provisions need to be made. In contrast to the EU, the US accounting system adjusts prices for quality improvements, the so-called 'hedonic' pricing, which may lead to an overestimation of US productivity values. Moreover, the US competitive advantage seems to be concentrated in just three sectors: (a) ICT production (rapidly falling component prices particularly favour those economies with strong ICT production industries); (b) retail, due to lower-level restrictions on green-field building in the US; and (c) finance, due to the higher value of transactions in the US.[14]

Since its adoption in March 2000, many important issues have arisen, which will affect the Lisbon strategy. International terrorism prompted the quest for security. The Internet bubble burst. Globalisation continues to progress rapidly, and new economic focal points such as China and India are emerging strongly on the global economic map. Broadband networks are becoming widely available in most EU Member States, and the number of broadband users is growing fast. Peer-to-peer file sharing has become the largest consumer of Internet bandwidth, spam and scam e-mail now represents about four fifths of all emails, and Internet blogging has become an important political force in the US and elsewhere. Digital storage is now cheaper than paper. Open source software is diffusing in enterprises and runs most of the Internet infrastructure. Wireless technologies such as WiFi and RFID are about to be widely deployed. Voice over IP telephony and multiplayer online role-playing games are examples of a new wave of emerging applications. As a consequence, new business models are emerging, which could change the competitive context.

Europe between Globalisation…

The globalized economy has been driven by accelerating fragmentation and recombination of value chains using ICTs. Global companies are trying to maximize the advantage of the global trend in terms of access to skills and labour force, taxation and investment, proximity to markets and demand, logistics, etc., rather than mere access to raw materials. The competitive advantage is built on knowledge.

At first glance, globalisation seems to challenge the very foundations of nation-states as it questions their "raison d'être" and reduces their

14 Comparing productivity data across the Atlantic is - however - questionable because they are based on an ever less appropriate industrial society model and are hardly suitable for the future knowledge society. In spite of the lack of commonly accepted good indicators, there seems to be consensus that the EU is behind the US using ICT to spur productivity growth. The OECD sustains this claim also neglecting the effect of hedonic pricing. And, deficiencies in measuring services are similar in the US as in Europe.

influence, strongly anchored in territorial logic since the Enlightenment in the 18th century. But this observation is only partly correct. Emerging economic focal points in China, India and South Korea have successfully matched national interest with globalization tendencies and are future challengers of currently economically strong nations, such as the US. In a way, the new emerging order is a kind of "global regionalism", i.e. quasi-continents with the critical mass to exploit incentives to move forward.

The construction of the European Union can be considered to be part of a global "consolidation" process. Europe has become a global region with its own geo-political and economic objectives. It has an increasing say in economic, political, environmental or social negotiation and decision-making at world-level. Europe can be regarded as both a consequence and a response of a group of states to the globalisation trend. It is accompanied by a progressive weakening of the nation-state as the central economic and political project. Ten new Member States joined the EU after the Lisbon process was launched and the forthcoming integration of Romania and Bulgaria before the end of this decade is a further step towards this 'consolidation effect'.

In economic terms, the last enlargement included countries with much less developed economies in terms of infrastructure endowment, per capita income, social and institutional control on illegal practices, participation in economic activities, etc. We have to acknowledge that many EU indicators of social and economic development have since decreased on average and that, for the New Member States, catching up with the former EU-15 Member States will be a slow process. In the New Member States and in the EU as a whole, there is the expectation that information society technologies will greatly influence the speed of this integration process.

… and Regionalisms

The nation-states seem to suffer increasing external pressure from globalization and internal pressure form reinforced regional demands. Political voices heard, at these sub national levels, are apparently fed, for good or ill, by social and cultural regionalisms and nationalisms. Still, this regionalism, complementary to globalisation, may offer proximity democracy providing the answers citizens seek in their everyday lives and a manageable space for governance. On the one hand, regionalism should foster competition among regions and thus increase Europe's economic competitiveness. On the other hand, uncontrolled competition may magnify unequal initial conditions with the risk of progressively concentrating populations in a limited number of better-off regions. This adverse effect may contribute to a vicious circle of underdevelopment which Europe's peripheral regions seem to suffer from. The trend towards regionalism challenges the European goals of (territorially defined) cohesion and the provision of similar conditions for Europeans wherever they may live.

… trying to benefit most from the last EU Enlargement

Europe should take full advantage of the opportunities offered by the New Member States and simultaneously help to reduce the negative impacts of the transition/enlargement decade. Unfortunately, the EU has not yet reaped the benefits from the last EU Enlargement of 10 New Member States, particularly as global partners in R&D. For example, the enlarged EU possesses an educated and modestly-paid labour force of considerable size but traditionally it has been the USA, rather than Europe, which attracts the most researchers across the world. Europe needs to reverse the trend. The collapse of national industries and the R&D systems in the New Member States was a considerable drawback. At the same time, 'closing with the past' may offer the opportunity to effectively exploit the new paradigm for global positioning, and benefit from networking, labour mobility, delocalisation, off-shoring, outsourcing, mergers and acquisitions in research activities. Europe's policy should be directed at maximizing the socio-economic

benefits for Europe as a whole and not only a part of it, just as a multi-national sets out to maximize its gains for the whole company, wherever its factories may be located.

Global companies contribute massively to R&D investment, patents, and marketed innovations, etc., but do not respond to national imperatives (even when presented by "their" governments as "national champions"). Their R&D tend to be organised globally, taking advantage of the best opportunities in terms of labour force, taxation and investment, proximity to markets and demand, logistics, etc. Therefore, Europe's public funding must be directed at improving Europe's position in R&D, making use of and not combating rules dictated by globalisation.

One way to go is to create an increasing number of high-tech regions. Although geographically restricted, R&D nodes and regional knowledge clusters seem to be sustainable models of development within globalisation. 'Silicon Valleys' across the world have often been analysed as examples for R&D and innovation policies. They take full advantage of the 'networked' society and economy. How to scale up this regional development model, without unbalancing cohesion goals and policies, or encouraging disruptive regionalisms, is not obvious. How can Europe's public funding for R&D foster the 'ideal' of regional hi-tech development without putting its legitimate goals for territorial solidarity and cohesion at risk? One option under discussion is the creation of distinct regional specializations which are complementary.[15]

Towards a more creative economy

In the future knowledge economy, traditional industries and agriculture represent only a small fraction of the total economy. The new economy will largely be based on knowledge-intensive services and products that combine goods with services. In the OECD economies, services already account for about 70% of the value added and intermediate services account for about a quarter of manufacturing production.[16] In the future, an increasing share of value creation will occur in the so-called 'creative' industries and services producing content, experiences, designs, cultural products, etc. ICT will largely contribute to economic growth and societal change by accelerating the transition from an industrial economic system to a knowledge-based service one. The effect is expected to be direct in the case of ICT research and production activities and indirect for the adoption and effective use of ICT in several layers of society. The latter will stimulate new forms of organisation through novel activities, and new forms of communication and social relationships.

Intangibles, quality and creativity are ingredients for a new growth model…

Europe has moved from an agricultural economy to an industry-based economy. It has developed competitive products, exported its production abilities, and still leads in many industrial sectors. But are we ready for the next transition? In the following paragraphs, we will discuss a number of key issues:

Circumventing Traditional Constraints. The long-wave economic model suggests that new key technologies experience 50 year growth waves because their logic needs to be embedded into the slowly changing social, cultural and material infrastructure of the society. The use of ICTs, however, has enabled businesses to bypass traditional constraints, thereby creating doubts about the traditional model. For instance, the extremely diversified 'long tail' of the content market is now a main part of the electronic

15 C. Pérez analyses this option, giving insight including how clear and manageable are the trade-offs in a democratic society.
16 Wölfl, A. (2005) "The service economy in OECD countries," STI Working Paper, DSTI/DOC 2005/3, OECD.

content industries, and impossible to realize without Internet-based distribution channels.[17] Instead of betting on individual 'super-hits' with many consumers, the content industry is exploring the growth opportunities offered by many 'micro-hits' which address specific communities of consumers. The associated "micro-markets" are extremely dynamic: they can self-organise very rapidly using ICTs, but they can also disappear quickly. It is therefore possible that the traditional long-wave model does not adequately describe the dynamics of the networked knowledge economy. In other words, in the deployment phase of the IST wave, there are more new ways to create value than in past technology revolutions.

'Social Value Creation'. Value creation in the knowledge society is tightly linked with social and cultural practices. The increasing diversification of the social and cultural foundations of consumption has direct implications for value creation. At the same time, ICT drives changes in communication patterns and life practices. In order to align policies with the emerging growth opportunities, the social and cultural basis of value creation and economic growth needs to be made visible.

Creativity. In times of globalization and harmonization, there is an increasing need for differentiation as a means for competitive advantage. This applies, at different levels, to corporations, entrepreneurs and workers. One major source of differentiation, i.e. doing things differently, is making use of creativity. Creativity and know-how are considered the key to integration between knowledge and engineering, and between the fragmented phases of the production systems. Europe's unique cultural diversity should be exploited as an engine for creativity. Europeans are creative enough to promote their identity, and to develop new brands and designs, but they need institutional support to transform creatitivy into innovation and products. For instance, the integration of creativity, knowledge and engineering needs to be firmly embedded in the concept of the learning organisation.

Creativity needs diversity. Diversity is considered to be a stimulus and an underlying asset which leads to greater creativity and to the ability to distinguish our intellectual products from others. Europe is culturally very diverse and a variety of societal systems co-exist. But how can Europeans effectively exploit this richness? Although everybody acknowledges the value of diversity, it is not obvious how this can be turned into a competitive advantage as regards the rest of the world. Although the outcomes are not clear, it seems reasonable that these will make extensive use of the networks.

The innovation dynamics in a networked world. In the traditional industrial economy, the generation, use and exploitation of technological knowledge was mostly located in the same place. Under global -rather than national or European- conditions, the location where specific knowledge is generated becomes less and less relevant; it is rather the *ability to use* and the *capacity to integrate this knowledge that really matters*. This indicates that global innovation systems within the knowledge economy are not exclusively based on cutting-edge research, but innovation can be generated equally outside on non-science based results as well. Anyhow, it is still true that R&D adds most value when it contributes to innovation and leads to direct economic and social benefits.

… and need to be combined with organisational change in industry and administrations

Work, Learning and Skills. There is a need to analyse the labour market, and the relationships between economic activity stakeholders using a wider approach, that takes into account the social

17 The term 'long tail', was coined by **Chris Anderson** ("The long tail", Wired 12.10, October 2004 **http://www.wired.com/wired/archive/12.10/tail.html**.) to describe certain business and economic models such as **Amazon.com** or **Netflix**. It refers to a feature of statistical distributions in which a high-frequency or high-amplitude population is followed by a low-frequency or low-amplitude population which gradually "tails off".

consequences and the economic constraints at the core of European development. However, experts have become more cautious in their analysis of the possible current and future skills gap after the burst of the Internet bubble. There is still no consensus amongst experts whether there is, or will be, an IST skills shortage and how big the shortage may be. Many experts argue that there is (and will be) an IST skills *mismatch* rather than an actual shortage. This may provide insights into how to move ahead. One option, for instance, would be to generate a reservoir of people with broad IST skills which are adaptable to changing environments, rather than training a lot of specialists in many specific ICT domains. Other options include life long learning, the inclusion of minorities and making the Member States more attractive to external experts.

In view of the fact that –on the one hand- planning IST education and training is difficult in the mid-term (>2010) and –on the other- the availability of highly skilled workers seems to be a necessary pre-condition for success and prosperity in the long run, Europe cannot escape from taking measures to reorganise current activities as a key factor for making the most of the current transformation and which allows for a flexible adaptation to a new IST environment.

In order to realise the new vision, Europe must make considerable modifications in several fields: economic, organisational, as well as technological. Preparing Europeans for these changes is a critical task, which will rely on old and new learning and education tools – e.g. distance learning, learning on the job, professional communities, knowledge sharing - and all the other ways which might enhance the "ready-to-use" skills of the labour force. A stronger commitment should be made to learning processes which address the specialisation level of the required skills, and also actions to enhance the ability of individuals to adjust to evolving labour and competition contexts.

Increasing the absorptive capacity of organizations. 'Absorptive capacity' is the rate at which organisations can assimilate scientific or technological information.[18] Limits to absorptive capacity partly explain why firms develop internal R&D capacities. R&D personnel not only conduct development along lines they are already familiar with, but they also have formal training and external professional connections that make it possible for them to evaluate and incorporate externally generated technical knowledge into the firm more effectively than other employees. In other words, firms also invest in R&D to diminish the constraints to absorptive capacity.[19]

Organisations have different capacities for acquiring, assimilating, transforming, and exploiting knowledge to achieve innovation and flexibility. The variation in organisational absorptive capacity can be attributed to factors such as: the capacity of the organisation to assess its exposure to knowledge sources, how well the organisation's existing learning model fits with the new models and its past experiences, the nature of the technologies which are available to the organisation; and other external and internal contextual factors influencing the absorptive capacity, e.g. the existence of government pressures, or the appointment of eLearning champions. The transformation from potential absorptive capacity into realised capacity is influenced by formal and informal social integration mechanisms. The exploitation of realised capacity for strategic outcomes is influenced by the characteristics of the organisational learners, such as their attitudes to technology-based learning, their motivation and capacity to learn.

18 Martin G., Massy J., and Clarke T. (2003), When absorptive capacity meets institutions and (e)learners adopting, diffusing and exploiting e-learning in organizations, International Journal of Training & Development, Vol. 7, No. 4, pp. 228–244.

19 See –for example- Cohen W., and Levinthal. D. (1990), "Absorptive capacity: a new perspective on learning and innovation." Administrative Science Quarterly 35(1) pp. 128-152.

Mastering the effects of the ageing population is a major challenge

The economic gap between the EU and the US is likely to grow in the future because Europe's population getting older rapidly, while ageing has far lower impact in the USA. Simulations indicate that Europe's ageing demography could be reduced but not completely stopped, even by high immigration flows. Europe should have taken advantage of the 'baby boom' generation of the Sixties. From 2010 onwards, this generation will start to reach retirement age and thus, many consider the present decade as the last window of opportunity before direct and secondary adverse effects will become more dominant. A direct result of ageing is the ever increasing ratio of dependents to workers, which will put the sustainability of the social security systems, including pensions, at risk, unless there is reform.

Secondary effects may be of social nature. Older people are generally less fond of 'new' products, forcing some companies to reconsider the time schedule for a return on innovation. To a great extent, the first wave of the knowledge economy was driven by young consumers, who actively adopted new information and communication technologies and adapted their life patterns to benefit from new technical opportunities. In the next decades, the ageing population will strongly influence the markets for IST applications. These products will have to fit the needs of older Europeans. The value of new products and services will be increasingly dependent on people who have made large investments in their established life-styles. For this user group, novelty is not always a value in itself and change may imply large adjustment costs. This demographic transition will lead to a change in the dynamics of product and service innovation, making successful innovation increasingly dependent on a better understanding of user needs and the contexts of use.

Ageing demographics have more adverse effects on weak economies than stronger ones, whose adverse effects may be particularly evident in some New Member States. This is because many NMS suffer from high unemployment rates and pronounced ageing at the same time – e.g. Poland and Slovakia. Although the growth rates may be considerable, they may still be insufficient to boost the economy and generate a large number of jobs. If the employment rate stays low, the dependency ratio – e.g. number of earners supporting the economically "non-productive" will gradually worsen.

The difficulty of measuring progress during the transition phase before the completion of a knowledge-based economy

The emerging techno-economic paradigm will require new indicators to measure progress. Current measurement systems and data collection methods represent solutions to problems that were socially and economically important in the earlier paradigm. The emergence of the new paradigm can be observed from the apparent discrepancies between institutionalized measurements of progress and 'common-sense' concepts of progress. For example, national accounting has difficulty calculating the value created in trans-national networks, the accumulation of intangible assets, or the added value quality improvements bring to products and services. The more the new paradigms emerge, the more old data and measurement systems are prone to deliver misleading results. Policymakers, therefore, should be cautious about interpreting progress using 'old' indicators.

As old indicators of progress become unreliable, there is a clear and undisputed need for both the definition of suitable indicators and the setting up of mechanisms whereby the new data is collected by the appropriate national, regional, federal statistics institutes. This seems to be a first priority for the development of a new conceptual framework for economic development. Obviously, the value and usability of the data will heavily depend on their geographical coverage and consistency. In the assessment of the ICT contribution to EU growth, the quality of products and services becomes a

critical competitive factor. Currently, quality is barely included in productivity rate measurement and needs to be taken into account in future models.

IST-enhanced economic disruptions

The availability of novel or significantly enhanced IST functionalities and the widespread adoption of new IST-based services are likely to create new ways of living and novel perceptions of values driving the evolution of culture. A blend of technology, production, and adoption may disrupt some market segments as we know them today. This offers opportunities to new entrants and may change the competitive position of whole countries. Progress in technology will lead to disruptions that, in some cases, will inevitably affect the value chains in several ways. This section analyses those disruptions which are likely to affect the international division of labour and the positioning of EU companies, along with industrial and service channels. Understanding the potential impact on the value chain is of great importance because of its economic implications for the fabric of European business and because it defines strategic initiatives to fill gaps (e.g. in education), promote investments (e.g. in infrastructure), revise the regulatory framework and the way that societal, ethical aspects are looked at. It is hard to predict what will cause a disruption and when, but some necessary (but not sufficient) conditions can be investigated. The FISTERA network identified a number of possible technology-enhanced topics as potential instigators of disruption, which are briefly summarized in the following paragraphs, as a basis for discussion.

IST enhancing the shift from a product-based to a service-based economic model

Manufacturers will increasingly skip the distribution and supply chain and deliver services directly to the end user. In doing so, some manufacturers will also be creating a platform which will enable third parties to offer new services. Distribution and supply chains become another link in the chain, rather than being decoupled from it. This shift in the business model away from simply producing and selling products, towards making money in after-sale services has already happened. For example, manufacturers in the automotive industry are increasing their after-sales services and money in the IT industry is mostly generated through sales of ink, rather than the printer itself. Though it is debatable whether this is an advantage or a disadvantage from the manufacturers' point of view, one issue appears to be clear:[20] IST will benefit in both cases – first, as an industry in its own right and second, as an enabling technology that promotes the shift from products to services.

IST will enable 'personal' mass production just as the production chain enabled mass products in the last century. Two factors favour "personal" mass production: the greater flexibility of production processes on the one hand and on the other, the surplus capability embedded in many products, which allows users to customise them to their needs. These two factors are difficult to manage (e.g. personal customisation, etc.) and do not meet fast changing possibilities (on the producer side) and needs (on the user side). A further step towards a service-based business model would address these aspects, disrupting, at the same time, whole value chains. Usability, understanding the changing needs of clients and

20 Selling products has a limited interaction range with the client as, once a client has bought a product, he is no longer a 'client'. Any interaction after the sale is often a disappointed client coming back with a complaint. On the positive side, a one-off contact with the client is an efficient way to get a return on advertising costs. The profit margins tend to be easy to calculate, as the sale is a single event. In a service sale business model, there is continuous interaction between the client and the service provider, who has the opportunity to maintain close ties. In a service relationship, revenues are distributed over time and the repeated use of the service leads to margins for the provider. Generally speaking, it is not sufficient to sell a service once; it must be sold over and over again. In the product sale business, it is necessary to have satisfied customers, (who are often attracted by brand names or word-of-mouth). In the service sales model, the satisfied customer must also be 'hooked' to generate revenue.

the creation of a relationship of trust will be key assets in this evolution.

With regard to IST as an industry, it has to be noted that many IST products are becoming commodities and suffering a loss of differentiation. The product is often no longer distinguishable by its function, but only by brand (think about the 'Intel inside' campaign). Therefore, in several IST market segments, brand value will lose appeal in favour of lower price, as is already happening in the growth of unbranded products. The more IST products become commodities, the more margins will be reduced, forcing companies to explore alternative ways of making money. The adverse effects of replicas increase with new copying capacity, increasing the risk of loss of product value. Shifting from a product-based model towards a service business model could reduce damage by copying, allow regular payment, and also dilute the customer's expenses (iPod business model versus illegal copying of songs).

The transformation into service companies will require supreme attention to customers' evolving needs. Changing needs will further shorten the product life cycle or demand greater flexibility in functionalities with remote update. The value chain needs to be adjusted to permit an integration of the production phase, the delivery phase and the customer care phase. In view of the time constraints and high level of flexibility required, the role of IST will be a key element in this transformation and the impact on industry is expected to be considerable. Scientific progress will enable the transformation. Technologies, including those used in production processes, have become cheaper and accessibility and management of centralised service provision has become easier. In the IST sector, for instance, rather than selling hardware, enterprises often provide the hardware to run the services for free. For instance, in telecommunications a voice message service is offered for free and the user only pays for the call to hear the messages.

The disappearance of the computer

We can confidently state that 'computers' are already fading into the background. For each personal computer sold, there are more than 100 microprocessors embedded in everyday objects, like remote controls, wrist watches or hotel room keys. The availability of cheap storage, processing, sensory and communication capabilities in every day objects and in the environment will further accelerate and create tremendous opportunities for new services. New appliances will increasingly include connectivity and processing capabilities, and will interconnect easily with each other, displaying information on the most appropriate device.

The drivers will continue to be cost reductions, shrinking physical size and increased computing power. The capacity of any object to process and communicate information will change the architecture of the environment. An object will rarely be a stand-alone device but increasingly be designed to be part of and interact with its local environment, in other words the "ambient". The embedding of microchips able to communicate with the environment opens up the opportunity to transform ambients and our relation with them. Thus, these ambients will not just become richer in services; they will also be used as platforms for service delivery. The ambient becomes both network and (aggregated) terminal(s) at the same time. Both the variety of existing production industries and the service industry need to adapt their view of the market in these terms. The ambient transformation, both physical and virtual, is possibly the single most important factor in the business changes lying ahead. It will have a continued positive effect on the creation applications, including those in the entertainment sector.

From content to packaging

Content production keeps growing at a staggering pace. Humans have produced more content in the last 30 years than in all

their previous history and it is forecasted that the amount of content will double every 3 years. Reduced production cost enhances the "explosion" of information. Individuals contribute one order of magnitude more information than enterprises to this explosion. Digital cameras, digital camcorders or personal web servers support this. The abundance of content will change the perception of the *value* of content. It is no longer the content *per se* that has value, but rather the way content is put into 'context to be consumed'. If 90% of the content you require can be obtained for free you will probably be unaware that 10% is missing. Here, packaging could make the difference by putting information into a specific context. Similarly, if there is too much information, filtering it and reducing it into a given package will also add value.

The large availability of content resulting from huge production in the private, public and business sectors and the ease with which it can be reached, is threatening companies that produce content. The disruptive force of this evolution can already be observed in the record/media industry and in the information industry. One example is the Encyclopaedia Britannica, which has been challenged by Wikipedia and other free services, and forced to release a large part of its content for free. The content and media industry is likely to undergo a profound reshaping. How far present business models can be protected in order to maintain content as an asset is unclear. Improved content protection technologies will be needed, but it is unlikely they will ever achieve the high standards desired by industry. Besides, as alternative "similar" content will often be free, 'protectionist' approaches are not likely to be sustainable.

In times of content abundance, value will shift to services able to retrieve a specific piece of information from the thousands, customise it and deliver it in the form that is most suitable for a specific use. Today, companies like Google seem in the best position to leverage from the abundance of content. Companies that come up with good packaging for content (like Apple's iPod) can also leverage on content availability. Both physical and virtual packaging (based on user profiling), will become very important businesses. Software technologies and an appropriate regulatory framework, which takes into account privacy and ownership issues, are essential. Regulations should be applicable in a trans-national context, possibly a big challenge.

Unlimited and ubiquitous communication

Infrastructures dedicated to communications will fade away as every object and ambient becomes connected. At the same time, better access to infrastructure will reduce communication pricing and bundling of communications access will increase as time goes by. The service industry is likely to embed communications in services and users will consider communications as a standard feature of any service. Customers will pay for the service, not for the communication. Most value chains will embed communications as a supporting feature. The usual relationship between a client using communications facilities and the operator providing them will disappear for most services. The question is who will cover the costs of infrastructure and minimal services.

Access to unlimited bandwidth will present current operators with new challenges. At the same time, unlimited bandwidth will offer new business opportunities. We will see an infrastructure that, from a perceptual view point, is providing steady always-on connectivity that will be paid for as such. Transaction support tariffs will be based on usage (charge per transaction, based on a variety of parameters) and service-based payment. The impact is on communication since it needs to readjust its architectures to traffic as diverse as always-on video or transactions. Present services, like voice communications, will drift from transaction-oriented tariffing (where time is the measuring stick) to always-on connectivity. The whole area of service-based tariffing is novel and requires the integration of concepts such as virtual networks, environment, application, content and information. The regulatory framework will have a

substantial impact in this area, either stimulating or hampering the pace of evolution.

The market drive will not be on ways to exploit bandwidth, but rather on the services themselves. Bandwidth will be taken for granted, as has happened with roads. Business does not think about exploiting roads, just using them. Telecom operators have been investing in creating ever more powerful infrastructures and now that these exceed demand, they are struggling to create the need for them. In fact, the drive should be to make them "more convenient" so that people linger. In road infrastructures, this translates into service areas, parking facilities, etc. In telecom infrastructures, this can translate into data management, data repository, and platforms for service aggregation, etc.

Considerations about the way ahead

There was general consensus amongst the workshop participants on the lack of enforcement mechanisms for the Lisbon agenda, especially at the Member States level. After having defined very challenging goals, no commitment to a detailed work plan for national policies followed. Agreement was expressed on the need to move from a "problems/solutions" binome to a "strategies/implementations" one, implying a pro-active approach from each of the Member States to move towards the general goals.

A systemic approach

Areas where poor performance could block the implementation of policy action were considered critical, namely public administration organisation, state governance,[21] organisation and roles of institutions, financial management, approach to risk-taking, production and use of available knowledge. All actions should be integrated in a systemic approach, able to cope with changing situations.

A systemic approach may demand some institutional structural reforms, for example, the clear definition of roles and the setting of priorities amongst the institutional layers concerned. All institutional layers must collaborate in the design of a more competitive environment for entrepreneurship, with a set of integrated structural reforms of the product, capital, and labour markets. These reforms are urgently needed to improve the way each of the dynamic markets functions, the effectiveness of their resource allocation, and the contribution each can make to innovation.

One of the bottlenecks identified is that, in some Member States, national priorities seem to prevail over European strategies. With regard to IST, several EU countries have performed foresight studies on national strengths and weaknesses in order to detect opportunities. These studies pay little attention to the European dimension and technology. This confirms the belief that national programmes are mainly designed to fit national interests (industry structure, academic expertise, etc.) and only occasionally incorporate European elements. But there are signs of opportunity. In view of the fact that only a few Member States have long-term national strategies for IST policy, the development of a Europe-wide vision and pathways may encourage the Member States to integrate a European dimension automatically into future national strategies.

Governance. Governance of economic growth and development has to rely heavily on the sub-national and regional level. An increasing number of powers and responsibilities are located at this level and a greater potential for participation and dialogue is foreseen. Therefore, to ensure that governance can cope with the greater numbers and types of actors involved, a combination of horizontal governance based on applications and multi-layer vertical governance, promoting the enforcement of its acts, should be foreseen.

21 i.e. the network and leverages of influence from the strategy definition layer to the various levels of the society.

State/public administration and eGovernment

Better quality public administration is recognised as a critical factor for the EU in facing the current challenges in terms of competitiveness and strengthening of its global role. The future European society should improve the efficiency and effectiveness of public bodies, integrate their functions at the European level, and evolve and enrich their functions towards structural cooperation between public and private actors and towards greater inclusion and participation of individuals.

IST can substantially contribute to this goal by wide deployment and increased use of eGovernment applications. In fact, there are already great individual and collective expectations for better and safer government services. There seems, however, to be an adoption problem. While the basic technological elements for properly functioning and efficient eGovernment are mostly available, the current usage rate by citizens is unexpectedly low. Interestingly, there is controversy as regards to the importance of eGovernment applications for the future. A recent Delphi study carried out by FISTERA, involving more than 500 experts, ranks eGovernment among the top IST applications. National foresight exercises and programmes, however, do not rank it as high. This may explain why some policy makers seem to underestimate their role in the diffusion of ICT developments. Because of the perceived importance, it is urged that active measures be taken, including changes in legislation where necessary and optimization of governmental back offices.

Promoting finance and a more risk-taking attitude

The Lisbon Agenda and the Commission's follow-up activities provide a political framework for action. This framework was meant to provide a detailed action plan that comprises all instruments available to the European Commission in a coherent way. However, workshop experts felt that these action plans may not have been sufficiently elaborated or supported by the stakeholders. With regard to IST, there is the need for a set of specific actions (research, standardization, regulation, etc.) that is clearly defined and has clear priority. It was felt that the financial mechanisms currently available in the EU need to be adjusted in order to favour a consistent risk-taking investment attitude for research and innovation. Prioritization must focus on key IST issues; otherwise the EU runs the risk that available human and financial resources are diluted with no critical mass for economic and social opportunities.

As technical and societal innovations have to go hand in hand, the experts expect that another couple of decades may pass before ICT achieves its full impact on society. If Europe does not want to be flooded by innovations from other parts of the world, specific IST choices have to be made now: socio-economic determinism and techno-determinism should be avoided when researching future developments. Any decision on the future of R&D, even if excellently informed, will necessarily incorporate a certain level of risk. Therefore progress is directly connected to risk taking, which should be encouraged at all levels. Due to the burst of the Internet bubble, and the difficult years in the telecom sector, however, there has been an adverse attitude to risk taking in industry and public organizations. Now that there is evidence of the importance of IST, the public sector should contribute to support risk taking and actively contribute to it.

Participation and socio-technical systems

An important and distinctive element of the European social model is the participation of its citizens. Participation involves all those mechanisms that allow citizens to take an active part in social, political, economic, and cultural activities, i.e. the pillars of our society. The principles of solidarity and cohesion are fundamental European values and they evolved in line with economic development, internationalisation of production systems and the opening of the European boundaries. With the

last Enlargement, Europe has gained an additional variety of cultures, societies and ways of doing business. This variety and rich diversity calls for a focused effort to extract the best elements in order to increase the shared portion of vision, ideals, and practices. The way this will happen is still not sufficiently defined, but it will build upon an agreement between Member States on their concepts of community, and their obligations and rights. Irrespective of how successful this integration of the New Member States will be and how this will affect the Union, some basic European values are likely to stay. One of them will be citizen participation in decisions regarding the future EU, and individual commitment to the path chosen. New mechanisms, including ICT tools, will be necessary to increase levels of participation. However, technology push alone will not be enough. Technical innovation needs to be complemented with social innovation and institutional and organisational transformation, if economic benefits are to be reaped and growth potential achieved. A systemic approach is needed which can include all the strategic components of the society, and integrate them, building on their complementarities. This appears to be a condition for knowledge-based development and growth.

Research capabilities and the role of the public sector

In the upcoming economic system, knowledge becomes an increasingly dominant factor for growth and the question arises as to whether 'knowledge' is a *'public good'* and, if so, to what extent this is true. In the optic of a public good, the role of public research centres becomes more critical, raising the demand to strengthen public research capabilities. The relationship between public and private knowledge becomes very important.

Public investment should be made in research laboratories and projects, the qualification of researchers, the systematic interaction between research institutes, and the close cooperation between public research bodies and private/ company research departments. European industry structure and company size seems to generate a lack of commitment to research, as compared to the USA. Specific policy actions, based not only on funding but also on the building of closer cooperation, might help the EU to face weaknesses originating from the fact that it has fewer medium-sized ICT companies active in R&D than the USA.

Policy action should be directed at encouraging cross-fertilisation between sectors and countries by sharing accumulated experience, and at systematically stimulating innovation. Additionally, it should promote "frontier research", which would complement vital "user-driven research" - a necessary condition for more integrated results. Besides the commitment to generate new knowledge, another important policy target is better exploitation of existing knowledge, for it use in new ways or developing new applications.

Concluding remarks

The Lisbon objectives are, by definition, a 'moving' target, requiring regular discussion and revision in geographical and temporal contexts. An appropriate monitoring system is needed, which is not available at the moment. A major concern arises as to whether comparisons or benchmarks will remain valid as Europe moves (from an industry/service based industry) further towards a knowledge society. It is generally agreed that, to grasp the economic dynamics underlying the information society, adequate indicators and effective tools for building data collection in order to guarantee their availability are absolutely necessary. However, there is no consensus on what these new indicators should look like. For instance, is 'productivity' still an appropriate indicator in a society which some scholars have started to define as "non-productive"? Similarly, how can we monitor the potentially beneficial role of knowledge and its development trend? What is the EU's position as regards knowledge trends? Who is sitting on what knowledge? How

can we access knowledge? How can we learn to use it best?

Europe has a unique social model based upon our history and values. Efforts should be made to keep those 'European' values related to welfare and civil responsibility for the future. This implies that the highest standards of citizen participation should be maintained and aligned to the current policy framework, the priority areas and the way improvements in participation are measured. One upcoming challenge is the ageing population which will affect Europe much more than other developed regions. Though the adverse effects of an ageing society are widely recognized, there is still little quantitative research on how this will affect our future knowledge-based economy, for instance in terms of the labour force. In a knowledge-based society, the number of jobs for people with tertiary level education is growing, while the number of jobs for those with lower education levels is decreasing in most fields. An effective strategy directing a larger share of the young people to higher education is therefore necessary. It should be possible to direct our efforts to increasing the labour force participation rate, dealing with the high unemployment rate in some social groups, and counterbalancing the ageing phenomenon by allowing increased immigration. The inward flow should include both skilled and unskilled workers, who will contribute to the quality of EU development.

With regard to a systemic approach that identifies both areas of concern and possible solutions, some factors were considered outside the reach of European influence. However, most of them were considered to be sources of possible stimulus, development, competitive strength and consolidation of the enlarged community. Some steps are considered critical to growth and to the establishment of the knowledge society. The first one is to monitor *systematically* technology evolution and opportunities and to make evidence-based assumptions about which technological disruptions will have high socio-economic potential. The second is to oppose the low propensity to risk taking, the low acceptance of a certain level of failure, and the lack of policy measures accommodating risk, all of which are major impediments for the future. A considerable effort is needed to turn this around into a positive trend. Third, it was felt that individuals and society need to be encouraged to adopt a new growth model based on creativity, knowledge, intangibles, quality, and to make best use of European strengths, e.g. diversity, skills and innovation, social and institutional learning, and inclusiveness. Finally, indicators for the dynamic changing context must be introduced, which suit the transition phase, and strengthen the EU's future position in a fast changing world.

Some workshop participants felt that perceptions of the EU's economic status were often too pessimistic. This pessimism may have been partially caused by the fact that Europe's vision is defined on a comparative basis and is not clear. Unattainable expectations may have arisen as a result of the ambiguities and difficulties in measuring progress towards it. A positive and constructive approach needs to be taken to strengthening the European vision, possibly by redefining the objectives not only in comparison to other regions, but also in 'EU internal' terms. It should take into account important EU socio-economic considerations, such as an ageing population, and balance these out against different trade-offs (e.g. how much growth can we afford at the expense of losing regional economic cohesion). The focus of European economic policy on growth and employment are a step in the right direction. A range of policy actions could be envisaged in areas, considered by the experts to contribute considerably to growth, where concerted public action is absolutely necessary. The first one is the integration and cooperation of public administration at European level, which must be accompanied by the evolution of the practice of governance. Secondly, there is a clear need for radical reform of some of the basic policies (market, regulation, etc.) of the current economic system in order to adapt them to the new wider

challenges presented by the knowledge-based global economy. Third, governments shall put in place a legal framework to encourage a more risk-taking attitude. This framework should also include appropriate financial mechanisms to support more risk-taking. Fourth, the promotion of a participatory and integrating approach to socio-technical systems should actively pursue ways of extracting the maximum from technology applications, and the related institutional and organisational changes. Finally, governments should reinforce research capabilities through higher commitment and deeper cooperation between public and private actors.

Greater attention should be devoted to the impact of Enlargement, labour mobility and re-localisation, and the better use of ICT and knowledge, rather than relying on production only. Additional effort has to be devoted to the elaboration of more effective ways of integrating national policies with each other in order to achieve results at European level.

A systemic approach to the economic institutions (labour market, product market) is needed, which should result in a full set of structural reforms to achieve better political governance. In order to encourage growth, Europe should increase its efforts to identify growth sectors, and reallocate resources to generate firms and sectors with high growth potential.

The establishment and consolidation of the knowledge society will rely upon a different weighting of factors (e.g. innovation, growth, and learning) than in the past. As the composition of these factors is dynamic and changes with time, priority setting gets difficult. Researchers would be advised to make trade-offs and feasible paths more explicit to decision makers, so that they can make informed choices between alternatives.

Priority actions identified during the workshop discussion are to:

- improve the use of existing knowledge, rather than focusing only on the creation of new knowledge,
- cover the whole span of research - from application-driven to curiosity-driven research – in R&D,
- solve Europe's governance difficulties, and its lack of both focus and implementation tools. These tools must match objectives - e.g., the 'open method of coordination' might need to be reinforced with a parallel method of involving national governments in converging policy actions,
- encourage innovation, as it is one of the chief remedies for unemployment,
- use a systemic approach to European growth and social improvement policy to inform all the above actions. This approach could be a critical means of overcoming the current phase of instability and uncertainty.

2. Re-specialisation and the Deployment of the ICT Paradigm - An Essay on the Present Challenges of Globalisation

by Carlota Pérez

ICT shaping, and being shaped by, the global context

The future of Information and Communications technologies (ICT) is inextricably intertwined with the future of the global economy and of each regional and national economy. This is because the core industries of a technological revolution are much more than a set of new products, industries and infrastructures to be added to the previously existing ones. Each technological revolution provides a set of generic technologies, infrastructures and organisational principles – a new techno-economic paradigm – capable of gradually modernising and increasing the productivity of the whole economy.

Therefore, the specific market opportunities in the ICT innovation space will be increasingly defined by the direction and intensity of growth in other industries, while innovation in all other industries and activities will be dependent upon the new potential, its characteristics and the associated capabilities.

Current biotechnology and nanotechnology wouldn't even be conceivable without the contribution of swift and massive data processing software and extremely precise computer-guided instruments. The trend towards customising chemicals and materials, which is rejuvenating what were mature industries, is made possible by computer aided engineering and simulation techniques. The same can be said about most innovations today, from products and process equipment in manufacturing to practically all the service industries, from finance to retail. Even the creative and craft industries are innovating with ICT, while shepherds and fishermen far from modern cities use digital satellite data for their daily work.

A similar situation ensued from 1908-13, when the mass-produced low-cost Model-T became the example that shaped the techno-economic paradigm of that revolution. Standardisation and assembly-line production were soon applied in one industry after another. The other core elements of the constellation, the internal combustion engine, coupled with increasingly efficient oil refining technologies, guided the revolution in massive transport from trains, ships, carriages, bicycles and horses to automobiles, buses, trucks and airplanes. Universal electricity fuelled by hydrocarbons led beyond industrial equipment to a whole range of household appliances destined to transform lifestyles radically. Petrochemical materials increasingly replaced natural fibres in the textile industry; they also tended to replace many natural materials, from rubber and wood to leather and even glass, in one use after another. Disposable plastics became the staple diet of the packaging industry and agriculture was transformed by oil-driven machinery and petrochemical fertilizers, pesticides and herbicides. In other words, for over half a century, oil-based mass production shaped the direction of innovation towards the energy and materials-intensive patterns of production and living that the Knowledge Society has inherited.

But the relationship is mutual. Technology shapes the economy as well as society and these, in turn, are constantly shaping technology, guiding its development and selecting within the potential it offers. The space of the technologically feasible will be filtered by the economically profitable and the socially and culturally acceptable as well as modified by market and policy developments (including inaction, as much as action, by the various social agents).

Thus, in the process of examining the future path of ICT, it is important to refer to the characteristics of the specific techno-economic paradigm and to the way they may be influencing the opportunities in other sectors of the economy. Equally useful is making reference to the regular patterns identified in the diffusion process of earlier technological revolutions. Both these frameworks can aid in assessing the options and the viable paths for action, depending on the goals of the different actors at play.

This essay is meant to go part of the way in that task. It will summarise some of the relevant aspects of the *great surges model* presented by the author in *Technological Revolutions and Financial Capital*.[22] On the basis of that framework, it will argue that, though the role of free markets was crucial in the early decades of diffusion of the ICT revolution, their continued unrestrained and unguided operation can only aggravate the tensions inherited from the casino economy and the income polarisation of the 1980s and 1990s. It will propose that a conscious, policy-facilitated and consensus-driven process of respecialisation in the developed economies can be the most effective way to overcome those tensions as well as the instabilities generated by the present uneven globalisation of production.

The intention is to share some of the concerns and ideas for action that emerge from observing the present circumstances with the aid of a historical model of recurrence. As such it is a personal contribution to a debate about shaping the future, the need for which is becoming more acute as globalisation proceeds.

The recurring diffusion pattern of revolutionary technologies

There has been a technological revolution every 40 to 60 years, beginning with the Industrial Revolution in England at the end of the 18th Century. Each has generated a great surge of development, diffusing unevenly across the world from an initial core country. The analysis of the previous four surges reveals regularities in the pattern of diffusion of technological change that help us understand the propagation process of the present fifth surge based on ICT. This can provide criteria for strategic and policy action.

Double nature of technological revolutions[23]

An important element of this recurring pattern is the double nature of each technological revolution. The great wealth-creating potential provided by each of them stems from the combination of the new technologies, industries and infrastructures with a set of generic technologies and organisational principles capable of modernising the rest of the economy. The resulting best practice frontier is superior to the previous one and becomes the new common sense for efficiency –a new *techno-economic paradigm*– that defines the guidelines for innovation and competitiveness.

This paradigm will transform the whole economy and will gradually bring it to a higher productivity plateau. Propagation is highly uneven in coverage and timing, by sectors and by regions, in each country and across the world. Whatever its shape and rhythm, the complete process of diffusion of each new technological constellation and its techno-economic paradigm constitutes a *Great Surge of Development*.

Table 1 summarises the elements of each of the five surges, indicating the core country or countries from which it is deployed, the date of the initial big bang – or initial breakthrough – that articulates the technological revolution, the main industries and infrastructures and the basic principles of each paradigm.

22 Pérez (2002). Given that the two following sections introduce the main concepts of the model presented in the book, the reader will be referred to the relevant chapters or pages in each case.

23 Pérez (2002) Ch. 2.

Table 1. The five great surges of development: Technological Revolutions and Techno-economic paradigms

Technological revolution Core country	**New technologies and new or redefined industries**	**New or redefined infrastructures**	**Techno-economic paradigm** 'Common-sense' innovation principles
FIRST: From 1771 The 'Industrial Revolution' Britain	Mechanized cotton industry Wrought iron Machinery	Canals and waterways Turnpike roads Water power (highly improved water wheels)	Factory production Mechanization Productivity/ time keeping and time saving Fluidity of movement (as ideal for machines with water power and for transport through canals and other waterways) Local networks
SECOND: From 1829 Age of Steam and Railways In Britain and spreading to Continent and USA	Steam engines and machinery (made of iron; fueled by coal) Iron and coal mining (now playing a central role in growth)* Railway construction Rolling stock production Steam power for many industries (including textiles)	Railways (use of steam engine) Universal postal service Telegraph (mainly nationally along railway lines) Great ports, great depots and worldwide sailing ships City gas	Economies of agglomeration/industrial cities/ national markets Power centres with national networks Scale as progress Standard parts/ machine-made machines Energy where needed (steam) Interdependent movement (of machines and of means of transport)
THIRD: From 1875 Age of Steel, Electricity and Heavy Engineering USA and Germany overtaking Britain	Cheap steel (especially Bessemer) Full development of steam engine for steel ships Heavy chemistry and civil engineering Electrical equipment industry Copper and cables Canned and bottled food Paper and packaging	Worldwide shipping in rapid steel steamships (use of Suez Canal) Worldwide railways (use of cheap steel rails and bolts in standard sizes). Great bridges and tunnels Worldwide Telegraph Telephone (mainly nationally) Electrical networks (for illumination and industrial use)	Giant structures (steel) Economies of scale of plant/ vertical integration Distributed power for industry (electricity) Science as a productive force Worldwide networks and empires (including cartels) Universal standardization Cost accounting for control and efficiency Great scale for world market power/ 'small' is successful, if local
FOURTH: From 1908 Age of Oil, the Automobile and Mass Production In USA and spreading to Europe	Mass-produced automobiles Cheap oil and oil fuels Petrochemicals (synthetics) Internal combustion engine for automobiles, transport, tractors, airplanes, war tanks and electricity Home electrical appliances Refrigerated and frozen foods	Networks of roads, highways, ports and airports Networks of oil ducts Universal electricity (industry and homes) Worldwide analog telecommunications (telephone, telex and cablegram) wire and wireless	Mass production/mass markets Economies of scale (product and market volume)/ horizontal integration Standardization of products Energy intensity (oil based) Synthetic materials Functional specialization/ hierarchical pyramids Centralization/ metropolitan centers–suburbanization National powers, world agreements and confrontations
FIFTH: From 1971 Age of Information and Telecom-munications In USA, spreading to Europe and Asia	The information revolution: Cheap microelectronics. Computers, software Telecommunications Control instruments Computer-aided biotechnology and new materials	World digital telecommunications (cable, fiber optics, radio and satellite) Internet/ electronic mail and other e-services Multiple source, flexible use, electricity networks High-speed physical transport links (by land, air and water)	Information-intensity (microelectronics-based ICT) Decentralized integration/ network structures Knowledge as capital / intangible value added Heterogeneity, diversity, adaptability Segmentation of markets/ proliferation of niches Economies of scope and specialization combined with scale Globalization/ interaction between the global and the local Inward and outward cooperation/ clusters Instant contact and action / instant global communications

Note: These traditional industries acquire a new role and a new dynamism when serving as the material and the fuel of the world of railways and machinery*
Source: Based on Pérez (2002) pp. 14 and 18

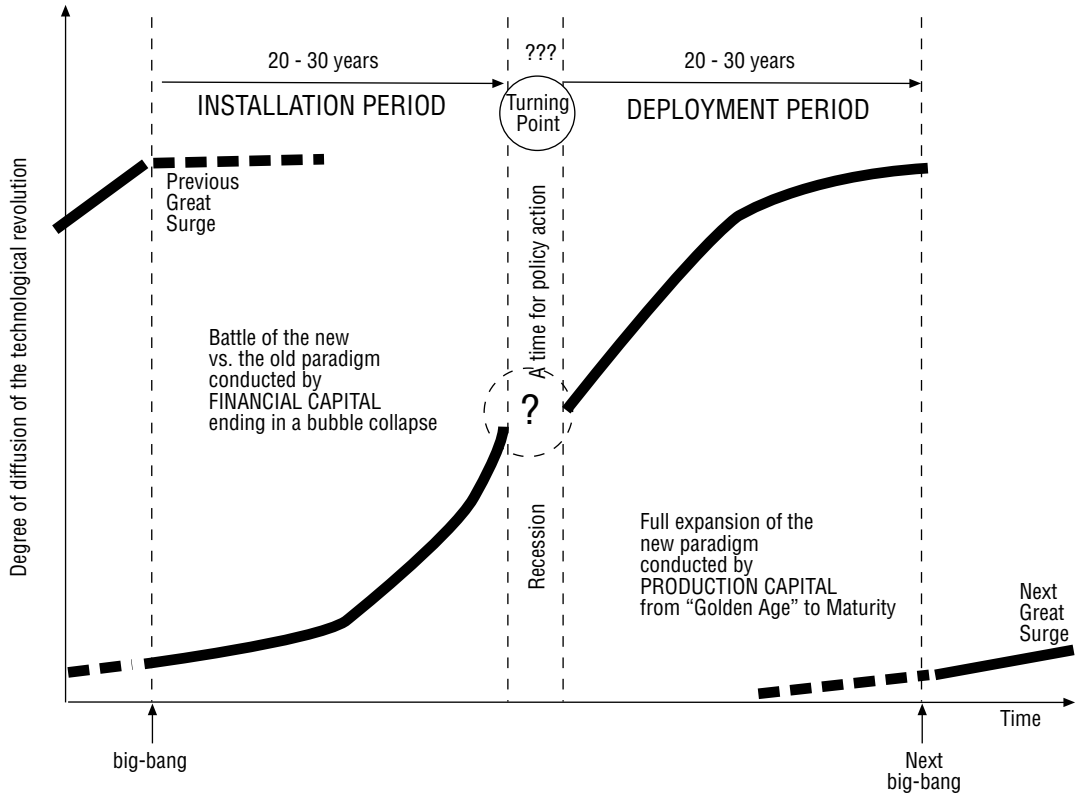
A similar sequence of propagation[24]

The other recurring element is the sequence of diffusion of each technological revolution in the core country. As shown in Figure 1, the overall process of propagation takes the shape of the logistic curve characteristic of epidemic models, as does the diffusion of most individual technologies and technology systems. However, in the case of a whole revolution, the process is broken in two halves with very different characteristics.

Due to the depth of commitment to the previous paradigm –on the part of institutions, companies, individuals and the economy– the initial decades of emergence and installation of each technological revolution are a turbulent battle between the new and the old, involving Schumpeterian creative destruction in both the economy and the institutional framework. This first half of each surge is the *Installation period*. It is after this battle against resistance has been won that the decisions are taken –through various social processes– as to what specific shape the fully-realised new potential will take. This usually happens after the collapse of a bubble caused by frenzied investment in the new technologies and infrastructures. This has occurred regularly midway along the propagation process of each technological revolution: canal mania, railway mania, the great booms in Australia, Argentina and other Southern countries, the roaring twenties and the euphoric 1990s

The following decades of diffusion constitute the *Deployment Period*; the "Golden Age" of each great surge, such as the boom after the Second World War, the *Belle Époque* at the turn

Figure 1. The social assimilation of technological revolutions breaks each great surge of development in half



Based on Pérez (2002) p.37

24 Pérez (2002), Ch. 4.

of the 20th Century or the British Victorian boom in mid-19th Century. It is no longer a time of easy millionaires as during the bubble, but rather of increasing well being across a wider range of the social spectrum.

There are major differences between these two periods, due to the relative roles and criteria of finance and production, which operate in capitalism as two distinct functions performed by two different sets of actors. During *Installation,* the economy is typically led by the short-term criteria of financial capital.[25] Once the point of exhaustion of a techno-economic paradigm's potential is approached, conditions are created for the articulation of the existing radical technologies into a technological revolution.[26] Finance capital breaks away from the now mature and risk-averse production capital and goes in search of extraordinary profits to be had from backing new entrepreneurs. The new technologies and industries can then flourish while the established ones are forced to modernise (or be destroyed as obsolete). It is the time when the new paradigm emerges and the old one needs to be "unlearned". These early decades are marked by the emergence of innumerable new entrepreneurs, a small number of which will grow into new giants, destined to become the engines of growth in the following Deployment Period.

During *Deployment,* the economy will once again be in the hands of production capital, now renewed and strengthened. The focus of attention will move from the stock market to the expansion of the world of production and employment, to growth and productivity as well as to its consequences in terms of well-being. It is these periods which have given rise to the term "golden age", when the whole potential of the technological revolution and its techno-economic paradigm are deployed across the economy, led by the longer-term criteria of production capital.

Historically, *Installation* and *Deployment* have lasted around 20 to 30 years each, displaying deeply different characteristics.[27] Between these two periods, and after the frenzied bubble at the end of Installation, there is a lapse of uncertain duration (from two to thirteen years, the last being in the 1930s in the fourth surge). During this lapse, or *Turning Point,*[28] the tensions left by the bubble need to be overcome. The way in which this is done, and the direction taken by the institutional changes and policy decisions, shape the ensuing Deployment period. The world now is traversing the Turning Point after the collapse of the NASDAQ in 2000.

The following section will examine some of the relevant characteristics distinguishing Deployment from Installation and the tensions that drive the shift from one period to the other.

Installation and deployment: different conditions and behaviours[29]

In the years preceding the first world war, there were in common use among economists a number of metaphors ... 'Money is a wrapper in which goods come'; 'Money is the garment draped round the body of economic life'; 'money is a veil behind which the action of real economic forces is concealed'...

During the 1920s and 1930s ... money, the passive veil, took on the appearance of an evil genius; the garment became a Nessus shirt; the wrapper a thing liable to explode. Money, in short, after being little or nothing, was now everything...

Then with the Second World War, the tune changed again. Manpower, equipment and organization once more came into their own. The role of money dwindled to insignificance..

Pigou (1949) pp.18-19

In order to find the source of the significant differences between the two halves of each surge, it is important to understand the power of the techno-economic paradigm in influencing the behaviour of all agents in the economy, from

25 The terms financial capital and production capital are used in the great surges model to represent the two complementary agents of the market economy: those that function by allocating or reallocating wealth in the form of money or paper assets and those that operate as generators of wealth by producing goods or services. For a full discussion, see Pérez (2002), Ch. 7.
26 For a discussion of why technical change occurs by revolutions, see Pérez (2002) pp. 27-32.
27 A figure with the approximate dating of the five surges and their periods can be found in Pérez (2002) p. 57.
28 Pérez (2002) Ch. 11 and Epilogue.
29 This section is based on Pérez (2002) Chapters 8-12.

engineers and managers, through investors and bankers, to distributors and consumers. In the process of Installation, the shared common sense of the new paradigm becomes embedded in the minds, in the actions and in the market behaviour of all the economic agents and rooted in the territory, lowering transaction costs through the infrastructural networks –of canals or railways, of telegraph or telephone, of ports and steamships or roads, airports and electricity or digital telecoms and internet. Further still, the whole institutional framework, from the forms of government policies, through the educational systems to the international trade and legal measures, the whole conditioning context for the operation of markets and for the styles of living and production is gradually made more and more compatible with the requirements for the full exploitation of the potential of that particular set of all pervasive technologies and their "common sense" paradigm.

When the potential of that surge is exhausted, the new one is articulated in circumstances that are unfavourable to it, because they have become over-adapted to the previous paradigm. That is why, it takes two or three decades of Schumpeterian creative destruction to demolish those obstacles and to prove the superiority of the new technologies and their capability to modernise the whole economy and increase its wealth creating capacities. Deployment is the relatively peaceful period after the battle has been won, when the paradigm has become common sense and all its advantages can be exploited, only to approach exhaustion in two or three decades and create conditions for the next revolution and the next turbulent installation period.

The basic differences

Since paradigms are all profoundly different, the battles waged to impose the new over the previous –both in the economy and in the minds and institutions– will be unique each time around. Nevertheless, with many caveats about its stylised nature, table 2 presents a set of features that, in general, can be said to distinguish the Installation and Deployment periods. History

Table 2. The different features of the Installation and Deployment periods

	INSTALLATION: From irruption to Frenzy Bubble collapse	**TURNING POINT: Recession, instability and changeover**	**DEPLOYMENT: From "Golden Age" to maturity**
Main criteria for investment	Financial; short-term. Stock market focus; aim for rapid capital gains (with any sort of financial instrument).		Long-term growth; production and market expansion. Search for dividends. Conscious of "fundamentals" and real long-term returns.
Industry structures	Fluid, changing, unstable, constant challenges to incumbents; many participants.		Increasingly stable; few firms (tending to form oligopolies). Successful business models identified; growing barriers to entry.
Competition	Very intense, survival of the boldest: exploratory process; definition of dominant designs and best business models.		Tempered by stable industry structures; battle for share of a growing market with dominant designs established.
Innovation	Constant, both real and sham. Forced by investor expectations and by fierce competition Accent on supply-pushed new products and services.		Mainly real, in both products and processes; continuous improvement, driven by profit seeking and market expansion requirements.
Productivity	Divergent by sectors and within industries. Natural consequence of the power of the new paradigm in the new sectors.		Converging onto a higher plateau within and across sectors. Conditions for a conscious and successful drive to improve it in all sectors.
Target markets	Very concentrated on top of the pyramid. Increasing sophistication.		Wider and wider segments (homogenised or diversified depending on the paradigm); increasing functionality.
Income distribution	Increasingly polarised: new rich, richer rich and poorer poor (persons, firms,regions).		Improving distribution; incorporating more and more layers and regions into prosperity.
Social climate	Individualism; complacency of the rich; increasing resentment of the poor; violence brewing.		Growing social awareness; increasing "good feeling" opening of opportunities for the excluded. Conditions for peaceful growth.

Source: Based on Pérez (2002), chapters 5, 8-10 and 12

can never be put into neat and tight boxes, but the processes of abstraction that select aspects associated with deeper causal chains can provide useful heuristics for approaching the analysis of complex socio-economic processes. This whole section is written in that spirit.

The main criteria for investment initiate the table because they indicate the essential distinguishing feature of the two periods: the difference between the aims of financial and production capital, which are the leading agents in one and the other period. The criteria driving growth during Installation are those aimed at short-term quick gains through negotiating with paper assets. In Deployment, it is the accumulation of wealth creating power in the form of production capacity –be it railways or a fleet of steamships, of several major manufacturing plants or of thousands of experts organised in a service producing company. It is not the stock market index but the steady flow of dividends, together with the growth of production, employment and GDP that manifests the reality of that growing power.

The differences in industry structures and forms of competition are related to the exploratory mode in which all technological revolutions develop at first. It is market competition that determines the survival of the fittest. But once the process has resulted in defining patterns of production and consumption based on the new paradigm, Schumpeter's defence of oligopolies comes into its own. It is difficult to make and put into effect long term plans of investment, growth or R&D under cut-throat competition conditions.

Thus the approach to innovation will be different in the two periods. It will go from high-risk "technology push" to more demand-pulled innovation in products and services as well as to greater attention to process innovation for accompanying market expansion.[30] This will influence productivity, which during Installation changes very unevenly across and within sectors. During Deployment, as the paradigm diffuses more evenly across the production spectrum[31] and the transaction costs of the whole economy benefit from the growing externalities provided by the infrastructure and better services, a synergistic process generates a more convergent trend towards higher productivity levels across the board.

Finally, the last three aspects indicated in the table are interrelated around a very important process that characterises the installation period: the polarisation of income. The extraordinary profits that become possible with each set of revolutionary technologies generate –with the intermediation of the financial agents of the period– a sort of whirlpool that gradually attracts all available money (from the host country or from abroad) towards those new technologies and to the geographic regions where they are developing.[32] This concentration in certain sectors and regions starves the excluded of investment funds (until they are forced to modernise with the new paradigm and join in, if they can). It also generates a centrifugal effect in the value of money separating the richer and richer asset owners from the poorer and poorer salaried and waged portions of the population. The latter are even worse off, given that some of the old industries have been made obsolete and eliminated by the new, while those that have survived are modernised through greater productivity and process changes, which lead them either to shed labour or to replace part of it with different skills (sometimes higher, sometimes lower skills, but often different from those of the incumbents).[33]

This polarisation of income will be at the

30 This shift of focus was shown by Abernathy and Utterback (1978) in relation to individual technologies.

31 See an article by Hamm (2005) in Business Week, for an example of applying Toyota type methods for productivity increase in a service company doing outsourcing in India. This sort of cross-pollination of organisational models from sector to sector occurs also as personnel moves from one company to another and the new paradigm is increasingly socially assimilated.

32 The process overshoots the mark and soon there are not enough projects to absorb the money coming to the feast. This leads to excess investment (canals or railways from anywhere to anywhere; dot com proliferation or unused fiber optics) but also and very importantly to the creation of other instruments that will artificially offer equivalent profits (futures, derivatives, pyramid schemes, and so on). It is this combination that generates the hyper-inflation of assets that is characteristic of the bubble.

33 See Freeman and Soete (1997) Ch. 17.

source of the most important economic tensions and socio-political pressures that will have to be faced and overcome in order to unleash the deployment period.

Since the contrasts in innovation, target markets and investment criteria will be particularly relevant for discussing globalisation and respecialisation in the current paradigm, it is worth taking a closer look at those aspects.

Shift in innovation and target markets

A regressive income distribution has a particularly pernicious and unexpected effect in relation to the direction of innovation. Increasingly, the solvent markets that are available to acquire and test the new products are those at the top of the income scale. This is the normal course of events in many consumer product industries and happens with most experimental products at all times. At first companies "cream" the expensive range, by aiming at the top of the income scale to get back some of the RD&E and introductory marketing expenditures. Then they move on to the wider markets with higher volume production and reduced prices. The problem is that if income is strongly skewed, as happens at Installation bubble times, then the wider markets are not available no matter how low the prices. This forces a high rhythm of innovation trying to force rapid obsolescence in order to convince the same high income consumers again and again. This happened in the 1920s with automobiles, radios and electrical appliances and in the 1990s with ever more powerful and smaller computers as well as with ever more versatile mobile phones. In both historical cases, though, markets for the new industries reached what can be termed *premature saturation*, as those top income layers of the population became less interested in having more technological gadgets or in once more upgrading the products they already possessed and began to turn to exclusive luxury goods and services (what Veblen referred to as "conspicuous consumption"[34] writing during the Installation of the third surge).

From creating to spreading the new lifestyles

However, in practice, the concentration of income growth in the upper strata during Installation has two great advantages for the new producers: it provides markets ready and avid for experimentation with the new products and it gives the opportunity for setting the new standards and components of "the good life". Both the products and the style of life that incorporates them will become the aspiration of the rest of the population. Prosperity is likely to depend on the expansion of the markets of the core industries of each revolution, since they will be the ones capable of serving as the engines of growth of the economy. But if institutional mechanisms to redress the income imbalances are not introduced, those wider markets will not develop.

One of the main features of the Deployment period is precisely market expansion, both due to the further reach of the infrastructure and to important modifications of the market context through the introduction of policy measures to facilitate market growth in the directions required by the paradigm.[35]

These changed conditions for the deployment period, will also modify the direction of innovation. Once the paradigm is established and the styles of life and main business models are more or less known, the core industries begin to make the transition from "supply push" innovation, of the sort that needs to create new markets by educating consumers and producers to a completely new way of functioning, to more of a "demand pull" model, where attention moves towards trying to fulfil consumer and producer's needs by completing the new life and production

34 Veblen (1899).

35 For a further discussion of paradigm-guided institutional innovation, see Chapter 13 in Pérez (2002).

styles with interlinking innovations or improving the ease of use of the existing products through complementary services and so on.

Thus, while Installation saw a strong concentration of innovation in the core industries and their surroundings –including the basic modernisation of the rest of the industrial structure–, Deployment will see a shift towards a wider range of innovation spaces while weaving a more harmonious and interlinked fabric of the economy.

The main innovation spaces are likely to be for new products, services, process technologies and business models:

- in the core industries (ICT in the current case), with further "user-oriented" applications for both producers and consumers,
- in the modernised industries, profiting from further applications of the new technologies and the new paradigm, changing their product profile and advancing their own technological frontier,
- in what can be called the induced branches that flourish by supporting, complementing and interlinking the fabric of the new economy and,
- in the radical new technologies that could become the next technological revolution.

The last two merit special attention here, the induced branches because their importance for employment may warrant measures of directed support, and the radical new technologies – which in this case would be especially nano- and biotechnology– because the great surges model provides an interpretation of their role that can also be useful as an input to policy making.

Complementary role of the induced branches

The induced branches are a typical phenomenon of Deployment. They consist of all the activities that facilitate the functioning of business in the new conditions and the massive adoption of the emerging styles of life. In the mass production paradigm these induced branches were related to the intense agglomerations of the high-rise cities and to the sprawling suburban way of life; especially construction, retail trade and services. It could be inferred that in the ICT paradigm the induced branches may be linked around the requirements of the Knowledge Society and the global economy. Among the activities associated with the first would be education and training, intermediation in the use of the Internet, health, leisure and all the creative industries and services of what we could call "good taste" in food and decoration, which have become central aspects of the new style of living. Those in connection with the global economy are likely to include the systems of physical distribution of the objects of e-commerce and the environmental industries, among others. One important aspect of the induced branches is that they tend to absorb the layers of unemployed created by the higher productivity in the new or modernised industries.

Not all the induced activities imply innovation coming from R&D. They may be more of the organisational kind, perhaps in the form of new business models or they may involve design and creativity. What is very likely is that they will become active markets for the products and services of the engines of growth of the time. The "Laundromats" or the local food stores with refrigerators that accompanied the suburban living styles of the 1950s used electrical appliances and electricity services and served as test beds (and user training) for home washing machines and fridges. Something similar is likely to happen with the role of ICT in rendering efficient front end services of many sorts to people and businesses. What these new companies will certainly involve is entrepreneurship and risk. Given their probable role in creating employment, the mechanisms to facilitate their emergence can make an enormous difference for the rest of the economy and for the general welfare of society.

Gestation of the next technological revolution

The historical precedents allow an informed guess around some combination of biotechnology, bioelectronics, nanotechnology and new materials. As in previous cases, the future technologies begin –in what later is understood as a primitive form– in the midst of the dominant paradigm. They are shaped by it and at first depend on the type of markets it has created. Stationary steam engines were successfully used to move the locks of the very canals that steam powered railways would replace in the future. Semiconductors were profitably used during the mass production paradigm to make radios and other appliances portable and for the huge centralised mainframe computers. The companies that incorporated them in their products were extremely successful, but no one could have imagined laptops, mobile phones, i-pods or even e-mail, without the major breakthrough of low-cost microprocessors.

These industries in gestation, in contrast with the induced branches, do increasingly rely on scientific research and are characterised by very high risks. They tend to require government –or private– subsidies in those costly early stages. It is thus crucial for both venture capital and governments to acknowledge that their rate of success is likely to be very much lower than that of any products of the current information revolution[36] but also to recognise that successes can be extremely profitable and will be a welcome contribution to growth. In addition, the resulting alliances and connections as well as the efforts themselves will strengthen the required links and capabilities to advantageously participate in the surge that may irrupt two or three decades hence.

Shift in investment criteria

One of the most salient characteristics of the bubble economy at the end of Installation is the high rate of return in the stock market, be it in the form of capital gains when reselling stock or as returns on the many other forms of derivative investment that are typically invented –or reinvented, as Galbraith[37] shows– in order to artificially spread to all financial investment the levels of profit obtainable in some of the core new industries. As in the 1990s, 1920s, 1880s-90s, 1840s and 1790s there is a "love affair" with technology and innovation, which almost guarantees high profits to investors in the new things even if the actual firms are not even breaking even or, in some cases, are still in the building process, as happened with many canals and railways. The dot.com bubble is perhaps the most extreme example of financial benefits without real productive backing. Many of the IPOs left the financiers with a huge gain and the entrepreneurs with a doubtful product and a company which could soon go bankrupt.

That casino atmosphere orients investment towards short-term gains and does not really engage the investor fully with the company whose equity is being acquired. Often in fact, given the aggregate nature of investment funds, many investors have no idea which companies their money is going to.

The collapse of the bubble usually brings back some sanity into the direction of investment while investors again seriously watch the so-called "fundamentals", which somehow serve as indicators of the true health of the companies. An equivalent phenomenon is bound to take place in the practices of the publicly traded companies themselves. During the bubble, they are pushed to attain the unattainable: profits at the same level as in the core industries of the technological revolution quarter after quarter. They may attempt to achieve this by cutting personnel below what would be optimal or by selling assets or, if no legitimate means remain, then… by accountancy tricks and outright fraud.

36 See an assessment in Nightingale and Martin. (2004)
37 Galbraith (1990:1993) pp. pp.5 and 18.

Deployment, by contrast, sees investment become more sober and rational. The companies that emerged successful from the installation period invest to expand their scale of production and markets and to increase their productivity. The larger ones are likely to pursue mergers and acquisitions to stabilise markets in their industry and to occupy strategic territories to strengthen their competitive positions. There is a clear long-term view among decision-makers and innovation becomes a complement of such strategies.

This switch in investment behaviour has a positive overall effect on the productivity performance of the economy, which is an issue of particular interest, not only in terms of potential growth and competitiveness but also because of its major influence on the capacity of a society to increase the economic and social welfare of its population.

The turning point as the space for the role-shift[38]

The discussion of the differences between the two halves of each surge opens the question of how the shift occurs between an economy led by finance capital and increasingly focused on the stock market and one where markets, expansion, full employment and growth take centre stage, with production capital at the helm.

It is precisely the tensions and instabilities that are the legacy of the frenzied bubble years that create the conditions for a shifting of roles, usually with the intervention of State regulation to control the excesses of finance, to counter its short-termism and to favour demand expansion and stable long term investment in production. That is the reason for the term *Turning Point,* referring to the tilting of the field away from favouring paper assets and towards favouring the flourishing of the real economy.

The world has been at that defining stage since the collapse of the NASDAQ in April 2000. The strategic and policy decisions taken to face its consequences by firms, governments and supra-national institutions will determine the way in which the potentials of ICT and its paradigm are deployed as wells the main trends in geographic and social distribution of production and wealth.

Positive legacy of the bubble: conditions for full expansion

Towards the end of Installation, in the midst of the bubble, the successful participants and their entourage celebrate the times as extraordinarily prosperous due to fundamental changes in the economy. In fact, on every occasion, the idea of a "new economy" has been advanced in different ways. In 1929, a couple of months before the crash, the so-called *Hoover Report* was at pains to argue against this widely held belief by showing that what was happening was nothing really new but only the intensification of pre-existing trends in the US economy. And yet, much of the report is dedicated to celebrating the newly achieved solid prosperity.[39]

Though the basic rules of the economy do not change during the bubble, by the time it collapses the economy is usually ready for the full flourishing of the wealth creating potential provided by the new paradigm. There is enough infrastructure for a decade or more (because bubbles are generally associated with overinvestment in the new networks), the new paradigm has been accepted as 'common sense', successful production, consumption and business models have been tested and copied, the winning companies in the core industries have become the new entrepreneurial giants and are ready to serve as engines of growth for the whole economy, while most of the old giants are rejuvenated. The new paradigm has been installed in the territory, in the economy and in the minds of the participants; the job of financial capital is done. It is time to rein it in and to hand control over to production capital. But that is easier said than done.

38 Pérez (2002), Ch. 11.
39 Hoover (1929).

The Installation period led to those results through a process of massive credit creation[40] that attracted, created and destroyed millionaires in the process of making the highly risky experiments required to define the trajectory of the technological revolution. The belief that those extraordinary profit levels are due to the free market itself (and to the entrepreneurial genius of the actors and investors in it)[41] rather than to the opening of a major new innovation space, is by then deeply rooted in the minds of most of the economic and political "elites", but especially among the successful participants.

What prepares the terrain for accepting the policy measures that will achieve the shift and unleash the deployment period for the benefit of the many are the tensions inherited from the bubble period, which gradually become serious obstacles to growth, resulting in political pressures that may lead to a consensus about the need to overcome them. It is only by doing so that society can pursue the social welfare potential implicit in the higher levels of wealth and productivity attainable across the board with the new paradigm.

Negative legacy of the bubble: three tensions making obstacle to growth

The building of the technology-spurred financial bubble generates very serious distortions of the economy, which involve three tensions that gradually intensify during Installation and become exacerbated with the bubble: [42]

Tension between the paper and the real economy

The first tension is the very essence of the bubble: a process of asset inflation in which the stock market (paper) values decouple from the real value of the companies they represent. Thus, rather than from dividends, profit gains come from reselling the assets or from participating in the many instruments (futures, derivatives, hedge funds or others) that are created in the casino economy that builds up during Installation.

Once the bubble collapses, this tension should disappear and the values should come back into line. The major losses bring the investors back to reality and the losers are likely to press for regulation. However, if the collapse is not big enough (as the author believes was the case with the NASDAQ in relation to the whole stock market) and/or if a healthy investment climate is not re-established after the bubble by an exemplary combination of punishment of fraud and "remedial" regulation, then the distorting influence of the financial world's short-termism will weigh upon the economy and against growth.

At present, the CEOs of production companies find it extremely difficult and risky to embark upon long-term projects, not because of competition but because of the continued short-term profit pressures of the finance world.

Tension between the size and profile of effective demand and those of potential supply

The second tension occurs in the market and is the consequence of the polarisation of incomes. It means that as long as the strongly skewed income distribution remains, the potential supply of the products associated with the technological revolution will be disproportionately larger than effective demand. In fact, the range of products and services that are possible with each paradigm could cater to a much wider profile of users than those targeted during Installation. As was discussed above, this polarisation ends up in *premature market saturation*.

This tension however is not necessarily overcome by the collapse of the bubble. On the

40 Pérez (2004).
41 Galbraith (1990:1993), pp. 20 and 95.
42 Pérez (2002), pp. 111-118 and Epilogue.

contrary, it can be exacerbated by it, because it effects major destruction of wealth in the most active section of a highly polarised market.

It generally has required government policies to begin redressing the balance by putting more money into the hands of middle or lower income consumers, be it through salary increases, job creation, tax policy, free education and health (thus freeing consumption income) or whatever redistribution measures, national or international, are appropriate to the specific paradigm. The Marshall Plan, established by the US to help rebuild Europe after WWII, did exactly that –together with the Welfare State– by expanding the markets that fed growth in the deployment period of the fourth surge.[43]

In this particular surge, the outsourcing and off-shoring to China and India can be seen as a "miracle cure" for the advanced countries, especially for the United States. Not only do these practices reduce costs and lower prices to expand effective demand in the previously saturated markets, but also –and perhaps most importantly—these highly populated countries have become rapidly expanding markets in their own right. [44]

As a result, the social problems at home can be ignored –and even increased through greater unemployment and downward pressure on salaries– while the paper economy can continue producing asset inflation (through housing bubbles, derivative mountains, hedge fund pyramids, etc.) and intensifying the income polarisation between the asset holders and the wage earners.

***The political tensions between the poorer poor and the richer rich*[45]**

This third tension is the inevitable social consequence of income polarisation. It is of a political nature but can have great influence over the course of the economy. The chasm between the richer rich and the poorer poor is not just about the profile of income distribution but about the direction in which that profile changes in time. What happens during Installation is a centrifugal process that gives a disproportionate share of the benefits of growth to those at the top of the income scale and leads to an actual worsening of the situation in the lower ranks of the scale.

Figure 2 serves to illustrate the sorts of processes that take place during Installation and Deployment. It shows the intense increases in the relative wealth of the top 0.1% of income earners in the US during the two Installation bubbles (of the 4th surge in the 1920s and of the current 5th in the 1990s), where this concentration reaches nearly 11%, while the moderation down to below 6% in the Deployment period suggests a reversal of the polarising trend and an improving distribution.

This overall trend can also be seen in the behaviour of the Gini coefficients of inequality, which have risen during the Installation of the present surge in both advanced and emerging countries (with some interesting exceptions), while they had generally been decreasing in the previous Deployment period.[46]

The phenomenon is partly due to the increasing disparity in the values of assets vs. wages and partly to the uneven spread of the new industries and to the equally uneven destruction of pre-existing industries and jobs brought about by technical change and intense, often cut throat, competition.[47]

43 The European Union in the current fifth surge applied successful redistribution measures in the early period helping to lift Ireland and Spain as they joined. For an analysis of the consequences of abandoning that policy see Reinert and Kattel (2004). See also Reinert, Chapter 7 below.

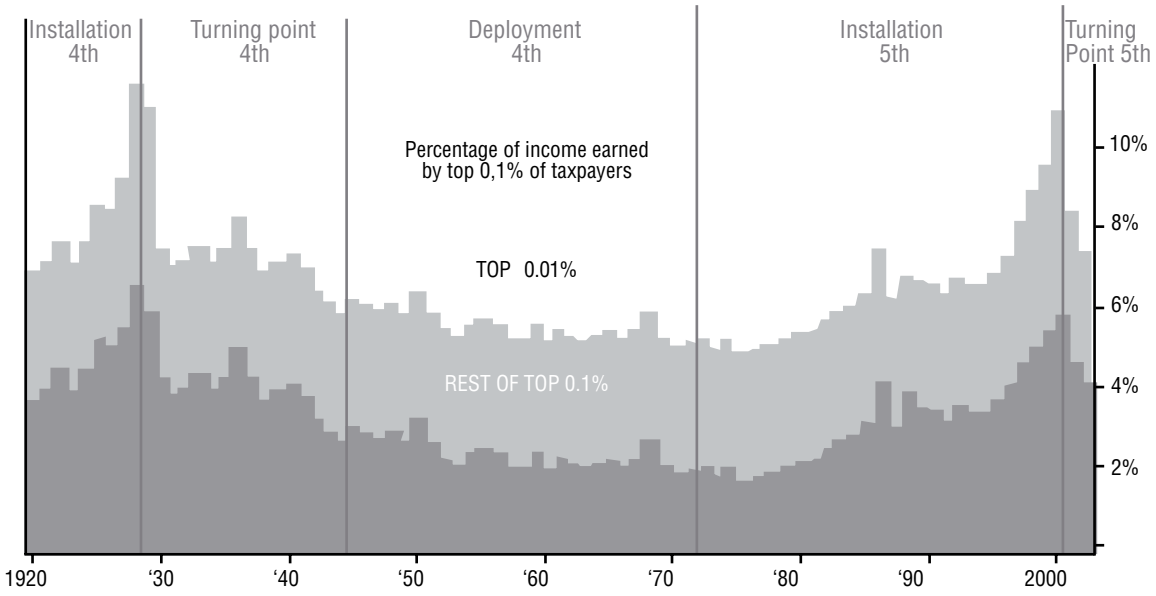
44 In addition, the reinvestment of the commercial surplus of China, Japan and others in the US financial markets, has created a virtuous cycle between the US and Asia that could turn vicious if something went wrong.

45 Tylecote (1985) called attention to the relationship between trends in income distribution and overall growth patterns.

46 See the WIDER-UNU (2005) database on inequality and Atkinson (1997).

47 See Freeman (2004). For the impact in the developing world see Palma (2005).

Figure 2. Variation in the share of the nation's income earned by the top 0.1 percent of U.S. taxpayers 1920-2002



Source: Johnston (2005) in The New York Times (based on US Treasury data) . See also Piketty and Saez 2003. The great surge period indications are by the author

What Installation leaves in its wake is the resentment stemming from downward mobility in the face of affluence. The conviction that "my children will be worse off than I have been", confronted with the conspicuous consumption at the other end, results in loss of hope and breeds anger, violence, problems of governance and an increase in the attraction power of messianic leaders who thrive precisely on intensifying that resentment.[48] There are also migratory pressures, as the most positive among the excluded run unimaginable risks to reach a place where –often accepting unacceptable conditions– they can hope for a better future.

At this Turning Point, the phenomenon is of a global nature, both in terms of where it takes place and in terms of access to means of communication, information and transport. These can exacerbate the consequences as well as the reactions to them.[49] Whole regions of the planet have been excluded and allowed to descend to the levels they had forty years ago; other regions have been marginalised such as most of Latin America where there has been a reversal of many of the achievements of the 1960s and 1970s[50]. But, through organised terrorism, the violence fed by global polarisation has reached the advanced countries too, while the internal income disparities have begun to surface in various forms of political rejection.

Free markets as intensifiers of the problems

Though Installation may indeed have created all the conditions for unleashing Deployment, it also resulted in these three tensions that can in practice turn into formidable obstacles to growth. Overcoming them becomes therefore imperative for society and for the economy.

48 As was the case with Hitler, Mussolini and others in the previous surge.
49 See Kaldor (1999) for the emergence, across the uneven global scene, of what she calls "new wars".
50 Palma about reversal of income achievements of 60s and 70s.

What cannot be expected is to achieve this result by the action of the markets alone. Since the tensions are already the consequence of the free market, its continued unrestrained action will only make them worse. Left to themselves, free markets will continue taking production to China and India and feeding the housing, derivatives and hedge fund bubbles; they will continue putting pressure on companies to have high profits every quarter by whatever means and they will keep well away from the impoverished, within their countries and abroad.

This means that there is bound to be an increase in economic instabilities as well as in various forms of political unrest, from the anger of those losing their pensions (or their mortgaged homes in a bubble collapse) to outright violence from abroad or from within.

That is why such imbalances must be confronted through government intervention. Yet trying to halt globalisation is a self-defeating goal. The complex processes ahead need the action of free markets; no other agency could do the job. However, there is enormous scope –and need– for changing the context for the action of markets and reversing the conditions that may lead to further bubbles, through setting up an adequate institutional framework –in the current case, national, supra-national and global. Without such a framework, the growth potential already in place cannot be fully deployed and the present instabilities are likely to increase with possible catastrophic consequences.

Globalisation, market segmentation and the nature of the ICT paradigm

One of the basic features of this paradigm is the trend towards globalisation, which is a consequence of the characteristics and the potential of information and telecommunications technologies.

It may be useful to make some parallels with the first globalisation in the third surge –from the 1870s to WWI[51]– since similar features were present in the technologies. In both cases, the nature of the infrastructure facilitated –and indeed induced– global reach in those industries and activities that can most benefit from such world-wide externalities. In both cases, the opportunities were taken and investment from the centre led to significant leaps forward in faraway countries.

A look at the two globalisations

During the third great surge, the advent of cheap steel allowed the development of three infrastructural networks that made world markets a practical reality: trans-continental railways by land, rapid steamship transport by sea and global telegraph along the rails and by undersea cables.

The extraordinary possibilities offered by these communications technologies opened the markets of the North to counter-seasonal Southern hemisphere products. Refrigerated ships (using ice blocks from the Antarctic, for instance) facilitated developing Argentinean and Australian wheat and meat production for the world markets, while they could bring locomotives, steels rails and other equipment on the way over. And once those railway and sea routes were established it was easy to use them for other products in both directions and to incorporate neighbouring countries: New Zealand, South Africa, Chile (first exporting saltpetre as natural fertilizer and later copper for electrical networks) and others.[52]

Much of the early development in railways and ports in these countries was organised by the local governments and financed by the City in London, which gradually also organised the raising of equity funds for private projects, often promoted by foreign companies.[53]

51 There is an overlap of about ten years between the third surge and the fourth, which begins in the US rather than Britain with the model-T in 1908. Pérez (2002), p. 56.

52 Wells (1889:1893), Hobsbawm (1987:1989).

53 A major study of this period is Davis and Gallman (2001).

In that case, the bubble economy developed mainly in these emerging countries or in relation to investment in them. The Baring crisis of 1890, for instance, related to their investments in Argentina but practically brought down the whole British stock market.[54]

What is important for our purposes is that the provision of major externalities for the formation of global markets led, in fact, to worldwide mobility and price competition for agricultural and meat products and influenced the location of production and the expected productivity levels. Meanwhile, international cartels and/or giant multinational firms were forming in the control of the infrastructure and in the basic materials industries, such as oil, steel, copper and others.

Another aspect of interest to note is that though Britain was the unquestionable leader of that globalisation, with the Gold Standard, the Bank of England and the Stock Exchange as the centres of global finance, it failed to complement that global drive with equally intense investment at home in the core industries of that revolution: chemistry, electricity and steel. By contrast, the US and Germany did concentrate in those industries while they also participated in the globalisation process. These two countries ended up forging ahead of Great Britain.[55]

Historical parallels do not lead to predictions; every paradigm and every set of circumstances is unique. They merely provide a useful frame of reference which points to aspects that may merit attention when analysing the corresponding period in another surge. The experience of the third surge shows that a powerful set of technological and infrastructural conditions facilitating worldwide expansion can function as an irresistible driver for global investment and trade. It gives a precedent showing that some well-endowed countries with appropriate policies can experience intense processes of catching up or forging ahead in connection with globalisation and the new technologies. It may also serve to warn that building finance-based empires abroad while neglecting advanced production investment in the home economy could later bring very unfavourable consequences.

The ICT paradigm and globalisation

The bottom row in Table 1 above, briefly summarised the main features of the current paradigm, shaped by the requirements and the potential of the Age of Information and Telecommunications. As tends to be the case, they are a coherent set of mutually reinforcing principles. *Knowledge capital and intangible value added* facilitate *heterogeneity, diversity and adaptability*. these in turn lead to -and interact with- the *segmentation of markets and the proliferation of niches*. *Globalisation* leads to the *interaction of the global and the local*, both in terms of comparative advantages for production and innovation decisions and in terms of adaptability of global products to local markets. Production is then conceived in a complex range that may go from "mass customisation" achieving *economies of scope and scale* to multiple niches geared to attaining *economies of specialisation*. These complex production and market profiles are achieved through *decentralised integration* and *network structures*, which characterise the organisation of giant global firms across the planet. Such complexity is made possible and efficient by the ease of *instant global communications,* allowing *instant contact and action*.

Still, the question may arise as to why globalisation should be inevitable. The answer is that reaching for giant global markets is a direct consequence of applying and taking full advantage of the potential and characteristics of information and telecommunications technologies (ICT). Intangible products, not only recognise no physical frontiers by travelling instantly and

54 Powell (1915:1966) p. 522.
55 For a discussion of this issue see Freeman and Louçã (2001) pp. 248-256.

invisibly through communications channels, but also have no marginal cost (or it is negligible) and no structural limit to market growth. Yet they often have high research and development investment. Moreover, the greater the number of users of a particular network or product the greater its value and the lower the price of it can be, while maintaining growing profitability.[56] Such features provide a very powerful incentive to overcome the limits of any national market, no matter how large.

In terms of the size of firm that can be accommodated, ICTs offer coordination capabilities that go well beyond the maximum size that the old international or transnational corporations were able to achieve with their pyramidal structures. Not only is it now possible to guide, monitor and control a truly giant organisation when it is networked, but territorial coverage and organisational complexity are relatively easy to handle with ICT and are likely to become much more so with further adaptive innovation. The technology itself is all-pervasive and can be incorporated into the most sophisticated processes for biotechnology, nano-technology or space travel as much as into the most traditional production systems, from global geo-positioning of sheep to information about fishing conditions for small fishermen.

But the maximum size of market for intangible products is defined by how far and how deeply the possession of adequate hard and software and the existence of communications links has reached, both socially and geographically. This means that hardware and telecom networks penetration are the true market frontiers for the ICT industries, rather that the digitally transparent territorial ones. The reach of such networks also constitutes the frontier of the "global" economy.

Thus, in relation to the size and scope of global firms, the logic of the potential leads toward assessing the whole planet for comparative advantages and estimating production, transport and transaction costs "as if" the economic space were unlimited and –through investment in the ICT infrastructure– making sure that it is so.

In this respect, it is interesting to note that out of the ten forces that Tom Friedman identifies as the triggers of globalisation (or, as he says, of the flattening of the world), nine are either major ICT innovations or business behaviour changes based on ICT. Only the fall of the Berlin Wall is outside those categories.[57]

ICT and the hyper-segmentation of markets: outsourcing and off-shoring

Precisely because of the nature of ICT and the sort of flexibility it facilitates, globalisation is not necessarily about moving whole industries or companies to other countries, but rather about disaggregating them and relocating the segments. Seen from the point of view of a global corporation, as is well known, the process involves disaggregating the business into processes and these into ever more precise activities in order to assess their requirements, decide where each would be most efficiently and profitably performed and then finding the most effective ways of coordinating the resulting complex network that would span a good part of the planet, with infinitely varied nodes and many different types of links.

These outsourcing practices take place within the countries of origin and across frontiers and they multiply the opportunities for specialised micro-, mini-, small and medium firms, to perform activities that range from the most sophisticated R&D projects to cleaning services or call centres. They also represent a source of market growth for the ICT industries. Both the disaggregated activities themselves and the links between them and the rest of the value network are almost

56 These changes are the real nature of the "new economy" and not an everlasting bull market, as many believed in the late 1990s. See Soete (2000) about the new economics of the new economy and Kelly (1998:1999) on the "new rules" governing market behaviour in the ICT industries.

57 Friedman (2005) pp. 48-172.

certain to make intensive use of ICT to maximise efficiency and minimise transaction costs.

Yet the industries that are being so disaggregated are at the same time catering to what are becoming hyper-segmented markets. The new potential for diversity and adaptability is dividing all industry markets in a kaleidoscopic fashion, where the bottom segment (which is the bulk of production in terms of volume) is the standardised, low price, narrow-profit-margin part of the market. Above it, there are the medium range segments gradually differentiating through innovation and/or brands, all the way to the splintering of the topmost range into multiple high-value specialised segments, adapted to specific sets of users and following their preferences. And this applies as much to what used to be considered commodity markets, which were primary sector raw materials, through manufacturing, to services. "Boutique" specialised steels are not commodities, whereas standard desktop computer components and call-centre services definitely are (see examples in figure 5 below).

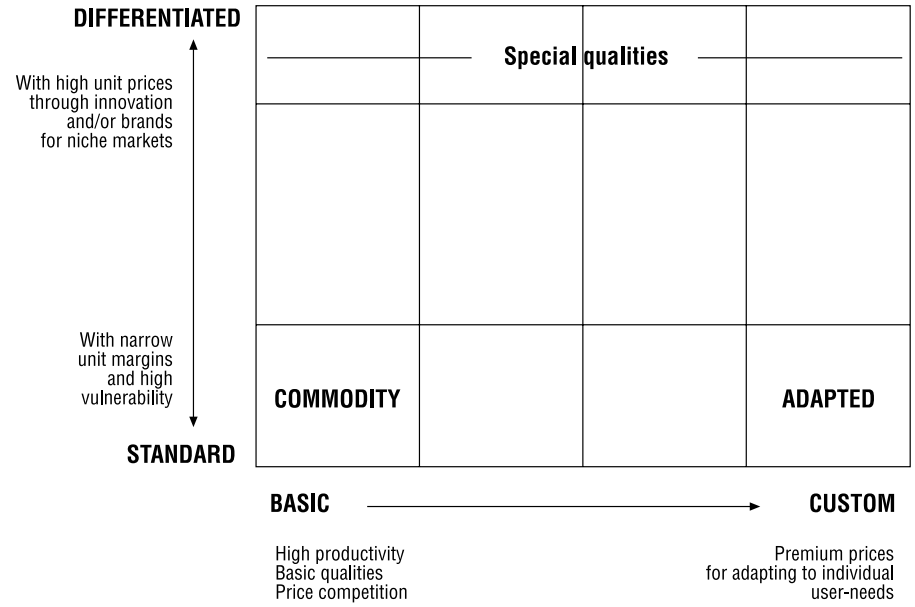
This new potential for upgrading raw materials, not by fabrication but by achieving special qualities that will command a premium –and more stable– price, is seen by Kaplinsky[58] as an important window of opportunity for producers to escape the vulnerability of most raw materials markets.

At the meso level, this diversity dimension leads to diversified industry structures, where certain segments can be "sold-off" to a company in a country with decisive comparative advantages for that segment; others can be kept as core activities of the large corporations, while others may become the province of truly specialised small companies. There are likely to be redefinitions of traditional industries, either by major splits or by technology-induced merging of previously separate industries. There are, for instance, growing segments of the textile industry that are producing highly specialised materials for sails or extreme sports, which increasingly separate them from their traditional industry base and incorporates them into the networks of the sports equipment industry.

One can further analyse the process by distinguishing diversity from adaptability. The latter could be defined as front-end customisation. It involves catering to the specific demands of each individual user. In that sense it would seem to be the opposite extreme of mass commoditisation. And yet, such products as Dell computers and "made-to measure" blue jeans are adapted to each user but made from commodity components. It is what has been called "mass customisation".[59] It also includes such products as SAP information systems, which make customised packages for companies on the basis of a set of standard modules or many software packages such as those for e-government functions, which also take advantage of the economies of specialisation and experience acquired in previous similar projects for other functions or other governments. At the other extreme one could find the Bilbao Guggenheim as a unique product designed by a uniquely qualified architect or the airport of a major city or perhaps a specialised instrument for use in a new nanotechnology product or any R&D project requiring experts, but also products that, though being in a traditional industry are unique in themselves, like tourism in the Vatican or boating in the Grand Canyon. In between, there are the many services that require personal contact with the client and/or the premises, such as the installation, maintenance and service front end of many products. The modular furniture to build a beautiful kitchen may be manufactured at a great distance, the actual design for the particular kitchen could even be done by Internet, but the transportation and the installation can only be done in place. This sort of case will become more and more typical of many complex products for both businesses and consumers.

58 Kaplinsky (2005).
59 Davis and Pine (1992).

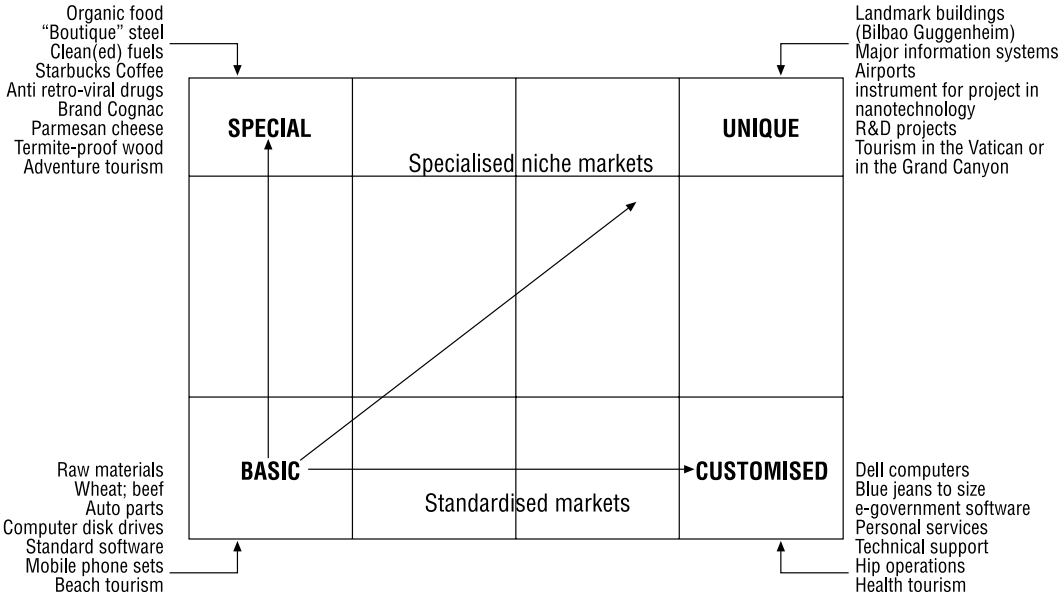
Figure 3. Market segmentation and its differing conditions from raw materials to all manufacturing and services



It is important to note that what opens the possibility for developing niche markets and customised products is the shift towards intangible value characteristic of the ICT paradigm. Both the creativity that leads to differentiation and the special services that accompany the specialised or customised product or service are part of the general trend towards privileging intangibles as sources of value. During the mass production paradigm neither the market nor the transport conditions favoured relatively small quantities of any good. Constant innovation was not facilitated as it is now by ICT, nor were knowledge-intensive services valued generally by the market.

Figures 3 and 4 are an attempt at mapping the dimensions of this hyper-segmentation and giving some examples. The distinctions in terms

Figure 4. Some examples of products in different market segments



of competitive factors for each type of market segment in each particular sector are of the utmost importance for companies in search of advantageous locations as well as for regions trying to position themselves as successful producers or attractive locations.[60] This way of understanding the impact of the ICT paradigm on the differentiation of markets is an essential input for the discussion of global respecialisation patterns.

As the processes of disaggregation and diversification become more and more complex and as the various competition factors in each segment become defined, so the relative advantages of the various regions, countries and companies become clearer for outsourcing and off-shoring. Thus, a feedback loop is generated intensifying the advantages of those initially successful in certain activities or segments, so that the assessment processes undertaken by various global companies favour them even further. This concentration eventually overshoots the mark and is, in turn, likely to generate new disadvantages that open opportunities for those discarded in the early rounds.

The challenge of respecialisation in a globalised world.

The policy dilemmas and the way forward

The process of globalisation has been both made possible and strongly induced by the potential and characteristics of the revolution in information and telecommunications technologies. In the early stages, from the 1980s it was mainly a question of tearing down all barriers to trade and finance. This in itself radically modified the map of world production, but it is only since the mid-1990s, and especially since the turn of the Century, that the real process of production globalisation has been taking place, though increasingly concentrated in the massively populated low-cost conditions of China and India.

At this stage, the advanced countries find themselves in a sorcerer's apprentice situation. The bigger and stronger the national corporations become by globalising, the greater the potential trade deficit, the more domestic unemployment problems this threatens to generate and the more unstable the economy becomes at home, while it is increasingly dependent on decisions taken abroad.

Neither free markets left to themselves nor setting up tariff protection can provide a sustainable solution. The former would ignore the unemployment problems in the advanced world and lead to serious political problems; the latter would bring loops of retaliation with unpredictable consequences. The only real solution is to lift all boats by moving globalisation forward to encompass more and more countries while also intensifying investment at home. This will open the space for growth by increasing demand and markets for all (while reducing the twin threats of violence and migration). Such a process supposes the respecialisation of the advanced countries, which is likely to require building a consensus vision involving business, government and society around a set of promising opportunities aiming at full-employment growth.

There are at least three forces creating opportunities for successful respecialisation in the advanced world, all within the conditions facilitated by the ICT paradigm:

- the increasing segmentation of each industry's market space,
- the "push" from globalisation,
- the "pull" from culture and quality of life at home.

Let us take a look at the possible effects of each.

60 For regions trying to position themselves as successful producers or attractive locations, see McGowan et al. Eds (2004).

Global redistribution of market segments in all industries

This process induces the positioning and repositioning of each company (and also of each region and country) in those segments where they have advantages of one sort or another.

The present "migration to China" does not mean that all of manufacturing will be globalised and the advanced countries will have "hollow corporations". The process of segmentation of all industries into commodity markets at one end and a proliferation of specialised niches at the other, will lead to a global distribution of segments tending to have the bulk of commodity production in the less advanced countries and the bulk of specialised niche production in the more advanced, with several countries in between (though every country is likely to have some proportion of each).

It should be clear that even in the mass production world of the post-war golden age, both the US and the main European countries produced the bulk of their domestic automobiles, but for the truly high end luxury or racing and sports car segments it was Europe that kept the expertise (Mercedes, Rolls Royce, Porsche, Aston Martin, etc.). Something similar happened in relation to motorcycles, where it was Harley Davidson, the US firm that supplied the super-specialised top end of the market.

In the present conditions, one can expect that most commodity segments of the fabricating industries will tend to go to Asia, those of the resource based process industries, are likely to go to Latin America, Russia, and other resource-rich countries. But each of these industries has a whole range of specialised segments, from those with medium complexity to those of very high complexity and customised. What is likely to happen is that the emerging countries will make every effort to climb up to higher value products and will succeed in some of them. This would leave the bulk of the higher end products with the more advanced countries and a certain proportion of them scattered in the rest of the world.

There is also likely to be an "80-20%"[61] distribution of the value chain in most industries: Coordination, R&D and design would tend to be mainly (but not only) in the more advanced countries; production would be mainly in the emerging countries, whereas the front end of distribution, technical services, maintenance and customising would be in each country in proportion to its consumption.

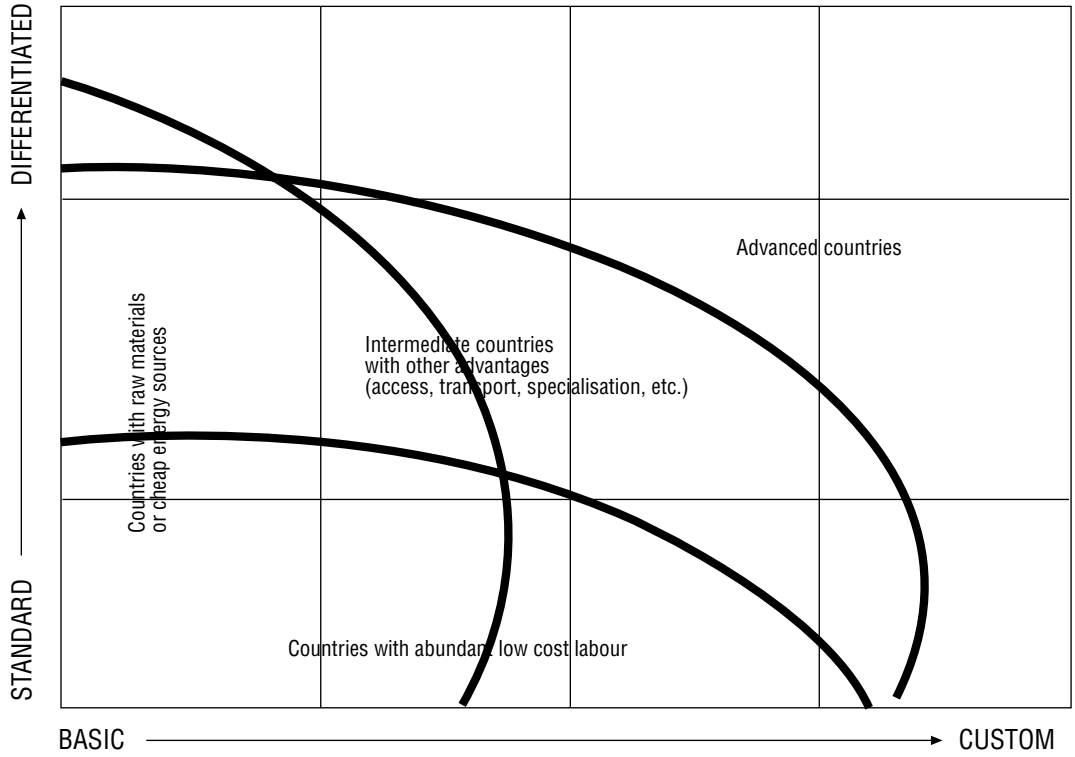
As mentioned before, the present obvious advantages that China and India have with significantly lower labour costs will be partly self-defeating through increasing the cost of raw materials and transport. This will gradually tend to require coordinating the *redistribution* of manufacturing across the planet (looking for proximity to raw materials and markets in those products that warrant it) in order to optimise overall costs. Such a process will open opportunities for the many "middle countries" whose labour costs are much lower than in the advanced countries but not as low as in China and India; who possess some highly skilled labour or access to crucial raw materials (for particular products) or to energy supplies or are close to important markets and have good transport systems.[62]

Figure 5 presents a hypothesis about the way that markets could eventually be distributed by type of country or region in a process of respecialisation. It suggests that global distribution of production may be more by type of segment than by type of product. Each country or region would tend to cover a much wider part of the spectrum than its segments of specialisation would indicate, but in smaller relative proportions. This wider range not only stems from the natural preservation of traditional strengths, but also takes into account the complexity of innovation systems. To specialise in niche agriculture without biotechnology or in the bulk segment of chemical industries without the capacity to build basic process equipment would make little sense.

61 This use of percentages is simply a convenient way of expressing a strongly skewed distribution, while trying to distinguish between 60-40, 80-20 or 95-5%.

62 The location of a significant part of European automobile "off-shoring" already announces that trend.

Figure 5. Possible trends in the global distribution of the hyper-segmented markets of each industry



Challenges and opportunities from "global push"

The globalisation process, by its nature, generates challenges and problems which turn into growth opportunities.

Global distribution and transport: Global dispersion of production for maximum cost efficiency plus the proliferation of e-commerce demands an urgent increase in the efficiency of global distribution, massively and door to door. The productivity of distribution is at present very low (while it is labour intensive and its energy costs are high). New systems of packaging,[63] transportation by various means and distribution will become an increasing proportion of the local, national and global economies.

Global coordination: The more complex the globalised networks, the more they will need various forms of coordination and management: supply chains, specifications, compatibility, research and design, global marketing, distribution chains, data sharing and storage, security, etc. This will in many cases be one of the main tasks of global corporate headquarters, but it will also be the object of service contracts from different parts of the world and one of the core services of independent networks. The latter could become the business model for strengthening the competitiveness of individual exporters all over the world.[64]

Major engineering: The more that globalisation advances across the world, the more engineering will be necessary to design and build infrastructures, from basic highways, electric utilities, oil ducts and transport systems to bigger projects such as hydroelectric dams, satellites, oil refineries, water treatment plants for growing

63 At present packaging is extremely intensive in the use of materials and energy (directly or indirectly). It could be expected that rising prices of both inputs may spur a wave of innovation in packaging.

64 For wide-ranging studies of the issue of systems integration see the work of the CoPS Project, of which Andrea et al. (2005) and Hobday et al (forthcoming 2006) are representative.

cities, bullet trains, major bridges and tunnels, intelligent buildings, major airports, automated port facilities, etc. Significant innovations in vastly superior transportation systems are likely to become an indispensable feature of a globalised economy.

Global contracting: The various processes related to global contracting are becoming more and more complex and will require specialist support, among them: organising bids and evaluating proposals; locating potential suppliers or customers and assessing relative advantages; evaluating the relative advantage of alternative locations; negotiating, preparing, applying and/or analysing contracts; monitoring commitments and projects; doing arbitrage in conflicts and many other similar or related activities.[65] This is already a big part of what big global corporations do and their demand for such services will grow. But next to it, a significant number of smaller companies entering the global arena will be requiring those services too and a growing demand for expert assistance will also come from abroad.

Global education: The more countries become involved in the globalisation of production, the more demand there will be for educational services. Up to now, the high level universities have been attracting foreign students in growing quantities, and a trend is beginning to emerge whereby that is combined with exporting education through expatriate teachers, university affiliates in various countries, internet-based or TV-based courses and degrees, teleconferencing, virtual systems training, etc. Equally, up to now, the transfer of technical skills is being done through internal corporate arrangements within global networks. Eventually, some of the displaced specialised and highly skilled workers in those segments of industries migrating from the advanced world could turn into highly paid international technology transfer specialists. In general, and depending on the policies adopted to stimulate it, the education industry is likely to grow in all its dimensions: formal and informal, preparatory and life-long, for individuals and groups, general and specialised, for work and for leisure, at a distance and person-to-person, in the public and in the private sector, local and global.

Environmental industries: The more China, India and other developing or ex-socialist countries industrialise, the bigger the environmental problems and the larger the market to prevent, moderate or overcome them. The advanced countries have the technological capabilities that can be concentrated in this direction and the most environmentally conscious populations. Yet, as was discussed above, the most powerful lobbies against regulation are also there: the present energy industry, the chemical industry, the automobile and air travel industries plus many minor ones from the mass production paradigm. The flourishing of the sector, which can be absolutely huge, will depend on increasing (and ever more stringent) national, regional or preferably global environmental regulation. This, in turn may ultimately depend upon the growing seriousness of environmental problems, the level of pressure from public opinion and the political will of the decision-makers in the advanced world.

The example of the environmental industries, as a major opportunity for growth which would also improve the quality of life for all, offers a powerful example of how policy actions or inactions can determine the context for market behaviour.

Opportunities created by "local pull"

The ICT techno-economic paradigm fosters two apparently contradictory trends: standardisation and adaptability. Both are global; both affect the local markets. They are, in fact, complementary and can even be combined as

65 This will pose the question of homogeneity and compatibility among national regulatory structures. It is not yet clear whether this will be a space for a standardising trend or the basis for national and regional differentiation (or both!).

in "mass customisation", as discussed above. The growing habit –and soon expectation– of the consumer to define the specifications of products and services will open a very wide space for local front end businesses based on fulfilling this expectation, wherever the original products may come from. The specific values, culture, lifestyles and demographic trends –resulting from the history of each country and shaped by the potential and character of the ICT paradigm– are already generating demands, which will increase with time and will create a wide opportunity space for growth and entrepreneurship.

There is obviously also the fact that many services do absolutely require the personal presence of the provider and these are also growing. Local culture and the need for personal contact form natural barriers to entry and/or make many products and services non-tradable at a distance.

Table 3 is an exercise that attempts to indicate the sorts of activities that may expand in the advanced countries (and some of the middle-range ones) as the Knowledge Society becomes established and intensifies. Such activities are all the more important given that they can absorb the personnel from the jobs lost to the lower cost countries.

Many of the activities can be ranged among what was termed above (in section 3) as "induced branches". They facilitate overall growth in the deployment period by intermediating, interlinking, supporting and facilitating the operation of an increasingly dense fabric of the economy and the more fluid functioning of the various markets. They also incorporate labour of all skill levels and, through their income, widen the markets for the main products.

It is not easy to predict which will be the induced industries that will complete the fabric of the economy with the full flourishing of a paradigm. In the USA during the 1930s and right up to the first year or two after the war, there was great pessimism about the space for further

Table 3 The respecialisation of the advanced countries: Local specificity as one of the forces guiding investment for the domestic market

Local pull factor	Examples of industries
Capabilities and requirements of the Knowledge Society	RD&E and top-end high-tech in general Expert services: Business and personal Education for the Knowledge Society (recognising the end of the "education once-and-for-all" and "job for life" models) Highly efficient physical distribution services to complement e-commerce Intelligent buildings and living spaces Special financial services geared to the new conditions: venture capital as a "normal" service; recognising the value of intangible products and assets, catering to highly irregular incomes and to the proliferation of micro and mini firms, etc.
Quality of life as defined by national culture and values	Entertainment industries Environment industry: Clean air and water, safer waste disposal systems, alternative energies, etc. Creative industries Health industries and services: Orthodox and alternative; preventive and curing. Beauty, body care, sports and healthy living Habitat: Architecture, landscaping, interior design the spread of good taste (fashion, home and office decoration, etc.) Specialised tourism: for locals and foreigners Food: convenience and gourmet foods (in-restaurant, in-store, home delivery, made-to-order, etc.)
Economic Growth and demographic trends	Old age care and leisure time use Personal services Business services for the self-employed, micro and mini firms Construction and urban renewal Infrastructure (new and old) extension, improvement and maintenance

innovation and for full employment.[66] Yet, after 1947, there were three sectors that absorbed the growth in the active population: construction, services and government, so that full employment became possible even though both manufacturing and agriculture were still shedding labour as their productivity continued to increase.

Construction is likely to play a similar role in the present case but it is not yet clear in which aspects. At the end of the mass production surge, which combined the development of urban agglomerations for work with suburban living, there was a time when the energy crisis prompted a rethinking of those working and living patterns. Integrated living models, where people would walk or cycle to work by daytime and to entertainment by night were proposed and experimented upon. The possible environmental and energy pressures resulting from full globalisation may yet revive those attempts. For the moment, the bubbles in many housing markets are perpetuating the old model. But, whatever happens in the housing and office areas, global transport infrastructures are sure to mobilise the construction industry and its suppliers.

The other major activities related to the Knowledge Society, education or health, as in the case of the environmental industries, are likely to depend very much on the policies and regulations that will stimulate –or stifle– their intense development.

The role of ICT as the platform for the whole process

Given that digital information and communications technologies (ICT) will be the shaping force for whatever course the economy takes, its strong development is crucial for any country or region that wants to be in the front ranks. Yet, the areas to develop and the trajectories to pursue in ICT itself will be strongly shaped by the dynamic sectors or segments in the countries in question. It is in this sense that the context matters. Knowing the areas of specialisation in the global division of production becomes a powerful guide for the direction in which to strengthen ICT capabilities and in which to develop R&D in each case.

It should be clear, then, that segmentation and the activities resulting from global pull and local push almost without exception require ICT, both as supporting innovations and as basic platform for operation. The whole idea of a techno-economic paradigm (as the tool-kit and the "common sense" of a technological revolution) is that it is all-pervasive. All activities, from frontier research, through distribution and health –which will be more and more electronically tagged and computer-optimised– all the way down to high tech crafts or work-from-home arrangements, everything, absolutely everything will be using information technology and weaving into the fabric of the information-based Knowledge Society.

It will be like oil in the fifties and sixties. It was not possible to conceive of any transport system without gasoline diesel or jet fuel. Materials were generally synthetics. Electricity (basically produced with oil derivatives or coal) moved production machinery and home appliances, down to the electric can-opener. Agriculture used oil-driven machinery and petrochemical fertilizers, pesticides and herbicides.

That's how the core – cheap! – inputs of each technological revolution shape product and process decisions and eventually also social decisions. It is the plentiful availability of ever more powerful and versatile "cheap chips" that make the ICT world possible... and inevitable![67]

66 The debate about productivity and structural unemployment among US economists in the 30s and 40s was still present in 1947. For a sample see Ross (1937), Fleming (1939), Bakke (1941), Morgenstern (1941), Graham (1947). This last article was titled "National Productivity: its relationship to unemployment-in-prosperity".

67 For the equivalent impact of cheap iron and cheap steel in earlier surges see Freeman and Louçã (2001) pp. 159-63 and 232-9.

So, there will be a constant need for computer savvy companies and personnel in the advanced world or anywhere on the planet, at least for the next two or three decades (until this paradigm reaches maturity). They might be innovating at the frontier or doing applications in (and for) other industries and activities or at the front end services of ICT. Those industries are the engines of growth of the whole –world! – economy; their services are the lubricating agent of the globalisation process.

Today, one could paraphrase Engine Charlie Wilson, the President of General Motors in the previous surge, and say that in the Golden Age that may lay ahead: what's good for global development is good for the ICT industries and *vice versa*!

Policy actions towards a sustainable and cohesive globalisation

As discussed in section three, the collapse of the bubble leaves three tensions acting in the economy: that between paper and real values, that between potential supply and effective demand (or premature market saturation), and that within society between the richer rich and the poorer poor.

Since these three tensions define the conditions under which markets operate, free markets will only aggravate them. In the absence of conscious regulation and policies that will create conditions for redirecting investment towards a truly positive sum-game and a virtuous feedback cycle of global growth, the instabilities underlying the present performance of the various economies may produce collapses that could bring the world economy into recession or intensify the social tensions to the point of generating serious social unrest.

Three tensions: three policy areas

Faced by this scenario, there are three policy options which could significantly modify the context in such a way that markets will find it profitable to redirect investment towards greater, more even and more stable global growth paths. Such a major shift in policy focus would involve an intelligent combination of regulation, respecialisation and social-net policies.

Regulation

To begin redressing the balance between the paper and the real economy, regulation would be needed to discourage short-term financial gain and rapid movements of capital and to favour long-term investment. Lou Gerstner's suggestion about high taxes for capital gains realised within one year and declining to zero at five years[68] is an example of a possible measure in that direction. He argues that this would make investors act like owners and become interested in the future of the enterprises they fund, rather than see equity as a source of quick gains. Such a policy, if extended to real estate, would help weed out the speculative purchasers from the genuine home buyers and help eliminate some of the bubble pressures.

Complementary policies would be needed to moderate excesses in the derivative markets and other systemic threats to financial stability. In general, given the ease with which finance can move from one country or region to another without any possibility of national controls, Soros'[69] call for enforceable regulation at the global level is the obvious condition for any such policies to be effective.[70]

Once the rules for stability are established one can expect a series of financial innovations that, in contrast with the current casino style derivatives,

68 Gerstner (2002:2003), p. 261.
69 Soros (1998 and 2000).
70 For an analysis of the sources of financial instability and the case for global regulation see Eatwell and Taylor (2000).

will be really destined to serve the purposes of economic expansion, locally and globally, and to cater to the specific needs of the Knowledge Society and the processes of respecialisation and globalisation of production.[71]

Respecialisation

In order to generate a virtuous circle of growing jobs and markets both in the advanced and the developing world investment must be high on both sides. This means that the higher productivity possible with the new paradigm would be accompanied by enough additional investment in further activities so that full employment – or, rather, full-income earning work, because the self-employed are likely to grow in proportion – can once more become a reality in the advanced world and an attainable goal in developing countries.

As suggested above, it would seem that the way to move towards that outcome is conscious policy-guided and consensus-driven respecialisation.[72]

As the various parts of the value chain and certain segments of different production sectors are relocated in successive emerging countries, the advanced ones would shift their pattern of specialisation towards higher value added activities and to those services that define the culture and give support to the expected rise in the style and standards of living for all.

Such a process is unlikely to take place through the operation of markets alone, given that it implies a strong bias towards "real" production investment and a change in the rules of the game favouring the quality of life and the long term interests of society. It is more likely to occur by a consensus-building process with ample public and private participation to recognise both the problems and the opportunities and to create the conditions to overcome the first by taking full advantage of the second.[73]

National and global social net policies

In order to remove all obstacles to the flourishing of investment in the Information Revolution, much of the Keynesian edifice that had been erected to facilitate mass production was demolished or weakened. One of the most dangerous casualties of this process has been the Welfare State, which had facilitated mass consumption and fuelled the post war Golden Age. The dismantling has been uneven among countries, but one could say that in terms of institutional creative destruction, what has mainly taken place is the "destruction" half. There is no reason whatsoever for supposing that the values of societal solidarity should be abandoned in order to foster growth and globalisation. What can be held is that, when there is a paradigm shift, just as business changes its organisational forms to achieve greater profitability, so societies must find more effective ways of achieving greater cohesion and social well being for all.

Reinventing the social net in a manner consistent with the current paradigm will contribute to social justice in prosperous societies, will increase security for all by reducing the conditions that can favour violence and through strengthening the wealth creating capabilities of all, including the weakest, will reopen the ample upward mobility routes that gave strong cohesion to the more developed societies until very recently. Finally, and in a more practical vein in relation to growth, the mechanisms of social redistribution generate new market spaces across the income spectrum and create further possibilities for investment and employment.

71 For a set of proposals to create financial instruments meeting some of the new forms of risk, see Shiller (2003).

72 Perhaps the time has come to revive interest in the participatory processes of foresight and focusing used by Japan, Korea and other countries that successfully reshaped their economies leaping forward through the fourth and into fifth surge competitiveness.

73 In a more ambitious vision, respecialisation could also open the way for a positive sum game in the process of global development covering all continents and lifting all boats.

But in the present globalising economy, the national social nets are not enough. Historically the income polarising trends typical of the installation periods had been generally within each core country[74] to be later partly or wholly reversed in the deployment period (or Golden Age). In the present surge, income polarisation has occurred both within each country and across the world, in some cases with an even more acute effect at the global than at the national level. As a consequence, the social expression of that polarisation has been global. The whole world is witnessing – or suffering – the resentful violence and the desperate migratory pressures of the excluded as well as other phenomena such as various forms of "fundamentalism", including the success of messianic leaders or the search for fanatical religious identities.

Previous success as the main obstacle

Introducing new forms of State intervention –national or global– after the experience of the installation period is difficult because of excess business confidence. A technological revolution brings such a wide space for innovation opportunities that it creates the perfect conditions for the success of free markets. When it gradually becomes an obstacle because all conditions are ready for longer term wider ranging stable growth, the business world is not ready to relinquish the "freedoms" gained. As noted before, the enormous successes of the installation period are seen as the creation of the market itself, rather than being ascribed to the temporary existence of a huge innovation space where free markets could thrive, are seen as the creation of the market itself. For that same reason, State intervention is still remembered as an obstacle for the free explosion of the ICT revolution, due to its over-adaptation to the mass production paradigm.

In the present Turning Point it could be said that excess free markets are as obsolete and represent as much of an obstacle to maximise growth in Deployment, as excess State intervention was seen to be during early Installation.

Perhaps only serious recessions or other difficult circumstances that truly constrict profitability can shake the confidence in the present set up and move business towards favouring regulation and income distribution measures. But, policy makers need to be ready to propose and promote solutions that are truly adequate for a modernised economy following a paradigm that is fundamentally different from the previous one.[75]

The 'other' globalisation, fully compatible with the paradigm and capable of unleashing a worldwide steady expansion of production, markets and well being, is waiting to be formulated. It would be production-centred and -led; pro-growth and pro-development; with dynamic, locally differentiated markets, enhancing national and other identities. But it will not be the creation of any invisible hand; it will work with the market but will require plenty of human imagination, ample participation, intense negotiations, much determination and collective political will.

74 Though many impoverishing processes had been international, such as the ruin of the Indian textile producers by British mechanisation from the 18th Century or the ruin of natural rubber producers by synthetic rubber in the 20th, those cases were directly the result of market displacement by technical change.

75 In the 1930s, during the Turning Point of the fourth surge, Keynes' ideas and Roosevelt's New Deal proposals were met with ferocious resistance from economists and from business as attempts at destroying the market and moving towards communism. After the war, the Keynesian measures that facilitated the Golden Age were, if anything, more radical than Roosevelt's original ones, but were welcome after the war had shown the advantages of industry-government collaboration.

References

- Abernathy, W.J. and J.M. Utterback (1978), "Patterns of Innovation in Technology," *Technology Review*, Vol. 80, No. 7, pp. 40-47.
- Atkinson Anthony (1999) "Is rising income inequality inevitable?" Wider Angle, WIDER-UNU Newsletter, No. 2, pp. 3-4.
- Bakke, E. Wight (1941), "The economists and unemployment" The American Economic Review, Vol 30, No. 5, February, pp. 294-300.
- CoPS (Complex Product Systems Innovation Centre) http://www.cops.ac.uk/
- Davis, Lance E. and Robert E. Gallman, (2001), Evolving Financial Markets and International Capital Flows: Britain, the Americas and Australia 1865-1914, Cambridge, U.K., Cambridge University Press.
- Davis, S. and B.J. Pine (1992) Mass Customization, New York-London, McGraw-Hill.
- Eatwell, John and Lance Taylor (2000), Global Finance at Risk: The Case for International Regulation, Cambridge, Polity.
- Fleming, Marcus J. (1939), "Secular unemployment", The Quarterly Journal of Economics, Vol. 54, No. 1, November, pp. 103-130.
- Freeman, Christopher (2004), "Income inequality in changing techno-economic paradigms", in Reinert ed. pp.243-257.
- Freeman, Christopher and Francisco Louçã (2001), As Time Goes By: From the Industrial Revolution to the Information Revolution, Oxford: Oxford University Press.
- Freeman, Christopher and Luc Soete (1974:1997), The Economics of Industrial Innovation, London, Pinter.
- Friedman, Tom (2005), The World is Flat, New York, Farrar, Straus and Giroux.
- Galbraith (1990:1993), A Short History of Financial Euphoria, New York, London, Whittle-Penguin.
- Gerstner Jr., Louis V. (2002:2003), Who Says Elephants Can't Dance? Inside IBM's Historic Turnaround, London, Harper Collins.
- Graham, Benjamin (1947), "National Productivity. Its relationship to unemployment-in-prosperity", The American Economic Review, Vol 37, No. 2, May, pp. 384-396.
- Hamm, Steve (2005), "Taking a page from Toyota's playbook" Business Week, August 22-29, pp. 47-50.
- Hobday, Michael , Andrew Davies and Andrea Prencipe (2006), "Systems integration: a core capability of the modern corporation", forthcoming in Industrial and Corporate Change.
- Hobsbawm, Eric J. (1987:1989), The Age of Empire 1875-1914, New York: Vintage.
- Hoover, Herbert, Chairman (1929), Recent Economic Changes in the United States, Report of the Committee on Recent Economic Changes of the President's Conference on Unemployment, New York, London: McGraw-Hill.
- Johnston, David Cay (2005), "Richest are leaving even the rich far behind", in The New York Times, June 5.
- Kaldor, Mary (1999), New and Old Wars: Organized Violence in a Global Era, London: Polity.
- Kaplinsky, Raphael (2005), Globalisation, Poverty And Inequality: Between A Rock And A Hard Place, Cambridge, Polity.
- Kelly, Kevin (1998:1999), New Rules for the New Economy, New York-London, Penguin.
- McGowan, F., S. Radosevic and N. von Tunzelmann, (Eds.) (2004), The emerging industrial structure of the wider Europe, London, Routledge.
- Morgenstern, Oskar (1941), "Unemployment, an analysis of factors", The American Economic Review, Vol 30, No. 5, February, pp. 273-293.

- Nightingale, Paul and Paul Martin (2004), "The myth of the biotech revolution" in TRENDS in Biotechnology, Vol. 22, No. 11, November.
- Palma, Gabriel (2005) "Four sources of de-industrialisation and a new concept of the Dutch Disease", in J A Ocampo (ed.) Beyond Reforms: structural dynamic and macroeconomic vulnerability, Stanford University press (ECLAC- World Bank series).
- Pérez, Carlota (2004) "Finance and technical change: a Neo-Schumpeterian perspective", Working Paper No. 14, CERF, Cambridge University [forthcoming in Hanusch and Pyka, eds. (2006), The Elgar Companion to Neo-Schumpeterian Economics, Cheltenham, Elgar].
- Pérez, Carlota (2002), Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages, Cheltenham, Elgar.
- Pigou, Arthur Cecil (1949), The Veil of Money, London: Macmillan.
- Piketty Thomas and Emmanuel Saez (2003) "Income inequality in the United States, 1913–1998", The Quarterly Journal of Economics, Vol. CXVIII February, issue 1, pp. 1-39.
- Powell, Ellis T. (1915:1966), The Evolution of the Money Market 1385–1915: An Historical and Analytical Study of the Rise and Development of Finance as a Centralised, Co-ordinated Force, London: Frank Cass and Co. Ltd.
- Prencipe, Andrea; Andrew Davies and Michael Hobday (eds) (2005), The Business of Systems Integration. Oxford: Oxford University Press.
- Reinert, Erik and Rainer Kattel (2004) "The qualitative shift in European Integration: Towards permanent wage pressures and the Latin-Americanization of Europe? " PRAXIS Working Paper No. 17.
- Reinert, Erik ed. (2004), Globalization, Economic Development and Inequality: An Alternative Perspective, Cheltenham, Elgar.
- Ross, Emerson (1937), "Unemployment. Relief and Insurance", The American Economic Review, Vol 27, No. 1, March, pp. 112-119.
- Shiller, Robert (2003), The New Financial Order: Risk in the 21st Century, Princeton, NJ, Princeton University Press.
- Soros, George (1998), The Crisis of Global Capitalism: Open Society Endangered, London: Little, Brown & Company.
- Soros, George (2000), Open Society: Reforming Global Capitalism, New York: Public Affairs.
- Tylecote, Andrew (1985), 'Inequality in the Long Wave: Trend and Cycle in Core and Periphery', European Association of Development Institutes Bulletin, No. 1, pp. 1–23.
- Veblen, Thorstein (1899:1953), Theory of the Leisure Class New York, New American Library.
- Wells, David A. (1889:1893), Recent Economic Changes, and Their Effect on the Production and Distribution of Wealth and the Well-Being of Society, New York: D. Appleton & Company.
- WIDER-UNU (2005), World Income Inequality Database, http://www.wider.unu.edu/wiid/wiid.htm, June V 2.0a, United Nations University

3. From Industrial R&D to ICT-based Innovation: the Social Policy Challenge for Europe

by Luc Soete[76]

Underlying the European Lisbon summit back in March 2000, were basically two, rather different views. On the one hand the view that probably the most straightforward way for European policy makers to increase their individual countries' welfare would simply consist of increasing the supply input factors. The input factor, which offered most scope for an easy and straightforward expansion, was, and still is in most EU countries, of course labour. From the experiences in Scandinavian countries, the UK to the one in the Netherlands in the late 90's, it appeared that an active labour market policy aimed at raising the employment activity level could indeed result in an immediate improvement in output growth performance. Given the gap between the activity level targets set in Lisbon and current employment levels in many EU countries, there are still today many job-extensive growth opportunities in EU countries based on a straightforward further expansion of employment, in particular to underrepresented groups in the labour force: e.g. women, immigrants, 55+ citizens, etc.

Since Lisbon some progress in increasing labour force participation has been achieved but is has been a piecemeal progress and time is actually running against continuous further improvements. Indeed, in the coming decades such further labour expansion growth in a high-income, ageing setting will become confronted with decreasing returns: a decline in the willingness of those "voluntary non-active" in the labour force[77] to seek formal paid employment. Exchanging the various activities they are involved in outside of the formal wage income sphere – not just leisure or time spent on hobbies, but also social and voluntary work, care, household and community activities – will barely be influenced by incentive schemes and active labour market policy tools put in place. Following Becker it can be argued that with the average rise in hour wage, the welfare value of leisure and voluntary "non-work" activities has also risen. In short, there are limits to further raising activity levels as sustainable engines for growth in high-income societies.

An even more straightforward economic argument holds with respect to the decreasing returns accompanying the accumulation of capital, the other traditional production input factor. Less and less profitable opportunities for capital appear available in the most developed, richest EU countries and European citizens' savings are actually looking towards new member countries and non-EU emerging economies for profitable opportunities. Here too increasing simply capital accumulation is in the long term not a sustainable policy to be pursued so as to achieve economic growth and welfare. For high-income countries, the only input factor, which promises long term sustainable output growth is ultimately knowledge accumulation. Knowledge accumulation in its various forms: embodied in more efficient capital goods, in human capital, in organisational methods, in new production techniques or products.

There is thus nothing peculiar about the second priority given to, and emphasis put on knowledge and innovation as engine for sustainable growth, both in the original and recently revised official Lisbon strategy declarations (EC, 2005). As a matter of fact this second view is much more crucial and essential for Europe's long term future than the first one focusing on increasing labour force participation. Worse, as I will argue under the next headings the mixing up of those two policy priorities

76 Professor of International Economics, University of Maastricht and Director of UNU-MERIT, The Netherlands.
77 I am hence not referring to the unemployed.

is at the centre of much confusion about the Lisbon strategy and what it implies for Europe's social model. But before entering into that debate I draw the attention in a first section to the quite fundamental way in which knowledge accumulation and innovation has changed over the last Century and is different today from what it was forty to twenty years ago. This change is closely related to the particular contribution of information and communication technologies to knowledge accumulation. As a result, realising the welfare and efficiency gains resulting from knowledge accumulation and innovation is today more closely and intractably linked to the dynamism and windows of opportunity offered by individual European countries' social model. The archetype of Europe's social model (ESM) as represented by its German continental version[78] was first and foremost an industrial society model: a model very much in line with a process of technological accumulation characterized by incremental innovations. Proposals for reform of the ESM, however defined, need to take much more explicitly into account the changing nature of such technological change. Ideally this might well involve recognizing more explicitly the emerging dual nature of the labour market. It is the "knowledge workers" segment of that labour market which seems today to lack dynamism in Europe, worse which appears today to undermine the financial sustainability of the ESM. Reform policies should in my view focus on that particular segment of the labour force.

In short, the shift in the knowledge economy paradigm agenda has implications which go way beyond the traditional research and innovation policy agenda discussed by European member countries' respective ministers and administrations on research and innovation. A truly integrated Lisbon strategy will have to take more fully into account these implications as highlighted in the conclusions.

On the changing nature of technological accumulation and innovation

From S&T to industrial R&D

Science and Technology has been the subject of public interest and support for centuries. The acceptance of a utilitarian argument for the public support of basic scientific research predates the Industrial Revolution itself.[79] Although government and university laboratories had existed earlier, it was only in the 1870s that the first specialised R&D laboratories were established in industry (Mowery, 1983).[80] What became most distinctive about this form of industrial R&D was its scale, its scientific content and the extent of its professional specialisation. A much greater part of technological progress became now attributable to R&D work performed in specialised laboratories or pilot plants by full-time qualified staff. It is this sort of professional work, which is today recorded in official, internationally harmonized R&D statistics. Already in the early days of defining what was to become the OECD Frascati Manual definition of "R&D", it was obvious that it would not be possible to measure the part-time and amateur inventive work of typical 19th century research. The present industrial R&D statistics are therefore a reflection, and also a measure of, the professionalisation of R&D activities. And while the extent of specialisation should not be exaggerated – even today in many manufacturing firms the "technical" or "engineering" departments or "OR" sections contribute far

78 Europe's social model cannot be described in precise terms. It consists of rather different diversified models across Europe. Broadly speaking though one might consider two main models: one financed through general taxation (the "Beveridge system") and the other based on social security contributions (the "Bismarck system"). Denmark, Greece, Spain, Ireland, Iceland, Italy, Norway, Portugal, Finland, Sweden and the UK all belong more or less to the first system. The "Bismarck model" can be found in Belgium, Germany, France, Liechtenstein, Luxembourg, the Netherlands, Austria and Switzerland.

79 The first clear and forceful advocacy of a national S&T policy based on public support for research was attributed by Freeman to Francis Bacon (1627). In The New Atlantis, he advocated the establishment of a major research institute ("Salomon's House") which would use the results of scientific expeditions and explorations all over the world to establish the "knowledge of causes, and secret motions of things". See also in more detail Freeman and Soete (1997) Part IV which gives a detailed overview of the historical development of public support for science, technology and innovation.

80 See Mowery, D. (1983).

more to the technical improvement of an existing process than the formal R&D department, more narrowly defined – the balance has significantly changed over the 20th Century with a gradual further specialisation of the R&D function. It is the emergence of this particular function, which can be most closely identified with the emergence and growth of the industrial society.

This industrial research "revolution" was, however, not just a question of change in scale. It also involved a fundamental change in the relationship between society on the one hand and technology and science on the other. The expression "technology", with its connotation of a more formal and systematic body of learning, only came into general use when the techniques of production reached a stage of complexity where traditional methods no longer sufficed. The older, more primitive arts and crafts technologies continued to exist side by side with the new "technology". But the way in which more scientific techniques would be used in producing, distributing and transporting goods led to a shift in the ordering of industries alongside their "technology" intensity. Thus, typical for most Western industrial societies of the 20th Century, there were now high-technology intensive industries, having as major sectoral characteristic the heavy, own, sector-internal R&D investments and low-technology intensive, more craft techniques based industries, with very little own R&D efforts. And while in many policy debate, industrial dynamism became as a result somewhat naively associated with just the dominance in a country's industrial structure of the presence of high-technology intensive sectors, the more sophisticated sectoral studies on the particular features of inter-sectoral technology flows, from Pavitt (1984) to Malerba (2004), brought back to the forefront many of the unmeasured, indirect sources of technical progress in the analysis.

At the same time, the "science" and "technology" parts of research developed increasingly autonomously and with an increasing degree of independence from each other, certainly when compared to the early phases of the Industrial Revolution. The latter could be described as a period of "industrial enlightenment" (Mokyr, 2005): a period of close and fruitful interactions between industrialists searching for a better scientific understanding of their technological inventions, and scientists keen on understanding the underlying scientific principles of those new industrial technologies. Thus the further development of the steam engine influenced thermodynamics, whilst scientific knowledge of electricity and magnetism became the basis for the electrical engineering industry. The two bodies of knowledge were nevertheless generated by distinct professions in quite different ways and with largely independent traditions. The scientific community was concerned with discovery and with the publication of new knowledge in a form, which would meet the professional criteria of their fellow scientists. Application was ultimately of secondary importance or not even considered. For the engineer or technologist on the other hand, publication was of secondary or negligible importance. The first concern was with the practical application and the professional recognition, which came from the demonstration of a working device or design.

Elsewhere I have described the growing dichotomy between science and technology over the last two decades as a "Dutch knowledge disease" phenomenon (Soete, 2004). A process, which has been set in motion in the 1970/80s and consisted of a dual "crowding out". A "crowding out" of fundamental, basic research from private firms' R&D activities on the one hand and a process of "crowding out" of applied research from public, primarily academic university research. The first process found its most explicit expression in the reorganisation of R&D activities, from often autonomous laboratories directly under the responsibility of the Board of Directors in the 60's to more decentralized R&D activities integrated and fully part of separate business units. Today only firms in the pharmaceutical sector and a couple of large firms outside of this sector are still involved in the funding and carrying out of fundamental research (as reflected e.g. in

the number of scientific publications authored by private firms). For most firms the increased complexity of science and technology has meant a greater focus on applied and development research and a more explicit reliance on external, university or other, often public, knowledge centres for more fundamental research input. Firms now "shop" on the world market for access to basic and fundamental research and choose the best locations to locate their R&D laboratories. In doing so they will not only hope to make their own, in-house R&D more efficient, but also look to the efficiency, quality, and dynamics of the external universities and public R&D institutions.

At the other end of the spectrum, public research investments in universities and other public research institutes became, in most advanced countries, increasingly subject to national public scrutiny over the 80's and 90's through systematic performance assessment and academic peer review. As a result, academic performance became even more explicitly the dominant incentive in public research institutes while applied, or more immediately relevant research, was second rated. Hence, in many countries, particularly in Europe, applied research became "crowded out" of the university environment.

These opposing "crowding out" trends in the nature of private and public research have to some extent accompanied the gradual shift in the economy from an industrial society to a more service based, immaterial economy, in which industrial production is no longer the prime recipient and carrier of technological improvement.

The emerging knowledge economy paradigm

There has been over the last twenty years a major shift in the understanding of the relationships between research, innovation and socio-economic development.

First, economists have come to accept that knowledge accumulation might well be analysed, like the accumulation of any other capital good. In short that economic principles can be applied to the production and exchange of knowledge; and, that knowledge is intrinsically endogenous to the economic and the social system, not an external, "black box factor, only to be opened by scientists and engineers" in Christopher Freeman's (1974) celebrated words. Hence, while knowledge has some specific features of its own, it can be produced and used in the production of other goods, even in the production of itself, like any other capital good that is used as an input in the production process. It also can be stored and will be subject to depreciation, when skills deteriorate or people no longer use particular knowledge and, in the extreme case, forget about it. It might even become obsolete, when new knowledge supersedes and renders it worthless; as in the case with leading-edge technologies.

However, there are some fundamental differences with traditional industrial capital goods. First, and foremost, the production of knowledge will not take the form of a physical piece of equipment, but will be embedded in some specific blueprint form (a patent, an artefact, a design, a software program, a manuscript, a composition), in human beings or even in organisations. In each of these cases there will be so-called positive externalities: the knowledge embodied in such blueprints, people or organisations cannot be fully appropriated, it will with little cost to the knowledge creator flow away to other firms or to the public knowledge stock. Knowledge is from this perspective a non-rival good. Many people can share it without diminishing in any way the amount available to any one of them.

Second, the emergence of the cluster of new information and communication technologies (ICTs) has also had a direct impact on research, international knowledge access and innovation. ICTs are in the real sense of the word an information technology, the essence of which consists of the increased memorisation and storage, speed, manipulation and interpretation of data and information. In short, it is what

has been characterized as the codification of knowledge. As a consequence, information technology makes codified knowledge, data and information much more accessible than before to all sectors and agents in the economy linked to information networks or with the knowledge how to access such networks. But ICTs have also had a direct impact on the R&D process itself. Research laboratories are today equipped with sophisticated ICT equipment allowing more precision, reliability and expanding dramatically the scope for research in many different scientific fields. The intensive use of sophisticated ICT instruments in the process of R&D is one of the major factors contributing to the increase in the efficiency in research over the last decades.

At the same time, the increased potential for international codification and transferability of knowledge linked to the use of ICTs, implies that knowledge, including economic knowledge becomes to some extent globally available. While the local capacities to use or have the competence to access such knowledge will vary widely, the access potential is there. ICT, in other words, brings to the forefront the enormous potential for catching-up, based upon cost advantages and economic transparency of (dis-) advantages, while stressing at the same time the crucial tacit and other competence elements in the capacity to access international codified knowledge. For technologically leading countries or firms, this implies increasing erosion of monopoly rents associated with innovation and shortening of product life cycles. Research efforts may not be profitable anymore in this setting, from the perspective of a single firm. The ability of each economic actor to innovate single-handedly in such a global setting is becoming more risky, and stresses the role of strong technology clusters and government investment in knowledge.

Third, the perception of the nature of innovation processes has changed significantly over the last decade. Broadly speaking, innovation capability is seen less in terms of the ability to discover new technological principles, but more in terms of the ability to exploit systematically the effects produced by new combinations and use of pieces in the existing stock of knowledge (David and Foray, 2002). This new model, closely associated with the emergence of numerous knowledge "service" activities, implies to some extent more routine use of a technological base allowing for innovation without the need for leaps in technology, sometimes referred to as "innovation without research". It requires systematic access to the state-of-the-art technologies; each industry must introduce procedures for the dissemination of information regarding the stock of technologies available, so that individual innovators can draw upon the work of other innovators. This mode of knowledge generation -- based on the recombination and re-use of known practices -- raises also much more information-search problems and must confront the problems of the impediments to accessing the existing stock of information that are created by intellectual property right laws.

The new concept of a "science, technology and innovation system" is, in other words, shifting towards a more complex, socially distributed structure of knowledge production activities, involving a much greater diversity of organizations having as explicit goal knowledge production. The old system reviewed above under a), was, by contrast, based on a simple dichotomy between knowledge generation and deliberate learning (R&D laboratories and universities) and activities of production and consumption where the motivation for acting was not to acquire new knowledge but rather to produce or use effective outputs. The collapse (or partial collapse) of this dichotomy leads to a proliferation of new places having the explicit goal of producing knowledge and undertaking deliberate research activities, which may not be readily observable but nevertheless essential to sustain innovative activities in a global environment.

To summarize, traditional R&D-based technological progress which is still very much dominant in many industrial sectors ranging from the chemical and pharmaceutical industries to motor vehicles, semiconductors and electronic

consumer goods has been characterized by the ability to organise technological improvements along clear agreed-upon criteria and a continuous ability to evaluate progress. At the same time a crucial part of the engineering research consisted, as Richard Nelson put it, "of the ability to hold in place": to replicate at a larger industrial scale and to imitate experiments carried out in the research laboratory environment. As a result it involved first and foremost a cumulative process of technological progress: a continuous learning from natural and deliberate experiments.

The more recent mode of technological progress described above and more associated with the knowledge paradigm and the service economy, with as extreme form the attempts at ICT-based efficiency improvements in e.g. the financial and insurance sectors, the wholesale and retail sectors, health, education, government services, business management and administration, is much more based on flexibility and confronted with intrinsic difficulties in replication. Learning from previous experiences or from other sectors is difficult and sometimes even misleading. Evaluation is difficult because of changing external environments: over time, among sectors, across locations. It will often be impossible to separate out specific context variables from real causes and effects. Technological progress will in other words be much more of the trial and error base yet without as in the life sciences providing "hard" data, which can be scientifically analysed and interpreted. The result is that technological progress will be less predictable, more uncertain and ultimately more closely associated with entrepreneurial risk taking. Attempts at reducing such risks might involve, as Von Hippel (2004) has argued, a much greater importance given to users, already in the research process itself.

This shift as I will argue in the next section has major implications for the functioning of the ESM, as typified in the German version of that model. The German social model was to some extent the "ideal" type of social industrial model (with Japan) with strong incentives for firms to invest in the internal learning and upgrading of their work force, a close and privileged interaction between firms and higher education establishments (dual learning systems) and specialized industrial R&D and engineering departments, guaranteeing a continuous improvement in production and organisational efficiency. It resulted in continuous improvements in the international competitiveness (unit labour costs) of German production as reflected in German trade surpluses, still the case today. It also explains the high expectations of economists in the 80's of the German (and Japanese) "*Standort*" likely to take over US industrial technology dominance.

Compared to the new mode of technological progress, the previous advantages of this social model are now quickly turning into disadvantages primarily associated with major emerging inflexibilities, which are to some extent at loggerheads with the newly required flexibility in the new knowledge paradigm.

Reflecting on the implications for Europe's social model

The organisational and social challenges associated with the emerging new knowledge paradigm described above and also closely associated with the service economy and the "e-conomy", have, and maybe somewhat paradoxically given the original emphasis on e-Europe in Lisbon, not really been addressed in the discussions leading up to the Lisbon summit. Most of the discussions focused on the technological aspects of knowledge creation and development, the lagging position of the EU vis-à-vis the US, the need for a European research area and better coordination of member states research policies, the shortages of scientists and engineers, etc. The challenges of the emerging knowledge paradigm for the social models in European members states (MS) were barely addressed.

Yet it is clear that in a knowledge-driven society as described above there are likely to be many institutional, social and cultural bottlenecks to entrepreneurial risk taking, trial and error innovation and the ensuing creative destruction,

which touch directly on the functioning of the ESM. To some extent the Lisbon declaration was not only an expression of a political desire to strive for a Europe belonging to the world's most knowledge-intensive regions in ten years, but also that this was to happen within the context of a strengthened, 'activated' social Europe that would have an eye for past social achievements. The question that was *not* addressed was how activating labour markets would enhance the shift towards the new knowledge paradigm.

Economists such as Giles Saint-Paul[81] have analysed the relationship between labour market institutions, and in particular the costs of hiring and dismissing employees, and the development of innovations from a purely theoretical perspective. Hiring and firing costs are in many ways the most explicit manifestation of the industrial employment "security" embedded in European continental social welfare states – the Bismarck model. They have led to stability in labour relations and have represented a useful incentive for employers and employees alike to invest in human capital. However, in terms of the new knowledge paradigm and in particular the accompanying process of "creative destruction" which might accompany the development of new activities – whether concerned with new product, process or organisational innovations – this model will raise dramatically the costs with which "destruction" can be realized. Thus as shown in Saint-Paul's model, the US, with lower firing costs, will eventually gain a competitive advantage in the introduction of new, innovative products and process developments onto the market, while continental Europe will become specialized in technology-following activities, based on secondary, less radical improvement innovations.

In other words, the dynamics of innovation, of entrepreneurship, of creative destruction thrives better in an environment providing higher rewards for creativity and curiosity than in an environment putting a higher premium on the security of employment, internal learning and efficiency improvements in the production of existing products. Viewed from this perspective, the gap between Europe, and in particular continental Europe, and the United States in terms of innovative capacity, efficiency, and wealth creation may look like the price Europe had to pay for not wanting to give up the social securities and achievements associated with its social model. Many of the proposals on "activating the labour market" with by now popular concepts like "empowerment" and "employability" appear to go hand in hand with innovation and growth dynamics, others though do not. Some European countries such as the UK and Denmark appear to have been more successful in reducing dismissing costs than others, and appear to have benefited much more from the knowledge paradigm in terms of growth dynamics.

The central question, which must be raised within this context is whether the social security model developed at the time of the industrial society is not increasingly inappropriate for the large majority of what could be described as "knowledge workers": workers who are likely to be less physically (but by contrast possibly more mentally) worn out by work than the old type of blue collar, industrial workers. The short working hours, the early retirement schemes, the longer holidays might well appear to knowledge workers less of a social achievement; work not really representing a "disutility" but more an essential motivating activity, providing even a meaning to life.

There is in other words, I would argue a need for a fundamental rethinking of the universality of social security systems in European countries social welfare systems. That rethinking should recognize explicitly the emerging duality in the labour force between work involving "*labour*", i.e. a physical or mental wearing out activity, and work involving "*pleasure*", i.e. activities providing

81 Saint-Paul, G. (2002).

primarily self-satisfaction in terms of recognition, realisation and creativity. Workers involved in the first sort of activity will consider the social achievements, including employment security, a relatively short working life and short weekly working hours, as important social achievements and intrinsically associated with their quality of life, which they will not be prepared to give up. Workers involved in the second sort of activity, have been given these similar social rights by extension because of labour law universality principles. At the same time such an automatic extension of social rights appears by and large inappropriate and could be considered to be behind the lack of dynamism of knowledge workers in Europe. Furthermore, the full application of the social model to the growing proportion of knowledge workers undermines the sustainability of the social model itself. In short, when work involves significant positive externalities as in the case of knowledge work, it appears particularly inappropriate to apply social "security" guarantees to employment aimed first and foremost at reducing the negative externalities of physical work.

Conclusions

The new Lisbon strategy "Integrated Guidelines for Growth and Jobs" consists of 24 guidelines brought together under five broad headlines (see Table 1). Reflecting the reformulation of the political priorities of the Lisbon strategy after the mid term review (July 2005) under three headlines ("knowledge and innovation – engines of sustainable growth"; "making Europe a more attractive place to invest and to work"; "more and better jobs") the different guidelines appear, I would argue, still poorly integrated. In this paper the focus has been on the first of these political priorities: knowledge and innovation. Europe's failure to achieve significant progress under this heading over the last five years has much to do with the interaction between knowledge and innovation and the three other broad guidelines considered in Table 1. The knowledge society which has emerged in Europe is, as has been argued here, indeed not an exogenous one, external to Europe's macroeconomic policy, competition policy or social model, but fully endogenous to those other areas of economic policy.

In this sense our discussion, while limited to the social policy implications of the shift from industrial R&D to information based innovation, highlights nevertheless the complete lack of integration of the knowledge and innovation Lisbon priority with the other areas of the Lisbon strategy. Focusing e.g. on the second headline in Table 1, the Lisbon strategy interpretation of "knowledge and innovation as engines of sustainable growth" represents still, I would argue, and despite brave attempts of the Commission to proof the contrary[82], a very segmented policy approach, addressing first and foremost the traditional R&D and innovation member countries and EC policy constituencies[83]. The proposed guidelines and the further detailed proposals from the Commission (EC, 2005) are from this perspective more reminiscent of the old industrial R&D model than of the emerging knowledge economy paradigm model described above. The only shift in attention paid is with respect to potential regulatory barriers to research and innovation, reflecting the broadening of vision no longer to limit support policies to just R&D but also to include now more systematically innovation, raising at the same time new competition policy issues. However, no attention is paid to interactions with Europe's social model, or with education policy buried as guideline 23 under the "more and better jobs" headline

82 As in the case of the recent Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on More Research and Innovation - Investing for Growth and Employment: A Common Approach (EC, 2005).

83 These range from the Science, Technology or Research ministries and the various advisory committees to the Trade and Industry, Economic Affairs or Innovation ministries and their various advisory committees. Within the EC it are primarily the DG Research and DG Enterprise constituencies.

Table 1: Lisbon Strategy

THE INTEGRATED GUIDELINES FOR GROWTH AND JOBS

Macroeconomic policies for growth and jobs

1. To secure economic stability for sustainable growth;
2. To safeguard economic and fiscal sustainability as a basis for increased employment;
3. To promote a growth-and employment-orientated and efficient allocation of resources;
4. To ensure that wage developments contribute to macroeconomic stability and growth;
5. To promote greater coherence between macroeconomic, structural and employment policies;

Ensuring a dynamic and well-functioning Euro Area

6. To contribute to a dynamic and well-functioning EMU.

Knowledge and innovation –engines of sustainable growth

7. To increase and improve investment in R&D, in particular by private business;
8. To facilitate all forms of innovation;
9. To facilitate the spread and effective use of ICT and build a fully inclusive information society;
10. To strengthen the competitive advantages of its industrial base;
11. To encourage the sustainable use of resources and strengthen the synergies between environmental protection and growth.

Making Europe a more attractive place to invest and work

12. To extend and deepen the Internal Market;
13. To ensure open and competitive markets inside and outside Europe and to reap the benefits of globalisation;
14. To create a more competitive business environment and encourage private initiative through better regulation;
15. To promote a more entrepreneurial culture and create a supportive environment for SMEs;
16. To expand and improve European infrastructure and complete priority cross-border projects;

More and better jobs

17. To implement employment policies aimed at achieving full employment, improving quality and productivity at work, and strengthening social and territorial cohesion;
18. To promote a lifecycle approach to work;
19. To ensure inclusive labour markets, enhance work attractiveness and make work pay for job-seekers, including disadvantaged people, and the inactive;
20. To improve matching of labour market needs;
21. To promote flexibility combined with employment security and reduce labour market segmentation, having due regard to the role of the social partners;
22. To ensure employment-friendly labour cost developments and wage-setting mechanisms
23. To expand and improve investment in human capital;
24. To adapt education and training systems in response to new competence requirements.

Source: Council of the European Union, 10667/05 and 10205/05

in Table 1. The result of this relatively narrow focus is that the proposed integrated guidelines are anything but integrated and convey an impression of "over-structure" with target setting on a multitude of particular aspects of knowledge and innovation which are by and large outside of the control of policy makers.

Second, there is, I would argue a need for a fundamental rethinking of the universality principles of social security systems as they were developed in Europe last Century, in a variety of ways, in broad synergy with the emerging industrial society. Such a rethinking should recognize the duality in the labour force between work involving "*labour*", i.e. a physical or mental wearing out activity, and work involving "*pleasure*", i.e. activities providing primarily self-satisfaction in terms of recognition, realisation and creativity. As I argued in section 2 of this paper, workers involved in the first sort of activity are likely to consider the past social achievements of the European social model as important achievements intrinsically associated with their quality of life. They will consider any change of those conditions as a clear deterioration in their quality of life and reject it. Workers involved in the second sort of activity, call them knowledge workers, are not so much in need of social

measures aimed at reducing negative externalities of physical work. Their work involves primarily positive externalities. Obviously they also will appreciate social "security" guarantees to their employment, but these will rather be used as substitute rather than as complement for own life long learning efforts and investments. Effectively, knowledge workers are "free riding" on social "security" guarantees designed in another industrial age and aimed at a different category of workers. The automatic extension of social rights to knowledge workers appears from this perspective not only unjustified, undermining the financial sustainability of the European social model, but could well also explain the lack of dynamism of knowledge workers in Europe.

References

- Aiginger, K. and A. Guger (2005), The European Social Model. Difference to the USA and Changes over Time, WIFO, September 2005, mimeo.
- David, P. and D. Foray (2002), "An introduction to economy of the knowledge society ", *International Social Science Journal*, Vol 54, issue 171, pp. 9-23.
- European Commission (2005), Implementing the Community Lisbon Programme: Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: More Research and Innovation - Investing for Growth and Employment: A Common Approach, SEC(2005), 1253
- Freeman, C. (1974), *The Economics of Industrial Innovation*, Penguin.
- Freeman, C. and L. Soete (1997), *The Economics of Industrial Innovation*, 3rd edition, MIT Press.
- Griffith, R., Harrison, R and J. Van Reenen, (2004). "How Special is the Special Relationship? Using the Impact of US R&D Spillovers on UK Firms as a Test of Technology Sourcing," *CEP Discussion Papers dp0659*, Centre for Economic Performance, LSE.
- Krugman, P. (1994), "Competitiveness: A dangerous obsession", *Foreign Affairs*, March/ April 1994, Vol.73, nr. 2
- Malerba, F. (Ed.) (2004), *Sectoral Systems of Innovation,* Cambridge University Press, Cambridge MA.
- Mokyr, J. (2005), *The Enlightened Economy: An Economic History of Britain 1700-1850,* Penguin New Economic History of Britain, forthcoming.
- Mowery, D. (1983), "Industrial Research and Firm Size, Survival and Growth in American Manufacturing, 1921-46: An Assessment," *Journal of Economic History*, 1983.
- Pavitt, K. (1984), 'Patterns of technical change: towards a taxonomy and a theory', *Research Policy*, vol. 13, no. 6, pp. 343-73.
- Saint-Paul, G., (2002), "Employment protection, international specialisation and innovation", *European Economic Review*, vol. 46, pp. 375-95.
- Soete, L. (1997), Technology Policy and the international trading system: where do we stand? in H. Siebert (Ed.), *Towards a New Global Framework for High Technology Competition*, J.C.B. Mohr, Tübingen.
- Soete, L. (2004), "The Lisbon Challenge: designing policies that activate" in Liddle, R. and M. Rodrigues (Eds.), *Economic Reform in Europe: Priorities for the Next Five Years*, London: Policy Network.
- Von Hippel, E. (2004), *Democratizing Innovation*, MIT Press.

4. How do Wealthy Nations Stay Wealthy? Challenges for the European Policy Agenda

by John Zysman and Tobias Schulze-Cleven[84]

The challenge for Europe is how to stay wealthy in a rapidly evolving and ever more competitive global economy. In the digital era, the continuous evolution of the mechanisms of value creation – i.e. the engines of productivity and growth – calls into question both established company strategies and public policies. There exists broad agreement that the digital era requires adaptation, but the precise 'how and what' remain unclear. This paper has the dual objective of clarifying the character of competition in the digital era and reflecting on European attempts to build advantages in the evolving global marketplace. In short, the paper asks how wealthy nations – such as those in Europe – can stay wealthy in a global economy with ever shifting levers of advantage.

The transformation of the marketplace in the digital era changes both the traditional tools of corporate strategy and the agenda of public policy. In this global era, characterized by digital technologies that as "tools for thought" transform all activities, firms' internal functions suddenly become products to be bought in the market, products that generated premium prices suddenly become commodities, and the sources of differentiation for products and production processes evolve.[85] It is not just that there is an increased pace of change, but that the market environment is inherently less predictable. Conscious experimentation will be central to both corporate and national adaptation. Companies will have to look at their initiatives as "experiments," attempts to find their way through a maze of fundamental uncertainty. Each company effort, and the efforts of competitors, must be culled and systematically assessed for lessons. Governments must consider what an "experimental economy" will require, and how an environment can be created for individual firms and networks or clusters of firms to experiment effectively.

Our analysis of the challenges raised by the digital era will proceed in three steps. A first section will review the historical evolution of production paradigms to build the empirical basis for the framework through which we want to assess the transformations of the digital era. A second section considers the dynamics of value creation in this digital era and the evolution of business models. The third section considers what our analysis can contribute to the understanding of Europe's adjustment to the marketplace of the digital era. In that context, we will revisit the long-standing debate on the relationship between labor market flexibility and social protection.

Evolving models of production and competition[86]

The influence of the technology progress is visible in the economy through the evolution in the production and distribution of goods and services. In this section, we distinguish among historical phases that involved distinct business problems, a changing role of the "international" in the dynamics of the national economy and the role of the state in the economy.

84 The interpretative framework for this paper was originally developed by John Zysman in his contribution to the forthcoming How Revolutionary was the Digital Revolution? National Responses, Market Transitions and Global Technology. A BRIE/ETLA/HELSINKI Project. Stanford: Stanford University Press. We present it here in shortened and revised form. The application of this framework to the European Political Economy is based on dissertation research that Tobias Schulze-Cleven is conducting on the comparative politics of increasing labor market flexibility.

85 This section is based on (Cohen, DeLong and Zysman, 2000).

86 This section is based on (Zysman, 2004 and 2006).

American dominance: Fordism and mass manufacture

Mass manufacture, epitomized by Henry Ford and the Model T, was the first twentieth century production revolution, though its roots lie earlier in the 19th century. In this system, large-scale manufacture implied rigidity. Fixed costs in the production line and design were high; consequently changes in products or reductions in volume were difficult and expensive. This rigidity created political, not just technical, problems. Mass manufacture is broadly understood to mean the high-volume output of standard products made with interchangeable parts being connected by using machines dedicated to particular tasks and manned by semi-skilled labor. Important features include a) the separation of conception from execution – managers design systems, which are operated by workers in rigidly defined roles that match them to machine function; b) the "push" of products through these systems and into the market; c) large-scale integrated corporations, whose size and market dominance reflect mass manufacture's economies of scale (Womack, Jones and Roos 1991).

There was a political consequence. Drops in demand were difficult to absorb for companies structured according to Fordist models, leaving the national economy rigid as well. An initial downturn in demand could cumulate into sharper economic downturns. Booms and busts implied worker dislocations, and the national economic policy counterpart of the corporate business cycle management task became the political debate about how to use public policy to cushion not only the economic dislocations but also the political dislocations associated with mass unemployment. Demand management policies, associated with the label of Keynesianism, were born. *Fordism,* an American innovation, was mass production with Keynesian demand management.

Challenges from lean production and flexible specialization

Challenges to the long dominance of American manufacturing came from two different directions. The more important challenge was the interconnected set of Japanese production innovations, loosely called *flexible volume production* or *lean production* Coriat 1990; Jaikumar 1988). From the 1970s onwards, Japanese consumer durables began to redefine the terms of competition in global markets establishing new trajectories of innovation and new standards of quality Success in the complex assembly of a large number of component parts for principally mechanical and electro-mechanical goods set American and European industrial establishments on their heels. The Japanese lean production system seemed to allow for rapid market response by providing both the flexibility to adjust output in existing lines as well as introducing new products (Tyson and Zysman 1989). Most importantly, it seemed to deliver high quality at lower cost. While the Fordist story highlights national strategies for demand management, the Japanese story of lean production highlights the role of a "developmental" state and the interaction among the markets and producers of the advanced countries in international competition.[87] The Japanese state actively promoted domestic development with closed markets at home, while 'free-riding' on the international system to use

87 The distinctive features of the Japanese lean production system were a logical outcome of the dynamics of Japanese domestic competition during the rapid growth years, and this system was firmly in place by the time of the first oil shock in the early 1970s. For example, Japan's automobile and electronics firms burst onto world markets in the 1970s and consolidated into powerful conglomerates in the 1980s. The innovators were the core auto and electronics firms who, in a hierarchical manner, dominated tiers of suppliers and sub-system assemblers; the production innovation was the orchestration and reorganization of the assembly and component development process. The core Japanese assembly companies of the lean variety have been less vertically integrated than their American counterparts. Rather, they have been at the center of vertical Keiretsus, loosely speaking, Japanese conglomerates conventionally understood to be headed by a major bank or consisting of companies with a common supply chain linking wholesalers and retailers, that have tightly linked the supplier companies to their clients. It cannot surprise that lean production became a focus of American policy and corporate attention because it represented a direct challenge to both mass manufacturing and assumptions of American global economic policy.

exports for stabilizing the domestic economy. The combination of an open international system with intense but controlled competition behind managed trade borders proved decisive in the emergence of the innovative and distinctive Japanese system of lean flexible volume production.[88]

The second challenge to the classical American mass production model came from Europe under such labels as *diversified quality production* (Streeck 1991) and *flexible specialization* (see e.g. Hollingsworth and Boyer 1997) at about the same time. The "Third Italy" and the Germany's Baden-Württemberg were the first prominently displayed examples of an approach in which craft production, or at least the principles of craft production, survived and prospered in the late twentieth century. The particular political economy of the two countries gave rise to distinctive patterns of company and community strategies (Hirst and Zeitlin 1997). Deploying flexible machinery and skilled workforces rather than on paying low wages, firms in these countries often competed in global markets on the basis of quality not price. Being able to produce short runs of semi-custom goods, the companies in these modern versions of traditional industrial districts could command an affordable premium for their products because of their distinctive performance or quality features (Sabel 1994). They were seen to be able, in at least some markets and circumstances, to more effectively adapt to the radical uncertainties and discontinuities of global market competition than larger, more rigidly organized companies. The emphases in these discussions are the *horizontal connections,* the connections within the community or region of peers, as distinct from the *vertical or hierarchical connections* of the dominant Japanese companies. The flexible specialization model hinges on local institutions, such as chambers of commerce, vocational training systems and public research facilities, which permit the continuous combination and recombination of local activities. Thus, the two innovative challenges to American production dominance each featured distinct roles for policy and the state.

The transition to a digital age and the American comeback: Wintelism and cross-national production networks

The first chapter of the digital era can be best characterized by the emergence of Wintelism as a strategic stance and the rise of *Cross-National Production Networks (CNPNs)* (Borrus and Zysman 1997). *Wintelism* is a short-hand term representing the transition from an electro-mechanical to a digital era. It reflects the sudden importance of the constituent elements and components in defining the terms of competition in the markets for the final products. This meant a consequent strategic shift in competition away from the vertical control of production by final assemblers. The prominent examples from the computer industry, the *Win*dows operating system and In*tel* processors, have given the name to this new production and competition regime. *Cross-National Production Networks* was the label first applied to the consequent disintegration of the industry's value chain into constituent functions that can be contracted out to independent producers wherever those companies are located in the global economy. CNPNs are associated with an increasingly fine division of labor. The

88 The argument is simple: The relationships of production and development in the Japanese production system are so delicate that measures to steady and smooth the expansion of demand in sectors such as autos proved very important for the success of the production innovations (see Tate 1995). In Japan, public programs generated domestic rivalries that lead to over-investment and excess capacity. This excess capacity was then "dumped" off of on international markets. Just-in-time delivery, subcontractor cost/quality responsibility and joint component development pushed on to the subcontractor considerable risks of demand fluctuations. It remains questionable if Japan's emerging auto sector could have continuously absorbed the stops and starts of the business cycle that typified Britain in the 1950s and 1960s. Would the trust relationships that are said to characterize Japan have held up? Could the fabric of small firms have survived to support just-in-time delivery and contractor innovation? Techniques to continuously reappraise demand levels and reduce unpredictability throughout the system as well as government and corporate programs to reduce the capacity break-even point in small firms only go so far.

networks permit firms to weave together the constituent elements of the value-chain into new production systems that facilitate diverse points of innovation. They also turned large segments of complex manufacturing into a commodity available in the market. The rise of CNPNs marked the arrival of a truly global economy, one in which competition and the critical final markets were in the advanced countries, but production – while organized by firms from these same advanced countries – was spread across borders, principally through Asia.

Wintelism emerged as a strategic response by American producers to the Japanese production challenge during the 1980s. As the semiconductor industry joined consumer electronics and automobiles as sectors under intense competitive pressure in the late 1980s, it seemed that the fabric of advanced electronics was unraveling. At that time, the erosion of equipment suppliers to the semiconductor industry was making it more difficult for American semiconductor producers to hold market position. With the weakening position of the semiconductor makers, many feared that final-product producers would not have access to the most innovative chip designs needed in their final products. However, suddenly, American producers rebounded. They had not reversed the loss of production advantage in electro-mechanical products, but rather, a new sort of consumer electronics product had emerged, defining a new segment of the industry. The then 'new' consumer electronics, as Michael Borrus (1997) argued at the time, were networked, digital, and chip-based. The have included products from personal computers to mobile devices. The nature of production changed dramatically from the complex mechanical or electro-mechanical assembly to electronic chip production, board stuffing, and packing the boards into boxes.

Wintelism involved both new terms of competition and a new model of production. Consider the PC; what part of the value chain confers the most value added and leverage in the market? It is not the producer of the final product, the metal box we call the PC, even if – like Gateway or Hewlett Packard – the box carries the company logo. Much of the added value is in the components or subsystems: the chipset, the screen, and the operating system. This has several implications:

- Producers from different nodes in the value chains compete over control of the evolution of technology and final markets. Some component companies succeeded in shaping market segments. Prominent examples are Microsoft and Intel, which set the pace of technological evolution in the personnel computer segment, and the independent networking equipment provider Cisco, which drove the emergence of internet technology.
- Competition in the Wintelist era tends to be a struggle over the setting and evolution of de facto product market standards. Components and subsystems are built to generally agreed standards that emerge in the marketplace, with the market power over those standards lodged anywhere in the value chain, including product architectures, components, and software. Open but owned standards create de facto intellectual property (IP)-based monopolies or dominant positions.
- As the fundamentals of Wintelism have evolved, the constituent elements of the product value chain have become modules. While distinctive intellectual property might remain in the modules, the knowledge about how they inter-connect becomes codifiable and will be diffused.
- With products being built as modular systems with clearly defined components and subsystems, the actual production/ manufacturing can be outsourced. Outsourcing evolved from a tactical response aimed at cost reductions by procuring a particular component from outside the organization into cross-national production networks that can produce the entire system or final product.
- The core engineering skills moved from mechanical to chip-based systems that are

given functionality by software. The range of production skills to produce an optical film camera is much greater than to produce a digital camera, whether in a cell phone or not.

The Wintelist era of the 1980s and 1990s – the moment of the American comeback in electronics – turned, politically, on domestic deregulations and international agreements that created an ever more open international trade system. At home in the United States domestic deregulation and competition policy in a variety of sectors – especially telecommunications and computers – contributed to significant market competition among, and a shift in market leverage toward, component makers. These initially domestic phenomena eventually reshaped the electronics industries worldwide. Ever more extensive and dispersed networks of investment, trade and production were the first step in an evolution of complex production networks and supply chain management. The emerging production and trade structure contributed to, if not drove, the expansion of something we might loosely call Globalism.

Globalization with borders

The classic version of the globalization story stresses how the internationalization of business – enabled by lower "transaction costs" associated with technological change – has severely constrained active government policy. In contrast, the evolution of production paradigms sketched out above suggests a different take on globalization. The paradigms' power in international competition rested on their national bases and/or explicit government action. From this alternate vantage, globalization is a story of national innovations played out on a larger stage. A sequence of new competitors, new and often unexpected loci of innovation and production, bring new processes, products and business models to the international marketplace. Indeed, the world has witnessed a "globalization with borders" (Borrus and Zysman 1997).

In the following section of the paper, we will turn to the chapter of the digital era that the world is currently entering. Again, as it was true in earlier periods, dramatic marketplace developments are cooking inside of national systems of innovation and competition, largely unobserved by the outside. They burst onto the global marketplace as unexpected competitive challenges at a seemingly increasing pace.

Value creation in a digital era[89]

The current phase of the digital era is best characterized by possibilities associated with a new set of distinctive tools, tools for thought. These tools amplify brainpower by manipulating, organizing, transmitting, and storing information in the way the technologies of the Industrial Revolution amplified muscle power (Cohen, Delong, and Zysman 2000, 7-8). The tool set rests on a conception of information as something that can be expressed in binary form, open to subsequent manipulation (see Shannon 1993). It consists of the hardware that executes the processing instructions and the software, i.e. the written programs defining the procedures and rules, that guide how the hardware equipment's information processing. In addition, it includes the data networks that interlink the processing nodes, and the network of networks, which together create a digital community and society.

The digital revolution is transformative, it has become conventional to observe, changing the character of products, processes, marketplaces and competition throughout the economy. The capabilities to process and distribute digital data multiply the scale and speed with which ideas and information can be applied. It affects both traditional goods, communication sectors, and services. Information technology has moved both inside of machines, controlling their functionality,

89 This section is adapted from (Zysman, 2006).

and into the communications networks, altering not only how and at what price we talk, but how we share, store, and use information. Because the expression and manipulation of information is now possible in a common digital electronic form, a range of previously separate information and communication sectors merge or become more intimately entangled.[90] Just as important, the knowledge component of much of industrial activity, and indeed an array of service activities, can now be formalized, codified, and embedded in equipment.

The logics of cost and functionality change. The cost of creating digital information remains fixed at often high cost, while the cost of reproducing and transmitting content in digital form drops toward zero. The consequences of often non-existent replication costs are amplified by the very nature of information goods. How do I price and value what you know and want to sell to me without me seeing it? But if I see it, and thus possess it, how can you still sell it to me? And if I can reproduce and distribute that knowledge widely at low cost, what happens to your market? New business models have to be invented; the forms of distribution and IP of older models have to be defended through contracts and courts.

All of this tells us that information technologies alter the product development, production and competition throughout the economy. It does not tell us how companies might take advantage of these changes, or how governments might support IT development and diffusion to benefit their societies. One might list the mechanisms through which the digital tools affect business strategy, noting in turn network effects and the changing character of content products. But this approach is rather limited. Information-based tools and goods have a distinctive logic, "information rules" to use the clever phrasing and insightful arguments by Shapiro and Varian (1999). But when does that logic apply? Certainly the logic applies in the competition over internet browsers. It may apply in the case of search engines. But which elements of information goods, or digital tools or network economics apply in the case of the automobile industry? And how do we decide which issues matter in a particular setting? If we cannot deduce the answers from first principles, we need an alternative strategy to understand value creation in a digital era.

Of products, commodities, and differentiated assets

These basic features of digital era profoundly affect the dynamics of competition and strategy in the global market. They change profoundly what must be done to assure real rising incomes for the community. Created market value, oversimplified, is price minus cost.[91] If we are to locate the influence of digital tools, there are two obvious questions about value creation. First, how do digital tools and information products change the task of generating something for which consumers will pay a premium? In other words, how does a company avoid having its products become commodities? How does the company create unique or differentiated goods so that a premium price can be charged? There is an array of means: the creation of distinctive products, early market entry, and ownership of product design standards. Second, how do these tools affect the cost of providing a product or service to customers; if you cannot charge a premium, can one generate distinctive margins by being a low cost producer? The argument here is that for a firm the points at which it can exercise competitive leverage to create strategic advantageare now constantly shifting and moving.

90 For example, print, broadcast, and communications suddenly become integrated with the possibilities of search and storage of information thrown in. Some argue that the moveable type contributed to the social revolution of the Renaissance, with the obvious question of whether the social consequences of these radical information technologies will be of similar historical scale.

91 Thanks to Stuart Feldman of IBM for his presentation at the Innovation Alliance: Succeeding in an Evolving Global Economy conference, Berkeley Roundtable on the International Economy, Berkeley, August 27, 2004.

To address these questions we need to define explicitly three notions we are generally familiar with: product, commodity, and differentiated asset.

- A *product*, whether object or service, is an item that can be bought and sold in the market,
- A *commodity* is a good or service that is exchanged in competitive markets with little advantage to any particular buyer or seller. A product becomes a commodity when it is generally available from a number of suppliers on common terms in the market,
- A *differentiated asset* creates the basis for premium price, distinctive sales advantage, or cost advantage in production or distribution.

There is a constant reshuffling among products, commodities, and differentiated assets. As reshuffling occurs, business models must change as well. Globalization accelerates the reshuffling, and digital tools often are the means of accomplishing the reshuffle. Globalization represents new competitors who may transform a premium good into a commodity with low cost production or generate advantage by adding value to what seemed to be a commodity good as when the Japanese made quality a "free" good. Digital tools change the levers of advantage and value creation.[92] The continuing reshuffle includes the transformation of internal company functions into products available on the market. There is a constant question of whether the function is a commodity that should be sourced in the market or a strategic asset that must be developed in house or in carefully nurtured supply relationships. R & D and production provide examples of internal company operations becoming either a strategic asset or a vulnerable commodity.

Traditionally an internal function differentiating a company's products from its rivals, R & D can now be sourced outside the company. The original presumption has been that product development, and the research to support that development, is at its core a strategic asset, the foundation of innovation and a powerful antidote to commodification. But even as innovation and continuous product/production improvement become more critical, major corporations are shrinking their core research departments. They are choosing to buy in R & D from universities or start-ups and spin-outs.[93] In addition, they source from joint product development projects and technology development outposts.[94] A wide range of countries are entering the development game by investing into R & D in both public labs and in support of industrial labs, thus growing the number of points of purchase for "technology" and "development" has grown. Major firms become, at least in part, technology integrators, and not just technology developers. Firms cannot be at the cutting edge in all the technology developments that affect them, and must look outside.[95] Firms have to decide, and continuously reassess, what elements of development are effectively high-end commodities, which technologies are strategic assets best acquired, procured on an exclusive basis or developed in house, and how to move to capture those distinctive technological assets.

92 Consider finance where the application of sophisticated mathematical tools to the creation of financial products and online transactions replace the ties to our local banker, transforming distinctive advantages into commodities and creating a new basis for premium products.

93 Many of the engineering schools are rooted in science based engineering, solving engineering problems by working with fundamental principles. The Bayh-Dole Act pushed universities into "marketable" technologies developed with federal funding. An array of mechanisms, from licensing through facilitating "spin-offs" to institutions for joint development, have been established at the major technology universities to facilitate ties to industry. In addition, companies turn to the start-ups or spin-out the development of particular elements of products or services, because they feel that many projects are best developed outside the traditional hierarchy of a major company. Firms from Intel through Nokia to IBM establish mechanisms, including their own investment companies, support startups as an approach to technology development and an alternative to internal development.

94 Companies set up joint product development projects with other companies, basically combining technology strengths. They also establish technology development outposts both to monitor developments and to tap into distinctive pools of talent and technology around the world.

95 Often disruptive technologies, which are capable of supporting newcomer entry into the market, are difficult to develop by established companies in-house (see Christensen 1997).

Similarly, production has increasingly become a commodity in a digital era. Manufacturing firms went offshore for cost reasons or to have access to local markets, but discovered abroad a widely distributed capacity for technical and management innovation. Outsourcing led to cross-national production networks and eventually skills of supply chain management, each step making the next phase of outsourcing, i.e. the commodification of production, easier. Consequently, it may be easier for services to move offshore today than it was for manufacturers to do so twenty years ago. The required tool set consisting of computers, software, and communications are available in the market and easily transported. These are largely general-purpose tools that can be adapted to particular service tasks. How far, we may ask, will this geographic dispersion go? Can all activities be placed just anywhere? Is there any geographic stickiness to production? While acknowledging that not all production is a commodity, we need to ask these questions, both in the context of the entire production processes and each individual element of a potentially segmented process. In turn, a nation/region should ask what it could do to make itself attractive as a location for world-class manufacturing.

In a world in which services as well as manufacturing are being outsourced and old distinctions between services and manufacturing are breaking down, we need to be clear on definitions. We propose to talk of production as the general case, the organized action of making goods and services for sale, and of manufacturing as the specific case of physical production.[96] In that case, production – the know-how, skills, and mastery of the tools required – is absolutely central to the products in the digital sector. Furthermore, we can now ask corporate strategy questions – such as what should be produced or built in house and which can be outsourced – for the new digital context.[97] There are at least three circumstances when in-house control of production, or elements of production, can be a strategic advantage: first, if the in-house control of production provides advantage in cost, timing of goods to market, quality, or of distribution that cannot be obtained by outsourced production; second, if knowledge about existing production processes is required to develop "next generation" product entry, whether design of the products themselves or of the processes to produce them, or put differently, in-house production mastery may be required for rapid product innovation; third, if critical intellectual property about the products themselves is so tightly woven into the production process that commodity outsourcing is tantamount to transferring product knowledge to competitors.

As noted before, the rapid entry of diverse new competitors into global markets contributes to the process of commodifying production and the transformation of "innovation / R&D" into a product that can be purchased in the market. The new entrants into markets and the ever-evolving competitive position of others, globalization, represent new opportunities, challenges and threats that come from unexpected directions. Following the early challenges posed by Japanese producers and the later rise of other Asian producers (e.g. Korea, Taiwan, Hong Kong and Singapore), now India, China, and the countries from the former Soviet Bloc all find their position in world markets. The new entrants represent both new markets and new competitors representing not only new sources of production and R & D but

96 "Manufacture: To make or process (a raw material) into a finished product, especially by means of a large-scale industrial operation. To make or process (a product), especially with the use of industrial machines. To create, produce, or turn out in a mechanical manner. To concoct or invent; fabricate. To make or process goods, especially in large quantities and by means of industrial machines." Source: The American Heritage® Dictionary of the English Language, Fourth Edition (Houghton Mifflin Company, 2000).

97 The critical question, once we acknowledge that software production is a form of manufacturing, is what are the most effective ways of organizing software production. For this discussion, the list begins with the conventional questions of whether to outsource, of where, geographically, to locate software development. The story becomes interesting when we ask whether to choose conventional hierarchical production structures typified by Microsoft or new alternatives such as the commercialization of Linux products developed in an open source model.

often new product, production, and management strategies.

Creating differentiated assets: segmentation strategies

How, then, can firms escape from the world of commodities, escape from new competitors from new places nipping at their heels? A traditional analytic approach to strategy will only be a starting point in the process of corporate adaptation. Companies will have to look at their initiatives as "experiments," attempts to find their way through a maze of uncertainty. They will need to learn how to evaluate their own experiments and interpret experiments of others. Doing so, of course, creates dilemmas. We address them in turn below.

The increasing importance of the classical approaches, branding and design, to differentiation needs to be acknowledged. They become critical, because in the digital era many electronic products are constructed from very similar modules achieving very similar functionality. Branding, the creation of an identity for a product or set of products, serves as a critical instrument to differentiate branded products from a pool of commodities. For example, amongst an array of similar products tending toward commodity, the question of whom you trust matters. Hyundai's efforts to establish the once low-end Korean cars as high quality, or GM Saturn's efforts to establish a no-trickery sales identity, are examples of an effort to create trust through branding.[98] Additionally, ever greater arrays of products are fashion/identity products that give expression to a customer's sense of self (often through the perception of the product through a third party). The "brand" identity in part states the "presentation of self" that the client chooses. Similarly, design takes on ever-greater importance in differentiating products that might otherwise be fundamentally commodities. The Danes for decades have been selling the Bauhaus, the source of Danish modern product style. An extreme example of value created by design is the Danish company Bang and Olufson, which sells high-end commodity technology at extraordinarily high-price as a lifestyle good. The "brand" identity is based on its exceptional electro-mechanical characteristics and pure design.

In contrast, alternative, "new" segmentation strategies involve digital tools, the "tools for thought" that underpin the digital revolution. It remains on open – and critical – question how to use their underlying capacities to their fullest potential and capture competitive advantage or generate productivity gains in the process. Investments in training, in reorganization, and in strategic reorientation are likely to be required (Brynjolfsson and Hitt 2004). Some of the new approaches to creating value and to differentiating products have become very well known. First, and now widely understood, are those to segment the market and then attack specific segments with functionally varied, and usually distinctively branded, products. A fundamental feature of the digital era is that analytic tools of database management permit the consumer community to be segmented into sub-components, each with distinct needs and wishes. At an extreme, individuals and their particular needs can be targeted. Early on, the insurance industry moved from using computers exclusively for back office operations to using them to create customized products for particular consumers (Baran 1986). Thus collecting detailed information about customers as groups or individuals in a variety of forms, credit cards or grocery store purchases are obviously very important to companies having chosen this particular strategy.[99] Once the market segments are defined, then digital tools help firms

98 On-line the issue of trust is even more important. Here the possible anonymity of the market participants, the difficulty of imagining recourse to a virtual participant, makes trust essential. It is that problem which E-bay has so cleverly addressed.

99 The result, of course, is a policy struggle about what information can be gathered, shared and combined. The wishes of companies and governments to assemble information from diverse sources into consumer profiles or threat assessments is set against individual rights for privacy and community needs for the integrity of the individual.

create functional variety in products. Standard products can be given diverse functionality. The coffee maker that automatically turns on at a particular time in the morning depends on simple digital functionality. The difference between many higher speed, higher price, printers and their slower, lower price, brethren is in the software that tells the printer how to operate (Shapiro and Varian 1999). Firms have new ways to identify who will pay how much for what, and then create products or give functionality to commodity products that people are willing to pay for.

Second, digitally rooted online sales/ marketing and supply chain management alter the links between a firm and its customers as well as suppliers. The Dell story tells how innovative uses of the net that tie customers from sales through production can create dramatic advantage (Fields 2003, Kenney and Mayer 2002). And, as development and production processes are woven together to speed up the time to market and improve design choices, the lines between production, design, and development blur even more.

Let us come at this problem of the changing character of business competition from a different angle. It was long conventional to consider market competition within sectors - defined market segments with understandable sets of competitors, terms of market entry and competition. There was the auto sector, the machine tool sector, the textile or apparel sector and the like. Then along with the dot com boom the language changed and the supposedly clever and astute began to refer to "spaces", asking what "space" are you in. Many of us, myself included, dismissed this talk as calling sectors by another name, as a clever linguistic differentiation of the dot com era from predecessors. Perhaps we did so too quickly. "Spaces" turns out to be a transition word. Now one hears of the talk of "value domains", which at first glance might seem to be the notion of spaces by a different vocabulary. But let us look more closely. The notion of "value domain" points to the array of digital functions that can be embedded in a small chunk. Canon's challenges go beyond competition from camera makers, but to the very question of how photography is used and how its tools are provided. In one sense Canon's worst competitor is Nokia.[100] And Nokia, which can provide music on its cell phones, faces competition from Apple iPod, expressed concretely in a new Motorola phone. That bloc of electronics encased in plastic can be a PDA, a phone, a camera, a music device, a television. It is a "value domain", in which the products, and their functionality and design, can be defined in a whole variety of ways. But how to address that value domain? Which functionalities should be given priority?

This captures an important catch with using digital tools in addressing value domains. It is just not always evident what needs to be done, what strategies and organizations are required to create value or generate productivity. What matters for productivity increases and growth is the capacity to imagine how the underlying digital technology can be used. The imagination and the applications evolve as an array of experiments, both in technology/tools and also in the organizations that employ the tools and the business models to establish new ways of creating value. Undoubtedly, many of those experiments will fail, but some will succeed. Rather than just adding up anecdotes of success and failure, we will proceed by considering three categories of experiments: work organization, the use of knowledge, and business strategy.

Reinventing production: work organization and knowledge management

In the continuing reshuffle of the levers of advantage, the reorganization and reinvention of production represents a first category of experimentation. The introduction and application

100 Thanks to Emilie Lasseron for this observation. She is currently developing these ideas further in her work on user-centered design in a digital age.

of networks that permitted easier communication and exchange of data, even in the years before the Internet, followed a clear three-step pattern. Bar and Borrus (1993) pointed out that first existing processes were automated; secondly, from the initial but automated base experiments in the use of the new networks were launched; finally, work processes were reorganized. Critical in their story is the question of where, and by whom, experimentation and learning takes place. The same processes are evident now. Consider production and the drive to outsourcing work in the service sector. Evidently the digital capacity to store and transmit information means companies can segment and distribute work geographically and organizationally. And in the current round in the United States of outsourcing service functions offshore, lower wages have been the primary driver. Kenney and Dossani (2004) have argued in the case of India, although lower costs drove the initial move offshore, which largely meant reproducing existing activity at lower cost as it did in the early days of offshoring manufacturing, many companies found that possibilities for higher quality emerged abroad. Yet management capacity of the contract producer to manage outsourced offshore projects is as critical a variable as cost in explaining the location of tasks.

When an Indian company such as Wipro opens outsourced production activities in the United States, it is clear that management skill and experience with outsourcing, experimentation with automation of existing processes, rather than the cost of labor alone underlies the move. The conclusion must be that the service sector reorganization afoot is only partly about cost, but more fundamentally about imagining and implementing new approaches to the organization of production. Sometimes for the buyer of outsourcing services, outsourcing is an excuse to avoid tough internal choices about product strategy or internal organization. Sometimes, as in finance, outsourcing obscures the possibility of delivering distinctive services. Sometimes, as in software development, outsourcing creates risks of losing intellectual property or propagating competitors. Hence the issues of who experiments and learns, what should be done in-house, what outsourced, all re-emerge with each step.

But, of course, there are also radically new production systems, such as lean production systems in the 1980s and perhaps open source software in the digital era. Open source as a principle of organization hinges on distinct approaches to mobilization and coordination of work, not a vague voluntarism but replicable rules of participation and gain. But the principles and rules on which it rests are new. For example, it rests on foundations that turn notions of property from ones of control of the use of an object, or an objectified body of code or knowledge, into control of the processes of distribution. The collaborative work arrangements it points to are both about production of software and made possible by the digital networks (Weber 2004).

Let us turn to question of knowledge management. Knowledge, particularly theoretical knowledge, has been recognized as an essential element of the contemporary economy. Critically though it is the expression of information, data, and knowledge in digital form that is truly distinct, permitting the application of digital tools, the suite of tools for thought. In a digital form information can be formalized, stored, searched, transmitted, and used to control the operations of physical processes (Cohen, DeLong and Zysman 2000). We can put the Library of Congress onto a single digital memory stick and transmit it in flash. The complex relationships on which engines operate or planes fly can be stated as algorithms, represented in digital form. In one sense the flood of data made possible by these tools can drown the recipient, but oddly the same "tools for thought" make easier the creation of meaningful information and the generation of knowledge from that flood of data. But codified knowledge, whether stored digitally or embedded in equipment, is only a piece of knowledge that cannot stand alone. For example, how do we know in an avalanche of facts and stated relationships which ones we care about? Analytically, there are limits to both the value of piling up and searching

documented knowledge and to formalizing the tacit knowledge embedded in individuals and communities of practice. Experiments with knowledge management in this information rich era force open the very fundamental question of what knowledge is. According to Nielsen and Nielsen (2006), knowledge unfolds in the iterative processes between tacit and codified forms, and optimizing knowledge in organizations is essentially an issue of optimizing these iterative processes.

There is an organizational implication of this consideration of the nature of knowledge. Internally, the company organizations required for most efficient manufacturing may not be the same as those required for effective exploitation of knowledge. In the 1980s the Japanese innovations of flexible volume production using lean, just-in-time techniques created distinctive production advantage and rocked market competition. Is there a similar revolution afoot now? Lorenz and Valeyre (2004) claim to have identified a new learning model of corporate organization, that significantly departs from traditional craft organization, taylorist organization and lean production systems; particularly, they see this distinctive organizational form emerging in Northern Europe, principally the Nordic countries. We can only speculate as to why, pointing to experiments in work organization in an era of mass manufacturing that may be paying off in a knowledge era.

Experiments in business strategy

The tactical experiments – branding, design, versioning, production reorganization, and knowledge management – have to find expression in new business models, the underlying strategies for creating and capturing value. Those new business models must reflect the shifting location of leverage in creating value. The mistakes of conception and execution in many of the failed bubble-era business strategy experiments prove that this is not easy. Recall that the dotcom investment wave hinged on the notion that the network tools would "disintermediate" traditional distributors, that brick and mortar relationships would be replaced by electronic links, or that wholesale intermediaries would be eliminated by electronic markets. Often the fantasy was that new entrants, new companies, using these digital tools could displace established companies. There are some evident successes; the travel industry from travel agents through airlines is being reformed by online operations, but the venture capital community made a whole array of largely unsuccessful bets.[101]

By contrast, consider IBM's two fundamental shifts. IBM's first fundamental shift is from a product company wrapping its products in high value service support into a service company selling solutions that embed its products. As IBM migrated from electro-mechanical to digital information processing, it established itself as the dominant player in the market. Consequently its per unit development costs were radically lower than its competitors, making its margins substantial. That allowed "service" to be bundled into costs, offering a sense of certainty and reliability to its customers. Its market share allowed it to keep its core software, operating systems and the like, closed and privileged. That model of competition was no longer viable as the era of the mainframe and even the mini computer passed. Networks emerged supporting

101 In the bookseller market, the Borders and Barnes and Noble chain stores in their brick and mortar form are more of a threat to the local vendor than Amazon. Indeed, venture capitalists behind Amazon report that the original investment was an "experiment" in the consequences of internet-based retail marketing by new entrants, disintermediation. The conclusion they drew early on from Amazon was that there were sharp limits to the retail possibilities the tools provided. Similarly, the telecom collapse hinged on faulty notions of how data networks would be used. A most evident false notion was the asserted belief in the staggering and continuing expansion in the use of bandwidth to carry entertainment content. The image was often that the consumer net would become a sophisticated vehicle for centrally distributed content. However, the error is evident in the history of the American post office. The post office in the United States was established to distribute newspapers, but the killer application that supported the system was letters, peer-to-peer communication to use today's vocabulary (Zysman 1998). Communication, not just voice but messaging and video meetings, and peer-to-peer exchanges are likely to be the killer applications.

business services comprised of multiple networks and varied suppliers. IBM began to offer service solutions.

More generally, the IBM story points to the blurring of the distinction between services and products in a digital era. The distinction between service and product has never been very clear. Once, national accounts categories obscured the relative importance of services and production in an evolving economy (Cohen and Zysman 1987). A window washer at Nokia or GM is a manufacturing employee; if Ace Window Washers contracts to outsource the washing of Nokia's and GM windows the same employees are counted in the service sector. Now the blurred line between product and service becomes a matter of strategic importance. Consider accounting: Accounting is a personal service provided by accountants utilizing tools from the original double-entry bookkeeping system to computers. But if you create a digital accounting program and put it on a CD, put it in a box, call it Quicken, and allow its unlimited use by the purchaser, then you have a product. If you put the program on the Web for access with support for use on a fee basis, then you likely offer a service.[102]

IBM's second fundamental shift was to support "open source" software, rather than proprietary software and the development of frameworks and tools to implement solutions within that framework. Microsoft and Unix provided common platforms through which competitors could integrate their offerings, limiting IBM's leverage. Selling solutions in a multi-vendor environment suggested that a move away from closed proprietary systems might as well be to one of hyper-openness in which a capacity to define solutions, provide an integrated offering, and embed some distinctive proprietary modules would be decisive in keeping customers tied to IBM.

Assume business strategies to capture the evolving advantages of the digital era are experiments or bets with uncertainty about their success, not investments with predictable returns. Then the question is, of course, why some companies make better bets, or more effectively conduct the process of experimentation that must carry them into the future. Possibilities must be seen as just that, hypotheses about the future to be continuously evaluated.[103] Each era, one must note, has its own uncertainties and its own risks, whether it was the weather threatening ships or technical and business concerns shaping the build-out of electricity and telephone. Entrepreneurs in each epoch confront those risks and transform the possibilities into profits and growth. What is distinctive about this era is the pervasive and continuous uncertainty, in technical terms across technologies, infrastructures, sectors and products, and with respected to the competitive environment, as competitors reach out for the strategy that will overturn the character of industry competition.

Towards the experimental corporation

In short, we conceive of digital-era corporations as fundamentally experimental in character. They have to maneuver in a competitive environment, in which the "sweet spots" for corporate success are constantly changing as company internal functions become products, products become commodities, and the sources of differentiation for products and processes are constantly evolving. To deal with this fundamental uncertainty, companies need to go beyond standard planning techniques and conceive of corporate strategy as a portfolio of "experiments" akin to the business model of venture capital firms, which succeed by managing a portfolio of investments to spread risk. In their quest to create

102 Alternatively, consider pharmaceuticals. If NextGenPharma sells a drug to be dispensed by a doctor or hospital, or sold in a pharmacy, it is producing a product. With gene mapping and molecular analysis, we are moving toward the possibility of a service model of therapies adapted to particular physiologies. If NextGenPharma really is a database company with a store of detailed molecular-level drug information and genome functionality, it could sell an online service to customize drugs or therapy.

103 Certainly the dotcom era bubble reflected greedy projections of assumption rarely reassessed of greed and hope. In fear that the "moment" would pass by, images that were projections of possibilities were taken as solid facts.

value and search for the levers of advantage as traditional notions of stable "sectors" are dissolving, companies need to develop business cases on the basis of different readings of the future's strategic landscape. Investments into these business cases will turn them into experiments. However, these experiments remain largely "contained", because they will only be pursued as long as their underlying assumptions have not been proven wrong. Constant review procedures that monitor the continued viability of both the theoretical business case and its early practical application are called for. Managers must cull and systematically assess for evidence their own company's efforts and those of its competitors. As experiments in the face of quite fundamental uncertainty, these strategic choices are not bets and gambles.[104] Rather, the formulation of corporate strategy becomes a consciously emerging iterative process.

The European social model challenged and sustained?

The ever-evolving marketplace of the digital era will require companies to frequently re-cast themselves, what they produce, which markets they address, how they produce and deliver the good or service, how they are organized, and indeed, with more difficulty, whom they employ and where they employ them. The flexibility to move and to move quickly is key, but that puts great pressure on communities and polities. The final section of this paper argues European traditions of social protection can be consistent with the flexibility required for successful adaptation to the global economy.

Certainly, the ability of wealthy nations to stay wealthy in the digital era turns on the capacity of companies to adapt and adjust, to steadily increase productivity even as they remain competitive in the marketplace. The capacity of the firms to create value, and to increase the value they create, must grow if they are to remain capable of creating substantial and rising incomes.

What is called for from governments? Policy, of course, has a contribution to make to assuring the resources and building the capacities for corporate experimentation and strategic adaptation in the ever-shifting global era. Necessary policies range from the innovative to the obvious.[105] It is conventional to stress the centrality of state action in providing the secure infrastructure of the economy, both physical such as broadband lines, road and bridges, and in terms of the political and social institutions of the marketplace. The latter is particularly important; it encompasses the rules that permit companies to innovatively deploy resources and be rewarded for successful implementation in the face of risk and imagination. Good protections of intellectual property are basic provisions in this context. Furthermore, most analysts agree that state action can play a role in supporting the availability of those resources that are important for companies' experiments. To that end, governments are often called to support the provision of a skilled workforce, i.e. the talented, trained and educated people that corporations need. Ideally, governments would also provide centers of technology development and diffusion, at which some of the valuable human capital would work to reach out to companies and build – on the basis of public-private partnership – effective centers of creative imagination in support of formulating effective strategies of value creation. All this is, perhaps, obvious.

Crucial as well is the social flexibility and adaptability, the capacity to support and absorb

104 Op. cit. Eliasson. Note that this argument is consistent with and now draws on the framing argument of Gunnar Eliasson (1991).

105 However, state action is not the solution; indeed, it never was. It is an important part of a regional development strategy that needs to span both the public and private sectors. The history of most crucial developments in the digital era – the development of the internet being among them – is one of the interplay of both public purposeful action and user-driven innovation enabled by deregulation. Private actors will (have to) continue to be the source of much of the needed entrepreneurialism.

the continuous change that the competitive companies will require. In an era of constantly shifting advantage and sustained experimentation, national performance in the digital economy increasingly rests on the two social capacities, each of which require considerable flexibility. They are a country's ability to sustain individual and collective learning processes and to implement – in a manner that assures real rising incomes – the business, social and technological innovations generated by these processes.[106]

Public policies for the digital era: towards a politics of experimentation

But how do we achieve social flexibility? The fear is that the goal of social flexibility for economic adaptation may require the destruction of social protections. Or can social protections be the basis of flexibility? Let us consider the question by revisiting the long-standing policy debate on the relationship of labor market flexibility and social protection. In the experimental economy, high-skilled labor will be necessary but not sufficient. Importantly, it will need to be sufficiently flexible to support the continuous corporate re-organization made necessary by experimentation.

Simple economic models referenced in the policy debate tend to treat labor as a commodity, as one of two or three key inputs into the production process. Policy recommendations formulated on the basis of such models stress the necessity of increasing the efficiency of resource allocation by removing rigidities that inhibit the matching of supply and demand through the price mechanism. However, this set-up of the policy challenge as a primarily technical issue avoids engaging with the central issues of the labor market adjustment in the digital era. To argue that in the experimental economy, workers have to be ready to switch their focus (and potentially locus) of activity at high(er) rates is one thing. To get workers to accept this reality and democratically support those public policies that sustain such a labor market regime is quite another. A narrow, technical conception of increasing labor market flexibility tends to produce analyses that fall into one of two camps pitted against each other. On the one side, there are those that equate increasing flexibility with the deregulation of the labor market, the removal of employment protection rules and welfare state retrenchment. On the other side, there are those that want to protect the welfare state as a cornerstone of postwar models of European democracy, which underwrites individual rights to liberty and equality through its property of selectively de-commodifying labor (see Schulze-Cleven 2005).[107]

Do we need to make a choice between establishing the flexibility needed to adapt to the evolving economy and sustaining social protections against the vagaries of the market that make economic growth worthwhile? We propose that the mechanisms of social protection can be the foundations of market flexibility.

Social protections in support of labor market flexibility

Social protections against market dislocations, in some cases coming in the form of agricultural protections and in others coming as welfare state programs, have played

106 See Cohen et al (1984); This argument is also being developed in work on regional growth by Stowsky, Nielsen, and Zysman. A current take can be found in Zyman and Newman (2006).

107 Framing the debate about increasing labor market flexibility as one of maintaining-versus-retrenching the welfare state is unfortunate, because it masks the real issues. Labor as a commodity has such special properties that the existence of regulating institutions can actually increase the efficiency of labor allocation, especially in the widespread presence of information asymmetries (Spence 1972). For example, it is a highly differentiated commodity, because human beings differ greatly in both their accumulated skill sets and willingness to employ them (Iversen 2005). Furthermore, Polanyi (1944) argues that labor is merely "fictitious commodity", because it that is not produced for sale. Neither from a theoretical vantage (Marsden 2003), nor from an empirical perspective (Freeman 2005), do deregulation and reductions in social benefits seem to increase labor market performance. The debate, as it often structured, fails to recognize the positive incentives provided by many welfare state programs. Indeed, they are incentives that will prove important for companies' success in the digital era.

an important role for legitimizing markets and facilitating resource transfers. Systems of social programs have often facilitated the evolution of different country's agriculture-based economies to the industrial powerhouses they have become today. Particularly important, they have de-politicized the social transformation associated with economic development and modernization. Social protections have both pacified the losers of economic change and provided the population with an incentive structure that supported the competitiveness of a country's economy. Often, social protection systems themselves enjoyed broad based political support. A prominent example is the set of welfare state programs, which for a long time could offer something for all stakeholders. These programs offered benefits (such as redistribution and/or insurance) for the entire population and supported businesses' attempts to adapt to changing market environments, either at the micro-level of the firm or at the macro-level by de-radicalizing the national political game.

Many welfare state programs, which were originally conceived in a pre-digital era to support older production strategies, have now become dysfunctional, undermining rather than boosting current strategies of value creation. While the success of Fordist systems required Keynesian policy buffers to offset systemic political and production rigidity, the digital era poses a new set of political and production challenges. But the basic historical lesson for the public policy challenge still holds: Systems of social protection can play an important role in supporting economic adjustment. The processes of cushioning market shocks might, under certain circumstances, facilitate the workings of the market; or, to invoke a metaphor, there is no doubt that shock absorbers in cars do actually increase the cars' driving performance. We believe that systems of social protection continue to have a role in the current era. Of course, the displaced may fear and resist, but accepting the necessities of the broader economic adjustment is always easier if one see the possibilities of one's own place in that future.

The level and distribution of social protection, who gets how much, is not the only issue. The mechanisms of providing it have distinct consequences for the operation of labor markets and the political dynamics sustaining economic adjustment. Take, for example, Japan, France and Spain. In Japan, social protection is often embedded in private employment structures. One consequence is that firm failure is "socially too expensive", in turn often leading to continued bank financing to prop up troubled companies. Achieving flexibility in the Japanese context would require unwinding the nexus of company/finance/social protection institutions (Levy, Miura, and Park 2006). In France, apart from the formal system of government finance social protections, the economy abounds with an array of "acquired rights," situations that embed privileges from taxi licenses through café licenses to protection of job locations. Social protection is embedded in the defence of particular social and employment arrangements (Cahuc and Kramarz 2004). In Spain, from the late 1970s onwards, the level of social protection and employment security has greatly diverged between labor market insiders and ever-larger numbers of outsiders, such as the unemployed and temporary workers. In the aftermath of Spain's transition to democracy, the first government introduced a set of wage-bargaining institutions that did not permit firms to set wages reflecting firm-level differences in productivity. Combining with a legal system that constrained firms from easily shedding excess labor, these institutions led to frequent company bankruptcies, a fall in output and spiraling unemployment. When in 1984 the government made it easier for firms to fire workers, these attempts strongly increased labor market segmentation, i.e. reinforcing the bargaining power and wages of insiders while concentrating economic insecurities among rising numbers of temporary workers (Watson 2006).

At the issue's most narrow framing, we can distinguish between two fundamental ways of protecting workers' against uninsurable labor market risk, either preventing worker lay-offs

through employment protection legislation (EPL) or provide unemployment benefits (UB) (Boeri 2002). More generally, social protection systems can either substitute for the market, i.e. discouraging structural change, or allow the market to allocate resources and provide security through benefits post-allocation, i.e. encouraging structural change. In Continental European countries such as Germany and France, social protection systems are structured so as to protect the job-insiders with strict employment protection rules and shield the self-employed from competition. Outsiders – while often recipients of public social assistance benefits – tend to remain unemployed with little chance of re-integration into the workforce. In contrast, universalist systems such as the Danish one, tend to allow the market mechanism to efficiently allocate resources while "embedding" its workings within an environment that provides significant levels of social security.

To gain analytic leverage on this diversity, we need to distinguish the different dimensions of social protection systems. They diverge in at least four respects:

- Who is protected;
- The level and form of protection, an issue not just about the monetary amount but a matter of whether particular jobs or positions are supported;
- The mechanism of delivery, i.e. whether services are administered or cash granted;
- The influence on the operations of adjustment in the economy.

The same level of protection for the same groups of people can be delivered in very different ways with very different consequences. And the obvious aspects of these different ways are not always the most important ones. The politically most difficult controversies are often about social identity. Often what is in dispute is not just economic well-being, the level of support, but the social place of particular groups and jobs in the economy that turns on the character and form of protection. Social protection systems are not created equal, and while some definitely act as barriers to labor market flexibility, others might actually increase both the legitimacy of a flexible labor market regime and the actual mobility of the workforce. While particular systems of social protection facilitate the social adjustment necessary for the experimental economy, others hinder it. As a result, stripping social protections represents only one possible way of increasing labor market flexibility.[108]

Security, flexibility and skills

The capacity to reconcile market flexibility and the social principles of security hinges very powerfully on how social protection is provided, not just who receives it or how much. This is evident when we consider two different aspects of labor market adaptation. One, already noted, is the question of providing social security to facilitate market functioning, the notion that labor market flexibility can be achieved with and perhaps through social protection. The other related matter is that of training, i.e. who is trained, in what form, and paid by whom as part of labor adjustment. We use the Danish case to consider each in turn.

The Danish notion of "flexicurity", i.e. combining the promotion of labor flexibility with the provision of social security, has attracted considerable attention in Europe (Sapir 2006,

108 The academic literature on the different regimes of welfare capitalism provides a good starting point for an inquiry into the different incentives for social mobility provided by countries' systems of social protection (see especially Esping-Andersen 1990). Importantly, in the process of studying this literature, we do not need to buy into the literature's frequent normative biases that prompted Philip Manow (2002) to invoke the title of one of Sergio Leone's famous Spaghetti Westerns for his characterization of the comparisons between the universalist Social Democratic regimes of Scandinavia, the low-spending Liberal Anglo-Saxon countries and the high-spending but stratifying conservative systems of Continental European countries as a competition between "The Good, The Bad, and The Ugly." Protecting current employment turns out to be harmful with respect to both efficiency targets and the legitimacy of a flexible labor market regime, while protections against the negative effects associated with unemployment can jointly enhance mobility and efficiency (Hall 2006).

Zysman 2006).[109] In Denmark, a Scandinavian country with a long Nordic tradition of providing social protection as part of citizenship rights, the broad social foundation of protections seem to have contributed to sustaining a political deal that makes it is easy for companies to adjust the sizes of their workforce due to the relative lack of employment protection legislation or collectively mandated rules. It is a system that is supported broadly by the various sections of society, not least because easy firing often translates into easy hiring.[110] As a result, Danish job mobility levels match those of the United States and Britain, with median job tenure in Denmark at a relatively short 4.4 years, compared to 10.7 years in Germany and 7.8 years in Sweden. Interestingly, the Danes do not seem to fear the flexibility that companies expect from them. In an OECD survey conducted in 1996, the proportion of Danish workers not strongly agreeing with the statement "my job is secure" was considerably lower in all other sampled countries (OECD 1997, quoted in Madsen 2006). It thus seems clear that far from always acting as rigidities, which hinder the workings of the market mechanism through distorting price signals and raising the reservation wage, systems of social protection can – if designed correctly – underwrite a flexible labor market regime by both increasing the legitimacy of the economic system and delivering actual outcomes.

In our view, the Danish case can act as a demonstration for the possibility of combining economic modernization with European traditions of social protection.[111] In fact, the Danes might have successfully updated the production paradigm of flexible specialization for the digital era. Denmark seems to have leveraged both long-standing historical legacies and more recent reforms of established systems of social protection for creating an environment that provides companies with the flexibility to experiment and facilitates both individual and collective learning (Campbell and Hall 2006, Lundvall 2002).[112] Reforms in the mid-1990s updated a set of institutions, which had sustained a high degree of fluidity in the Danish labor market during the last 70+ years, through selective decentralization and the introduction of more competitive elements into a highly cooperative system.[113] Consequently, the Danish policy regime has become widely known as one delivering "flexicurity" (Wilthagen

109 For a good overview piece on the Danish "flexicurity" regime, see Marsden (2006); for a more theoretical and comparative perspective, see Wilthagen and Tros (2004).

110 The Danish Confederation of Trade Unions stresses that "Danish companies are more willing to hire new employees in times of economic revival than their European competitors, who have trouble letting off workers when the economy goes downhill again (Fuller 2004)."

111 The economic success of Denmark in the current market environment has come as a surprise to many analysts. As recently as in 1990, influential business analyst Michael Porter predicted Denmark's certain decline on account of its outdated political economy. Now, with employment and growth numbers envied by many other European countries, politicians and academics have started to speak of the Danish 'miracle' (Nielsen and Kesting 2003, Schwartz 2001). Such talk is partially due to the relative inability of established frameworks to account for the Danish success story. Denmark could not build on a legacy of high-technology industries or homegrown multi-national corporations such as neighboring Sweden. Rather, Denmark's performance largely rests on small and medium-sized enterprises in sectors that were originally seen as being mature, generating slow growth and exhibiting low technological intensity. With the analytic framework developed in this essay, we can get a handle on understanding why the country was able to weather the storms of the digital era.

112 Among the legacies being invoked by various analysts are the social cohesion stemming from the particulars of the Danish history of nation-building (Campbell and Hall 2006) and the high degree of concertation flowing from Denmark's small-country size (Katzenstein 2006, Nielsen 2003). Kristensen (2006) stresses the role played by Denmark's worker training systems and the peculiar organization of the systems of social protection in creating the high degree of fluidity that has characterized the Danish labor market for almost 75 years.

113 In the process, the degree of strategic rationality displayed by Danish elites in their reflection on the Danish performance in the digital era is most remarkable (see Innovation Council 2004, FORA 2005). On the basis of the country's small size and a strong corporatist tradition, Denmark's policy networks display strong public-private links and a high degree of coherence. In such a context, formulating a "national strategy" seems an entirely realistic vision, an assessment shared by many Danish decision makers. This outcome has been achieved in an environment, in which 76 percent of Danish workers were union-members in the mid-1990s, and collective wage-bargaining has a very strong tradition. Indeed, while recently yielding more scope for decentralized decision-making, collective agreements have played an important role for delivering flexibility in another dimension of labor deployment. Since 1965, these agreements have included provisions for flexible working hours, which – after further expansion in 1995 – also place the Danish labor market among the most flexible in Europe with respect to work scheduling (Campbell and Pedersen 2005, 16-20).

and Tros 2004), i.e. combining the promotion of labor flexibility with the provision of social security.[114]

Encouraging skill investments in the face of labor market flexibility

The story, of course, is not just one of 'protection from change' but 'preparation for change'. That the skills required by future workforces will evolve constantly over the next years, it is well understood. Lifetime jobs are giving way to careers of shifting position. The knowledge one has at entry in the workplace will not suffice. Skills, and skill training, will become all the more important as lifetime employments give way to a sequence of shifting positions.

Investment in skills is an important aspect of the ability of workers, of any sort, to adapt to changes in job requirements. It is, as we all know, a real element of labor market flexibility. Again, as with security against the dislocations of the marketplace, the absolute level of spending is only one part of the story. Again, the questions relevant to labor markets include not just whether there is investment in skills or what the level of spending is. Rather, it is important who pays, what kind of training is provided, and which obligations might be involved. Our intent here is not to propose a "correct" scheme of training, or explore the proper balance between "general knowledge" and "firm specific skills". The purpose is, rather, to emphasize that "how" training or skilling are provided is a central matter.

As a means to emphasize the importance of the mechanisms, the how of delivery, let us consider the balance between "general knowledge" and "firm specific skills". Recent research has pointed out that systems of social protection can provide workers with important incentives to invest into skill sets that are specific to companies or sectors (Estevez-Abe et al 2001). Prominent examples range from the study of certain engineering methods at the university level to the completion of narrowly defined apprenticeships. In the absence of generous unemployment insurance schemes, a rational worker would choose to invest in general skills, such as they are provided in management training. The reasoning is simple: The more general the skill set, the easier it is to find a job and minimize dependency on unemployment benefits; also, more general skill sets are less threatened to become outdated by technological change (Iversen 2005). However, the aggregation of these rational individual choices presents a collective action problem. Economies, experimental or not, need workers with highly specific skills to develop new products in support of economic growth.

Workers' incentives for skill investments are arguably becoming more important than they have always been, because employers' incentives to invest in training are likely being reduced in the new age of labor market flexibility. At least this is a possible and logical conclusion to draw from the empirical findings of another body of comparative empirical research on the political economic consequences of the positive relationship between employers' incentives for human capital investment and the stability of employment relationships. In the digital era, experimental companies desperately need a high-skill workforce, but they continue to want their investments in human capital to pay off for them and not their competitors to which their employees might well move. A standard comparison has long been that between Germany and Britain. In Germany, a high degree of employer coordination has long sustained both industry-wide collective bargaining, which has

114 This outcome has been achieved in an environment, in which 76 percent of Danish workers were union-members in the mid-1990s, and collective wage-bargaining has a very strong tradition. Indeed, while recently yielding more scope for decentralized decision-making, collective agreements have played an important role for delivering flexibility in another dimension of labor deployment. Since 1965, these agreements have included provisions for flexible working hours, which – after further expansion in 1995 – also place the Danish labor market among the most flexible in Europe with respect to work scheduling (Campbell and Pedersen 2005, 16-20).

encouraged longer job tenures through restricting the scope of worker poaching by competing companies, and a vocational training system run jointly with unions and state authorities, which provides even smaller companies with the capacities to train their new workers. In contrast, companies in the flexible British environment never successfully solved their collective action problem of investing into the broad up-skilling of the national workforce (see e.g. Thelen 2004). The respective success of national business communities in generating high-skill workforces have deeply affected the production strategies that individual companies could adopt and the types of wages they were able to pay. While German companies could embrace the strategies later described as diversified quality production and flexible specialization (Streeck 1991), British companies have tended to go the low-skill, low-cost Fordist route that very quickly brought them in direct competition with producers from newly industrializing countries (King and Wood 1999).

With shorter job tenures in the digital era, employers' human capital investment decisions are made on the basis of shorter time horizons for potential amortization. This development can have important consequences. An undesirable scenario would be the one that has played itself out on the Iberian Peninsula. With strong incentives to reduce labor costs through using temporary workers, Spanish companies are much more likely to adopt a low-wage/skill production strategy. In turn, their productivity has slipped. In contrast to the Spanish trajectory of consolidating the position of labor market insiders at the expense of ever-larger numbers of outsiders such as the unemployed and temporary workers, Portugal adopted a set of policies that facilitated employment adjustment rather than the maintenance of the wages and benefits of current workers. Although Portugal's 'flexible' strategy of low-wage economic growth has arguably limited the spread of unemployment by maintaining employment in low-skill, labor-intensive sectors such as textiles and ceramics, it has not provided a stable basis for growth in high value-added sectors. As a result, Portugal faces rising competition from new EU and other industrializing countries, which have higher-skilled workforces and lower wages (Watson 2006).

However, the contrasts between high-skill and low-skill production strategies might at least be partially over-drawn, and rather than reducing company-sponsored skill investment, shorter job tenures will merely be associated with new forms of employer-sponsored skill investments. In combination with the increasing pace of technological change that leads to accelerated outdating of skill sets, shorter job tenure rates might make unsustainable the heavy reliance on intensive skill investment at the beginning of workers' careers of German-style two to three-year apprenticeships. At the same time, efforts to frequently re-skill worker might remain viable and indeed very important, in particular as these are focused on specific tasks in the spirit of continuous employee and organizational learning. Interestingly, continuous re-skilling is another area in which Denmark excels. In contrast to other European countries' apprenticeship programs, the Danish system does not concentrate on vocational education and training at the beginning of workers' careers. According to EU statistics, Danish workers spend more time in training and skill formation programs than workers in any other member state of the European Union.[115]

115 Importantly, three changes in the 1990s have further increased the efficacy of these programs. First, the vocational training system was opened to the unemployed with the goal of using the economic downturns to upgrade their skills, making it in turn more attractive for companies to hire them during the next upswing. Second, union-employer negotiations over the organization of the blue-collar training curriculum were decentralized, so as to target skill acquisition more effectively to local needs. Third, new skill upgrading programs were introduced to allow workers to spend more time away from work. This measure increased the level of competition among technical schools and raised the quality of the training provided (Campbell and Pedersen 2005, 21-26).

Again, Denmark serves to demonstrate that a tradition of social protection can be reconciled with the necessities of market flexibility. Flexibility does not require removing social protections. Consider that Denmark is the country with the highest labor market mobility and training rates on the European continent and also the OECD country with the highest level of employment policy expenditures. In cases of unemployment, the Danish system offers generous replacement levels for limited periods of time, so that individuals can search for the most suitable job for themselves rather than having to take the first available one for lack of personal financial liquidity. Furthermore, individuals, who do not find new employment within this period, are required to join training schemes to remain eligible for public support. Public expenditures for training and unemployment benefits are high, but they constitute an investment into the future of the affected individuals and the productivity of the country. In contrast to the mixed record of active labor market policy in other countries, the Danish system seems to work well, not least because companies can shape the programs to meet their local needs.

In turn, on the micro-level, Danish businesses seem to have an extended set of options for organizing their activities. In comparison to their competitors, they can grant their workers more autonomy, leaving them with more discretion for decision-making unconstrained by hierarchical supervision systems (Dobbin and Boychuk 1999). Lorenz and Valeyre's recent analysis of European data demonstrates convincingly how a new corporate 'learning' model with these organizational features is more prevalent in those countries with universalist systems of social protection.[116] Through tapping into individuals' knowledge to provide organizational flexibility, the learning model provides a good basis for experimental corporate strategy.[117] For instance, Campbell and Pedersen (2005, 25) invoke the characteristics of the learning organization in their explanation of the Danish success in niche market opportunities in the global economy. They attribute Denmark's position as a world leader in the production of wind turbines to the "incremental innovations in wind turbine technologies that Danish firms developed through close collaborations with their customers, production workers, and engineers who continuously experimented with and developed improved blade and turbine technologies over the years."

In lieu of a conclusion: the agenda for Europe

This essay makes two arguments. First, countries and companies face an ever more volatile competitive marketplace. They have to maneuver in a competitive environment, in which the "sweet spots" for corporate success are constantly changing as company internal functions become products, products become commodities, and the sources of differentiation for products and processes are constantly evolving. This new "formula" for corporate success requires a social capacity for flexibility and adaptation. Second, social protections often serve as essential sources of social capacity for adaptation and

116 The analysis was conducted using data from the third European Survey on Working Conditions (Paoli and Merllié 2001). To arrive at this conclusion, the authors distinguish between the 'lean' production model, originally theorized by Womack et al (1991), and the newly conceptualized 'learning' model as corporate organizational templates geared towards the competitive marketplace of the digital era. While both models display stronger learning dynamics and higher problem-solving activity on the part of employees than either taylorist or pre-Fordist traditional organizations, the learning model constitutes a distinct way of delivering flexibility and cooperation within the company. Companies organized along the lines of the lean model display such attributes as the strong use of teamwork, job rotation, quality management and multiple work pace constraints. In contrast, the uniquely socially embedded learning model is more decentralized and grants employees a high degree of autonomy. According to Lorenz and Valeyre, the learning model building on local traditions in work organization, for example, the Swedish socio-technical principles of the 1970s. For a review of Lorenz and Valeyre's findings and a discussion of their implication for research in Comparative Political Economy, see Schulze-Cleven (2006).

117 For example, Sabel (1994, 136) reports that shop stewards in the metalworking industry invented new payment, training, and job classification systems to increase the flexibility of production and the general skill level among workers.

change. There is not an inherent contradiction between social protections and market flexibility. The essential issues are how those protections are organized and delivered. The dilemma of many continental European countries to provide "welfare without work" (Esping-Andersen 1996, Scharpf 2001) after a history of "adjusting badly" (Manow and Seils 2000) is only one possible outcome. To the contrary, if adapted rather than abandoned, European traditions can be the basis of continued growth and productivity in a competitive marketplace.

It has always remained outside the scope of this paper to advance specific policy recommendations. Writing in the United States, we feel hesitant to prescribe solutions – for that task we defer to our European friends. In an insightful recent piece that appeared as we were editing this essay, André Sapir (2006) advances policy recommendations on the basis of an intellectual framework that seems compatible with ours. In his view, only the Scandinavian and Anglo-Saxon variants of the European Social Model will in the end be sustainable, leaving those countries that make up two-thirds of the GDP of the entire EU-25 with a list of necessary reforms. Sapir seems to agree with us that Denmark might have valuable lessons to offer. While reforms will in the end involve a fair share of deregulation and liberalization, we strongly believe that one should not forget about the potential efficiency-enhancing benefits of pre-exiting institutions such as the systems of social protection (see e.g. Ornston and Rehn 2006). Europe has benefited from them in the past. Our analysis leads us to believe that reforming – rather than scrapping – them will best support economic adjustment in the digital era.

References

- Bar, François and Michael Borrus. 1993. *The Future of Networking*. Berkeley: Berkeley Roundtable on the International Economy.
- Baran, Barbara. 1986. The Technological Transformation of White Collar Work: A Case Study of the Insurance Industry. PhD Dissertation. Berkeley: University of California.
- Bell, Daniel. 1973. The Coming of Post-Industrial Society. A Venture in Social Forecasting. New York: Basic Books.
- Boeri, Tito. 2002. Let Social Policy Models Compete and Europe Will Win. Paper presented at a Conference hosted by the Kennedy School of Government, Harvard University, April 11-12.
- Borrus, Michael. 1997. Left for Dead: Asian Production Networks and the Revival of US Electronics. BRIE Working Paper 100. Berkeley: Berkeley Roundtable on the International Economy.
- Borrus, Michael and John Zysman. 1997. Globalization with Borders: The Rise of Wintelism as the Future of Industrial Competition. Industry and Innovation, 4 (2).
- Boyer, Robert and J. Rogers Hollingsworth. 1997. Contemporary Capitalism: The Embeddedness of Institutions. New York: Cambridge University Press.
- Brynjolfsson, Erik and Lorin M. Hitt. 2004. The Catalytic Computer: Information Technology, Enterprise Transformation and Business Performance" In William Dutton, Brian Kahin, Ramon O'Callaghan and Andrew Wyckoff (eds.), Transforming Enterprise. Cambridge, MA: MIT Press.
- Cahuc, Pierre and Francis Kramarz. 2004. De la Précarité à la Mobilité: Vers une Sécurité Sociale Professionnelle. Paris: Rapport au Ministre d'Etat, Ministre de l'Economie, des Finances et de l'Industrie et au Ministre de l'Emploi, du Travail et de la Cohésion Sociale.
- Campbell, John L. and John, A. Hall. 2006. The State of Denmark. In John L. Campbell, John A. Hall and Ove K. Pedersen (eds.), National Identity and the Varieties of Capitalism: The Danish Experience. Montreal: McGill-Queen's University Press.

- Campbell, John L. and Ove K. Pedersen. 2005. The Varieties of Capitalism and Hybrid Success: Denmark in the Global Economy. Unpublished Manuscript.
- Christensen, Clayton. 1997. The Innovator's Dilemma: When New Technology Causes Great Firms to Fail. Boston: Harvard Business School Press.
- Cohen, Stephen S., Bradford Delong, and John Zysman. 2000. Tools for Thought: What is New and Important about the "E-conomy"? BRIE Working Paper 138. Berkeley: Berkeley Roundtable on the International Economy.
- Cohen, Stephen S., Laura Tyson, John Zysman and David Teece. 1984. Competitiveness (Volume III of the Report of the President's Commision on Industrial Competitiveness). BRIE Working Paper 8. Berkeley: Berkeley Roundtable on the International Economy.
- Cohen, Stephen S. and John Zysman. 1987. Manufacturing Matters: The Myth of the Post-Industrial Economy. New York: Basic Books.
- Coriat, Benjamin. 1990. The Revitalization of Mass Production in the Computer Age. Paper presented at the UCLA Lake Arrowhead Conference Center, Los Angeles, CA, March 14-18.
- Dobbin, Frank and Terry Boychuk. 1999. National Employment Systems and Job Autonomy: Why Job Autonomy is High in the Nordic Counties and Low in the United States, Canada and Australia. Organization Studies 20(2): 257-292.
- Dossani, Rafiq and Martin Kenney. 2004. Went for Cost, Stayed for Quality? Moving the Back Office to India, BRIE Working Paper 156. Berkeley: Berkeley Roundtable on the International Economy.
- Eliasson, Gunnar. 1991. Modeling the Experimentally Organized Economy. Journal of Economic Behavior and Organization 16(1-2): 153-182.
- Esping-Anderson, Gøsta. 1990. The Three Worlds of Welfare Capitalism. Princeton: Princeton University Press.
- Esping-Anderson, Gøsta. 1996. The Welfare States without Work: The Impasse of Labour Shedding and Familialism in Continental European Social Policy. In Gøsta Esping-Anderson (ed.), Welfare States in Transition: National Adaptations in Global Economies. London: Sage.
- Estevez-Abe, Margarita, Torben Iversen and David Soskice. 2001. Social Protection and the Formation of Skills: A Reinterpretation of the Welfare State. In Peter Hall and David Soskice (eds.), Varieties of Capitalism: The Institutional Foundations of Comparative Advantage. Oxford: Oxford University Press.
- Fields, Gary. 2003. Territories of Profit: Communications, Capitalist Development, and the Innovative Enterprises of G. F. Swift and Dell-Computer. Stanford: Stanford University Press.
- FORA. 2005. Innovation Monitor: An Assessment of Denmark's Innovation Capacity. Copenhagen: Ministry of Economic and Business Affairs.
- Freeman, Richard B. 2005. Labor Market Institutions without Blinders: The Debate over Flexibility and Labor Market Performance. International Economic Journal 19 (2):129-145.
- Fuller, Thomas. 2004. The Workplace: Firing's Easy in Denmark; so is Hiring. International Herald Tribune (Wednesday, December 15).
- Hall, Peter. 2006. Danish Capitalism in Comparative Perspective. In John L. Campbell, John A. Hall and Ove K. Pedersen (eds.), National Identity and the Varieties of Capitalism: The Danish Experience. Montreal: McGill-Queen's University Press.
- Hirst, Paul and Jonathan Zeitlin. 1997. Flexible Specialization: Theory and Evidence in the Analysis of Industrial Change In J. Rogers Hollingsworth and Robert Boyer (eds.), Contemporary Capitalism: The Embeddedness of Institutions. Cambridge: Cambridge University Press.

- Innovation Council. 2004. Denmark in the Global Knowledge Economy. Copenhagen: The House of Monday Morning.
- Iversen, Torben. 2005. Capitalism, Democracy, and Welfare. Cambridge: Cambridge University Press.
- Iversen, Torben and Anne Wren. 1998. Equality, Employment and Budgetary Restraint: The Trilemma of the Service Economy. World Politics 50(4): 507-46
- Jaikumar, Ramchandran. 1988. From Filing and Fitting to Flexible Manufacturing: A Study in the Evolution of Process Control. Working Paper 88-045. Boston: Graduate School of Business Administration, Harvard University.
- Katzenstein, Peter. 2006. Denmark and Small States. In John L. Campbell, John A. Hall and Ove K. Pedersen (eds.), National Identity and the Varieties of Capitalism: The Danish Experience. Montreal: McGill-Queen's University Press.
- Kenney, Martin and David Mayer. 2002. Economic Action Does Not Take Place in a Vacuum: Understanding Cisco's Acquisition and Development Strategy. BRIE Working Paper 148. Berkeley: Berkeley Roundtable on the International Economy.
- King, Desmond and Stewart Wood. 1999. The Political Economy of Neoliberalism: Britain and the United States in the 1980s. In Herbert Kitschelt, Peter Lange Gary Marks, John Stephens (eds.), Continuity and Change in Contemporary Capitalism. Cambridge: Cambridge University Press.
- Kristensen, Peer Hull. 2006. Business Systems in Age of the "New Economy": Denmark Facing the Challenge. In John L. Campbell, John A. Hall and Ove K. Pedersen (eds.), National Identity and the Varieties of Capitalism: The Danish Experience. Montreal: McGill-Queen's University Press.
- Levy, Jonah, Mari Miura and Gene Park. 2006. Exiting Etatisme? New Directions in State Policy in France and Japan. In Jonah Levy (ed.), The State after Statism: New State Activities among the Affluent Democracies. Cambridge, MA: Harvard University Press.
- Lorenz, Edward, and Antoine Valeyre. 2004. Organisational Change in Europe: National Models or the Diffusion of a New 'One Best Way'? Paper presented at DRUID Summer Conference, Elsinore, Denmark.
- Lundvall, Bengt-Åke. 2002. Innovation, Growth and Social Cohesion: The Danish Model. Cheltenham, UK: Edward Elgar.
- Madsen, Per Kongshoj. 2006. How Can It Possibly Fly? The Paradox of a Dynamic Labor Market in a Scandinavian State. In John L. Campbell, John A. Hall and Ove K. Pedersen (eds.), National Identity and the Varieties of Capitalism: The Danish Experience. Montreal: McGill-Queen's University Press.
- Manow, Philip. 2002. 'The Good, the Bad, and the Ugly.' Esping-Andersens Wohlfahrtsstaatstypologie und die konfessionellen Grundlagen des westlichen Sozialstaats. Kölner Zeitschrift für Soziologie und Sozialpsychologie 54: 203-225.
- Manow, Philip and Eric Seils. 2001. Adjusting Badly: The German Welfare State, Structural Change, and the Open Economy. In Fritz W. Scharpf and Vivien A. Schmidt (eds.), Welfare and Work in the Open Economy (vol. II): Diverse Responses to Common Challenges. Oxford: Oxford University Press, 2000.
- Marsden, David. 2003. Adapting European Labour institutions to Global Economic and Technical Change. In Jean-Philippe Touffut (ed.), Institutions, Innovation and Growth. Cheltenham: Edward Elgar/ Saint-Gobain Centre for Economic Studies.
- Meulders, Danièle and Luc Wilkin. 1987. Labour Market Flexibility: Critical Introduction to the Analysis of a Concept. Labour and Society 12(1): 87-106.

- Nielsen, Klaus. 2003. Dansk Mirakel Nat Litenhet Omvandleats Till Styrka. Axess 2: 22-24 (The English version is published as "Why Small is Beautiful in the Danish Economy" at www.axess.se).
- Nielsen, Klaus and Stefan Kesting. 2003. Small is Resilient: The Impact of Globalization on Denmark. Review of Social Economy 61(3): 365-387.
- Nielsen, Niels Christian and Maj Cecilie Nielsen. 2006. Spoken-about Knowledge: Why it takes much more than 'Knowledge Management' to Manage Knowledge. In John Zysman and Abraham Newman (eds.), How Revolutionary was the Revolution? National Responses, Market Transitions and Global Technology in the Digital Era. A BRIE/ETLA/HELSINKI Project. Stanford: Stanford University Press.
- OECD. 1997. Employment Outlook. Paris: OECD.
- Ornston, Darius and Olli Rehn. 2006. An Old Consensus in the "New" Economy? Institutional Adaptation, Technological Innovation and Economic Restructuring in Finland. In John Zysman and Abraham Newman (eds.), How Revolutionary was the Revolution? National Responses, Market Transitions and Global Technology in the Digital Era. A BRIE/ETLA/HELSINKI Project. Stanford: Stanford University Press.
- Paoli, Pascal and Damien Merllié. 2001. Third European Survey on Working Conditions 2000. Luxembourg: Office for Official Publications of the European Communities.
- Polanyi, Karl. 1944. The Great Transformation. The Political and Economic Origins of Our Time. Boston: Beacon Press.
- Porter, Michael. 1990. The Competitive Advantage of Nations. New York: The Free Press.
- Sabel, Charles. 1994. Flexible Specialization and the Re-Emergence of Regional Economies. In Ash Amin (ed.), Post-Fordism: A Reader. Oxford: Blackwell Publishers.
- Sapir, André. 2005. Globalization and the Reform of European Social Models. Bruegel Policy Brief 2005/01. Brussels: Bruegel.
- Scharpf, Fritz W. 2001. Employment and the Welfare State: A Continental Dilemma. In Bernhard Ebbinghaus and Philip Manow (eds.), Comparing Welfare Capitalism: Social Policy and Political Economy in Europe, Japan and the USA. New York: Routledge.
- Schulze-Cleven, Tobias. 2005. The Politics of Increasing Labor Market Flexibility in Europe: The UK, Germany and Denmark. Paper presented at the Annual Meeting of the American Political Science Association, September 1-4 in Washington, DC
- Schulze-Cleven, Tobias. 2006. A Research Note on the Learning Organization. In John Zysman and Abraham Newman (eds.), How Revolutionary was the Revolution? National Responses, Market Transitions and Global Technology in the Digital Era. A BRIE/ETLA/HELSINKI Project. Stanford: Stanford University Press.
- Schwartz, Herman. 2001. The Danish 'Miracle': Luck, Pluck or Stuck? Comparative Political Studies 34(2): 131-155.
- Shannon, Claude Elmwood. 1993. A Mathematical Theory of Communication. In N.J.A. Sloane and Aaron D. Wyner (eds.), Claude Elmwood Shannon: Collected Papers. New York: IEEE Press.
- Shapiro, Carl and Hal R. Varian. 1999. Information Rules: A Strategic Guide to the Network Economy. Boston: Harvard Business School Press.
- Spence, A. Michael. 1972. Market Signaling: The Informational Structure of Job Markets and Related Phenomena. Cambridge, MA: Harvard University Press.
- Streeck, Wolfgang. 1991. On the Institutional Conditions of Diversified Quality Production. In Egon Matzner and Wofgang Streeck (eds.), The Socio-Economics of Production and Employment. London: Edwar Elgar.

- Tate, John J. 1995. Driving Production Innovation Home: Guardian State Capitalism and the Competitiveness of the Japanese Automotive Industry. Berkeley: Berkeley Roundtable on the International Economy.
- Thelen, Kathleen. 2004. How Institutions Evolve: The Political Economy of Skills in Germany, Britain, Japan and the United States. Cambridge: Cambridge University Press.
- Tyson, Laura and John Zysman. 1989. The Politics of Productivity: Developmental Strategy and Production Innovation in Japan. In Chalmers Johnson, Laura Tyson, and John Zysman (eds.), Politics and Productivity: The Real Story of How Japan Works. New York: Ballinger.
- Watson, Sara. 2006. Party Strategies and the Politics of Social Protection in Post-Authoritarian Southern Europe. PhD Dissertation in Political Science. Berkeley: University of California.
- Weber, Steven. 2004. The Success of Open Source. Cambridge, MA: Harvard University Press.
- Wilthagen, Ton and Frank Tros. 2004. The Concept of "Flexicurity": A New Approach to Regulating Employment and Labor Markets. Transfer 2(4).
- Womack, James P., Daniel T. Jones, and Daniel Roos. 1991. The Machine that Changed the World. New York: Harper Perennial.
- Zysman, John. 2004a. Manufacturing in a Digital Era: Strategic Asset or Vulnerable Commodity?" New Directions in Manufacturing: Report of a Workshop. Washington DC: The National Academies Press.
- Zysman, John. 2004. Transforming Production in a Digital Era. In William Dutton, Brian Kahin, Ramon O'Callaghan, and Andrew Wyckoff (eds.), Transforming Enterprise. Cambridge, MA: MIT Press.
- Zysman, John and Abraham Newman (eds.). 2006. How Revolutionary was the Revolution? National Responses, Market Transitions and Global Technology in the Digital Era. A BRIE/ETLA/HELSINKI Project. Stanford: Stanford University Press.
- Zysman, John. 2006. Creating Value in a Digital Era (Exploring the Experimental Economy: How Do Wealthy Nations Stay Wealthy?) In John Zysman and Abraham Newman (eds.), How Revolutionary was the Revolution? National Responses, Market Transitions and Global Technology in the Digital Era. A BRIE/ETLA/HELSINKI Project. Stanford: Stanford University Press.

5. Beyond the Lisbon Strategy: Information Technologies for the Sustainable Knowledge Society

by Emilio Fontela

Although the time required for a technological development to move from the laboratory to the market is shortening, it still remains true that broad technological change is a long-term affair. For example, the successful implementation of the innovation of mobile phones has required more than twenty years to achieve maturity in the advanced industrial countries.

Although many economists had been interested in the great fluctuations that were observable in prices and rates of economic growth over the first two centuries of the industrial era, it was Schumpeter who associated business cycles with the discontinuous behaviour of technological developments and innovation (Freeman, 1996; Fontela & Pulido, 1991). Schumpeter had been in contact with Walras, and was sceptical of the prevailing notion of 'static general equilibrium'. Since his early doctoral research project, Schumpeter had been of the opinion that economics had to incorporate more dynamic considerations and that economic dynamism was linked to entrepreneurial innovative capacity. He envisaged two possible models for the role of technology in these entrepreneurial innovative strategies. These can be summarised as follows:

- The first was that technology emerged from science without further explanation, and was available to innovating entrepreneurs in a 'pool' of technological opportunities—a view that was, in a sense, coherent with the classical economic idea of small entrepreneurs acting in free competition.
- The alternative model was that technology resulted from a conscious research investment on the part of the entrepreneurs. This was part of their quests for temporary monopolistic positions that would allow them to increase their profit rates above market-driven averages. This second ('endogenous') model of technological change led to Schumpeter being characterised as a promoter of large corporations with high market power.

In some respects, these two views of the entrepreneur's strategies reflect what are now known as: (i) the 'supply–push' conception of technological change (analogous to the 'pool' of available technologies noted in the first model above); and (ii) the 'demand–pull' conception of such change (analogous to the conscious research investments for 'endogenous' technologies noted in the second model above).

Although there are no special references in these models to factors that could cause sudden discontinuities, Schumpeter's intuitive belief that technological change is linked to long-term cycles requires analysis that takes into account the essential characteristics of the technological production system—in particular, the existence of links between technological innovative developments and economies of scale and economies of scope (Wolff, 1997). In this regard, the concept of 'clusters of technologies' has been used by neo-Schumpeterians, such as Pérez (2002), in their analyses of cyclical paths and technological discontinuities. Similarly, neo-classical scholars have conceived the notion of technological 'chocks' causing temporary disturbances of the general equilibrium of economic systems (Adelman, 1965; Verspagen & Werker, 2003).

Allowing for the limits of historical analysis, and assuming that the past existence of these technological 'clusters' can be established (Bruland, 1998), the question arises as to whether future technological clusters can be predicted for the first half of the twenty-first century. If so, can these clusters provide a reasonable basis for a long

wave of economic growth? Moreover, what public policies could support these long-term evolutions in science, technology, and economics?

The first part of the present paper posits the emerging concept of 'nano-bio-info-cogno convergence' (so-called 'NBIC convergence') as providing a basis for a new cluster of technological innovations for human enhancement and social change in the context of modern developments in information technology.

The second part of the paper reviews some deep economic and social trends that pertain to the emerging concept of a 'Sustainable Knowledge Society' (SKS). These trends include the nature of work, global environmental and ecological issues, education and learning, the role of services, and the nature of the welfare state. The paper considers the consequences of these trends in terms of possible changes in large socio-technical systems (including health, education, security, and so on).

The final part of the paper is devoted to the economic implications of these new technological and socio-economic scenarios. The paper considers these matters in: (i) general terms (at the macro-, meso-, and micro- levels) and (ii) in terms of applied policy recommendations (including the role of the state and market mechanisms).

Technology trends and key new technologies

Because technological advances play a central role in shaping the future, the forecasting of technological change has received considerable attention. This has been particularly so since the Second World War, when the rate of economic growth has increased in the advanced industrial countries well above that achieved in the previous two centuries. An influential OECD report by Jantsch (1967) on technological forecasting gave impetus to the concept of 'future scenarios'. This report emphasised the importance of rigorous methodology in achieving consensus among expert opinions on future developments (Delphi, morphological analysis, cross-impact, and so on) if such foresight was to complement the more traditional methods of trend modelling and extrapolation (S-curbs, system dynamic models, causal econometrics, and so on). The future is, and will remain, unknown; however, the analysis of alternative futures and the development of hypotheses about trends and events (including purposeful actions) can be of great importance in decision-making processes—including those relating to research investments for the development of new technologies.

Jantsch (1967) made a clear distinction between *exploratory scenarios* (possible and more-or-less probable future alternatives emerging from current anticipations) and *normative scenarios* (desirable futures in relation to some set of social values, and often linked to clearly stated policy aims). This distinction, although essential for all exercises in foresight, is not always made. For example, the Lisbon Strategy of the European Union envisaged the scenario of an 'SKS', but it is often unclear whether this was intended to be an *exploratory scenario* derived from current trends (and therefore seeking reactive decisions), or a *normative scenario* establishing clear aims for European policies (and therefore seeking proactive decisions).

In the area of technological foresight, research effort in recent years has concentrated on collecting the views of experts, usually through Delphi consultations. The process has thus been essentially *exploratory*. Many countries (including the United Kingdom, Japan, Germany, France, and most other EU members) have engaged in large Delphi exercises in technological foresight or have established groups of experts to identify key future developments in technology. The fact that these various studies have produced many similar results is clearly a consequence of the globalisation of scientific and technological information.

In a recent initiative by the EU Commission, a high-level group of experts synthesised the core of the available foresight information to present a set of 'New Technologies' that were expected to have significant potential for future innovations

(EC 2005). This selection of technologies, well adapted to the current practice of EC research policies, included research activities that were both 'supply-pushed' (scientific developments likely to lead to new technological proposals) and 'demand-pulled' (social and economic problems that required new technological solutions). The distinction is not always clearcut, but those that can be described as mainly 'supply-pushed' (in which creativity is driven from inside the discipline) include:

- nanotechnologies,
- biotechnologies,
- infotechnologies,
- cognitive sciences, and
- the methodological area of complexity.

Those that can be described as essentially 'demand-pulled' (in which the more creative aspects rely on the application of available knowledge) include:

- manufacturing,
- agriculture,
- services,
- environment,
- communication,
- transport,
- energy,
- health, and
- security.

In this schema, the social sciences and the humanities (which are here characterised as part of the 'cognitive sciences') are expected to fulfil the difficult task of establishing bridges between supply and demand of future technologies.

Trends in supply-pushed technologies

The reports of the experts in each of the broad domains of technology and science provide useful orientation regarding possible future developments (EC, 2005). The four technological and scientific domains of *nanotechnology*, *biotechnology*, *infotechnology*, and the *cognitive sciences* are likely to lead the supply side of the next wave of innovations. Each of these is briefly explored below.

The *biotechnologies* appear to be responding to the demands and financial stimuli of the pharmaceutical, agrochemical, food, and chemical sectors. However, their more recent developments depend on breakthroughs from fundamental research—including the discovery of recombinant DNA and nanoclonal antibodies, and the mapping of the human genome. New 'supply-pushed' developments are expected in such areas as 'gene silencing', antibody engineering, macromolecular structure determination, and embryonic stem cells.

In the area of *nanotechnologies*, the recent possibilities for 'seeing' (and even manipulating) atoms and molecules has led to a better understanding of the composition of materials and has opened the door to the development of materials with new properties. Indeed, it is even possible to envisage the creation of entirely new materials previously unknown in nature (for example, carbon nanotubes).

In the area of *infotechnologies*, the emphasis has been on research applications in computing and in communications. Fundamental developments in hardware and software continue to open opportunities, especially in high-level computation and mobile networks that are likely to push the Internet to new frontiers.

Finally, in the area of the *cognitive sciences*, the scientific understanding of the brain is opening wider perspectives. The application of new imaging tools in neuroscience is especially important in this regard. The cognitive sciences are closer to determining *what* the brain does (psychology, linguistics, social sciences, philosophy) and *how* it does it (neuroscience).

As noted above, these four great domains in science and technology ('nano-bio-info-cogno') are likely to be leading the supply side of the next wave of innovations. Two characteristics can be

identified in the evolution of these domains:

- they have adopted systems models of connections and interactions that rely heavily on complexity theory; higher-level information tools are essential for these developments; and
- because the connections and interactions are multidimensional, the disciplines tend to converge; again, advanced information tools are essential for this convergence.

The nature of a so-called 'technology wave' is affected by complexity and convergence. More challenging developments occur at the interdisciplinary frontiers (for example, at the bio–info frontier, the bio–nano frontier, or the bio–info–nano frontier). Higher levels of convergence—such as those involving several frontiers (the 'nano-bio-info-cogno convergence', or 'NBIC convergence')—offer the potential for substantial and dramatic changes to human capabilities and societal functions.

It is clear that such convergence is already taking place at the molecular level—where animate matter meets inanimate matter. However, it is also increasingly evident that such convergence is likely to raise more fundamental questions at the level of the human mind. At this level, the contribution of the cognitive sciences will play an essential role in the new technological wave and in the advent of the knowledge society.

Trends in demand-pulled technologies

Whereas the 'pushed' agenda does not need a specific timetable, the 'pulled' agenda is subject to constraints of space and time. There is some sense of urgency in strengthening European competitiveness, and in increasing economic growth and employment. Within the overall concept of a 'knowledge society', some of the lines of technological action that will be required include the following.

- In *manufacturing*, the specific development of submicron manufacturing is directly related to the progress of nano-technologies and new materials. In more general terms, the expected progress of enterprise simulation and modelling is likely to be associated with developments in the areas of complexity and systems thinking, as well as in the cognitive sciences and information technologies. As noted above, several industrial sectors (for example, pharmaceuticals) are heavily reliant on new bio-technological outputs. In addition, computer manufacturing and the electronics industry demand new bio-nano technologies if they are to remain competitive.
- In the *agri-food industries*, the concept of multifunctional agriculture requires advances in plant and animal sciences to keep pace with the developments in biotechnologies. Moreover, the food industry is continuously looking for new products and processes in accordance with the developments and demands of the health industry.
- In the fast-growing and multidimensional *services sector*, the emphasis is on the efficiency of production processes (service engineering) and the measurement of productivity and quality. These require ongoing developments in information technology, and in the cognitive and social sciences.
- In relation to the *environment*, there is a growing need for modelling interactions between society and ecology. There is also a need for: (i) systems management (an area of application for complexity and systems research); (ii) generic technologies (nano- and bio-, with a special interest in new materials and information); (iii) specific technologies (for industrial flows in many sectors); and (iv) 'green' products, 'green' product services, and 'eco-design'.
- In the area of *security*, there is a growing demand for surveillance and recognition systems, modelling of such systems, and associated logistics. Most of these requirements are associated with new applications of infotechnologies, complexity,

systems, and cogno- sciences. There are also expectations for new materials.

- In the area of *transport*, the perceived needs are in the management of mobility, transport equipment, environmental impacts, and energy efficiency. In many cases, these developments are linked to information and communication technologies (ICTs), and they often require techniques for managing large-scale systems. There are already nano-materials and nano-technologies associated with future transportation development aspects (for example, nano-instrumentation).
- For *energy*, in connection with transport, there is a demand for: (i) biofuels (especially from cellulose-containing raw materials); (ii) sustainable 'clean' energy technologies (such as biomass, hydrogen cells, and other fuel cells); and (iii) alternative renewable energy resources.
- *Communication* is expected to provide enabling technologies for security and other activities—including a complex agenda of applications in areas such as e-commerce, network design, and architecture. Moreover, advances in communication are crucial to the development of models for understanding the networks of today and tomorrow.
- In *health care*, growing interest in preventive medicine, screening, and self-care presents a wide range of opportunities for new developments in bio-, nano-, info-, and cogno-technology. NBIC convergence can be seen in areas such as pharmacogenomics, gene therapy, genetic diagnostics, stem cells, telecare, telemedicine, e-health, bioinformatics, minimally invasive surgery, medicinal nanotechnology, regenerative medicine, artificial and bioartificial organs, tissue engineering, rational drug design, and xenotransplantation.
- *Social sciences and the humanities* will be required to provide a smooth transition between supply-pushed and demand-pulled technologies. Moreover, these disciplines will be responsible for internal consolidation of the growing information requirements of the complexity and systems approaches that will become more prominent in future. Social sciences and the humanities are essential for the full development of *education*—another demand-pulling sector for new technologies that could provide a major area of application for the outputs of NBIC convergence.

This brief survey of expected key technologies has identified the key elements of the 'pushed' and 'pulled' agendas—as well as the many links that exist between them. Detailed research in individual fields of study could doubtless fill the cells of a matrix of the relationships—in terms of precise contents and necessary resources, and in terms of urgency and complexity. However, even in the absence of such detailed analyses, the main structural characteristics of the coming 'technology wave' are becoming reasonably clear at the beginning of the twenty-first century.

Economic and social trends

For a new technology wave to develop, it is not sufficient to have supply-pushed technologies. Nor is it sufficient to have a clear picture of where demands for innovation reside. Rather, the new technologies have to be adopted by society, by culture, and by institutions. Growth and development can be achieved only when a perfect match is achieved between new technologies and the economic and social context in which they are to be applied (Fontela, 1998).

A 'new wave' necessarily concerns the future. It is therefore necessary to investigate the changing nature of the economic and social context, and to identify possible long-term trends. The following account describes the present situation in terms of a 'New Economy' model that appears to be instrumental for the full development of a 'Sustainable Knowledge Society'.

From the industrial model to the 'New Economy' model

The EU 'Lisbon Strategy' states long-term aims for European growth and employment. In defining an 'SKS', the strategy is stating a desirable and normative future for the economy and for society—a future to be matched with feasible technological developments. The concept of an SKS is not utopian; rather, it is a logical step in a process of social change that started with the Industrial Revolution more than two centuries ago.

The early stages of the industrial process were characterised by growing capital accumulation that fostered workers' productivity and improved living standards. The process was stimulated by public policies and market mechanisms, and by the relative costs of production and prices of goods and services. In general, environmental protection and sustainability were disregarded, and knowledge focused on the capital to be gained through new products and production processes.

Towards the end of the twentieth century, several aspects of this growth process in the advanced industrial countries began to change, and a new direction pointed towards the issues of sustainability and knowledge development. In summary, the following changes can be documented:

- the introduction of environment-protection policies,
- a new wave of innovations associated with information and communication technologies (relying on computers and microelectronics),
- improving educational levels and research capabilities,and
- a greater proportion of *services* (compared with goods) in economic production and consumption.

Economic analysis of this process reveals that *prices* provided the signals to both producers (cost of input factors) and consumers (prices of the goods and services).

The scarcity of relevant statistics means that it is more difficult to document the earlier phases of industrial society in the nineteenth and early twentieth centuries. However, it could reasonably be argued that this phase was characterised by:

- low prices of (indeed, even free access to) non-renewable resources—which effectively stimulated a non-sustainable pattern of production and consumption,
- decreasing relative prices of manufactured objects compared with services (because production processes allowed for a continuous flow of innovations stimulating productivity gains in industry, whereas services where characterised by traditional production processes and stagnant productivity), and
- decreasing relative prices of mass-quantity outputs compared with quality outputs (because quantity was associated with economies of scale in cheaper products, whereas quality was associated with expensive custom-made production).

Labour productivity growth (the ratio of the output of objects per unit of human input), which is an end product of new technologies, contributed to relative costs and prices. The products of highly productive activities were decreasing in price, whereas the prices of stagnant productivity activities were increasing. Sustainability, services, and quality were becoming relatively more expensive in the markets. These deep-seated drivers of relative prices were forcing the advanced industrial economies towards ecological imbalances. Economic growth was dependent on increasing use of non-renewable energy and materials through consumption and accumulation of objects, and environmental decay became apparent through pollution and over-use.

The advanced industrial economies also began to suffer from the so-called 'Baumol syndrome' of unbalanced growth (Baumol, 1967), and from a consequent move of employment towards the less productive services sector. As anticipated by Baumol (1967), this produced

a slow down in the overall rates of growth of productivity and of the economy—as activities with high rates of productivity growth lost 'weight' in the total structure, and as the responsibility for growth leadership was transferred to sectors with low average productivity and slow rates of productivity growth. The growth process peaked in the advanced industrial countries at the end of the 1960s.

BAUMOL'S DISEASE

'Some years ago, Baumol (1967) presented a model of unblanaced growth in which an oversimplified economy was divided into productivity growth sectors, one 'stangnant' and one 'progressive'. It was argued that relative cost and prices in the stagnant sector would tend to rise persistently and cumulatively, and that if the output proportions of the two sectors happened to remain fairly constant, the share of the economy's inputs used by the stagnant sectors and the share of consumer expenditure devoted to outputs of the stagnant sector must both rise towards 100 percent. Finally, it was concluded that the net result must be a ceteris paribus decline in the economy's overall productivity growth rate'.

'The output shares of the progressive and stagnant sectors have, in fact, remained fairly constant in the postwar period, so that with rising relative prices, the share of total expenditures on the (stnagnant) services and their share of the labour force have risen dramatically (their productivity lagged behind the progressive sectors), just as the model suggests. Similar trends are also found internationally.'

Source: Baumol, Batey Blackman, Wolff (1985)

At the end of the twentieth century, the emerging paradigm of information and communication technologies profoundly affected these long-term evolutionary processes within advanced industrial societies. Three significant effects can be discerned.

First, the new paradigm of information technology *placed information products at the centre of the production and consumption models*. In so doing, energy and resources no longer represented the core factor in advanced industrial models. The new information activities were relatively more intangible than the erstwhile emphasis on the physical production and consumption of objects. Information technology addressed the *information content* of objects, and this came to represent a larger share of their added value. Information technologies generated income and wealth with less pressure on the finite resources of the earth.

Secondly, the new paradigm produced technologies that *enhanced productivity in previously stagnant activities*. Information technologies have profoundly changed many basic services in networks (communications, trading, transportation), business services (finance, insurance, consulting, auditing, advertising), and many personal services (medicine, health care).

Thirdly, the new paradigm has *stimulated institutional change by promoting global efficiency in the meeting of supply and demand*. The 'big bang' of financial globalisation is the pre-eminent example of this phenomenon—with the combination of financial market liberalisation and information technology producing a revolution in international financing.

These profound changes fully justify the emergence of the concept of a 'New Economy' at the end of the twentieth century in the USA. The concept came to be erroneously associated with the speculative financial 'bubble' that accompanied numerous failed information and telecommunications ventures. But this erroneous association masked the real (and valid) content of the concept (as will be explored in the following paragraphs).

Under the 'New Economy' model, the 'Baumol disease' seems to have found a cure. After the long (predicted) productivity slowdown of the 1970s and 1980s, US productivity has started to increase. A close analysis of the US model shows that large productivity gains in the industrial sectors have been directly associated with the production of information and communication 'objects'. This has been complemented by a productivity upsurge in many service sectors that were previously part of the 'stagnant' economy, but which have now become highly innovative users of the new technologies.

The growth model of the 'New Economy' synthesises the convergence of the three main schools of contemporary economic thinking:

- *from the Schumpeterians*, the model takes the leading role of entrepreneurial innovation and the functioning of technological systems, and confers high priority to research and development (R&D) policies,
- *from the neo-classicists*, the model takes the 'perfect market' idea for the allocation of the dividends of innovation, and heavily relies on intensive competition, and
- *from the Keynesians*, it takes the driving role of new demands and income multipliers, operating in an expansionary macro-economic context.

Through the new paradigm, these three economic mechanisms are thus related in what appears to be a 'virtuous circle' leading to economic growth. The 'New Economy' model suggests that the appropriate use of information and communication technologies can stimulate a new wave of growth and employment in the advanced industrial societies—basically relying on an increase in the efficiency of service activities. However, this new growth model is not necessarily sustainable because:

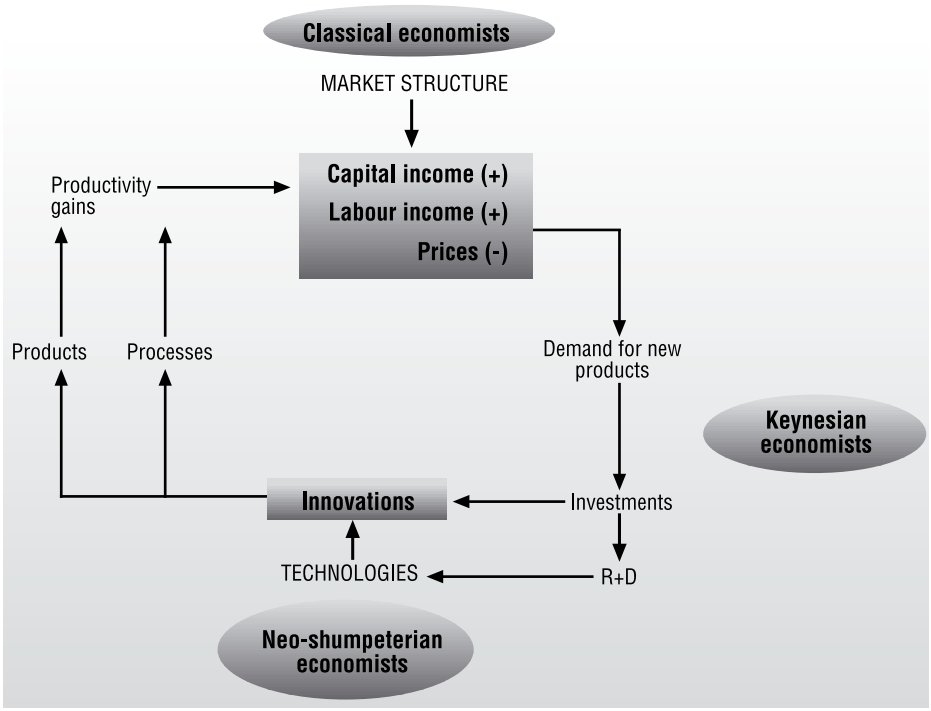
- the model forces changes in world specialisation that could be socially costly,
- it creates new disparities (the so-called 'digital divide'), and
- it does not produce sufficient reduction in the various pressures that exist on the environment, energy, and materials.

Nonetheless, the model clearly points to the fundamental economic reality of post-industrial society in the following respects. The model:

- suggests ways of increasing the size and productivity of service-oriented activities (including those performed in the process of industrial or agricultural production);
- opens the door to an economy of 'quality'; and
- offers opportunities for full employment.

The way towards a 'Sustainable Knowledge Society' has been identified.

The virtuous circle of the new economy



Source: Fontela, 2000.

From the 'New Economy' model to the 'Sustainable Knowledge Society'

The 'New Economy' model is characterised by highly competitive market frameworks, constant flows of innovations, and powerful property rights. In the advanced industrial economies, the model has implied increased liberalisation and deregulation of markets, as well as the privatisation of many public functions. According to this model, economic growth is associated with increasing disparities in income and wealth, and although this might encourage entrepreneurship it might also induce a loss of social cohesion.

Because the fundamental growth process of this model depends on the rate of innovation (especially in the low-productivity sectors of the early industrial model), the process of capital accumulation that is characteristic of the model of industrial growth has been broadened and includes three additional classes of capital:

- technological capital,
- human capital, and
- social capital.

These three forms of accumulation benefit from flows of research, education, and organisational experience, and are subject to continuous obsolescence. The economic gains from innovations (Carter, 1990; Fontela, 1994), as portrayed by the growth of total factor productivity (the surplus of production over the increased use of manpower, equipment, and material or service intermediate inputs), are a direct result of these three new processes of capital accumulation. Here again, the processes of accumulation that are characteristic of the 'New Economy' model have the potential to produce disparities in income and wealth that, especially in the case of human capital, are linked to differences in access to knowledge by individuals.

Furthermore, according to this model, there is no inherent reason to adopt policies to protect the environment or to reduce the use of non-renewable energy and materials. At a certain point, price mechanisms are expected to reflect such scarcities, but these same mechanisms cannot anticipate the final substitution costs for these undesirable developments (because the market is necessarily short-sighted).

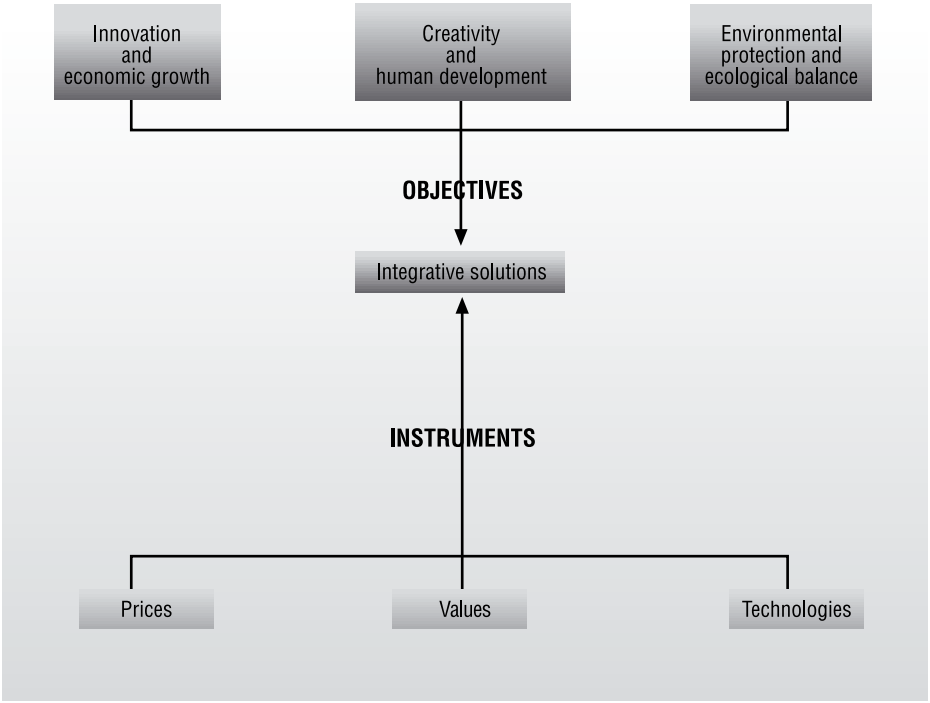
As a consequence, long-term extrapolation of the 'New Economy' model leads to unsustainability—not so much in economic competitiveness, but in terms of social and environmental problems.

Since the Second World War, with the adoption of the model of the 'Social Market Economy' in Germany (Nichols, 1994; Hieronymi, 2002), and with the successful example of the 'Nordic Welfare State' (Buhigas & Martens, 2005), Europe has shown a preference for a more sustainable development model—a preference that has become more marked in the latter decades of the twentieth century with growing public concern for environmental issues. The 'New Economy' model has thus become oriented in Europe towards a 'Sustainable Knowledge Society' (SKS).

The three pillars of the SKS model are: (i) the economy; (ii) society; and (iii) the environment. From this conceptualisation, it is possible to derive three long-term objectives for sustainability:

- innovation and growth in the economy,
- creativity and human development in society, and
- protection and ecological balance in the environment.

Although these objectives have received considerable attention and have been increasingly incorporated in European policy statements, such as those made at the Lisbon and Barcelona EU Council meetings, there is less clarity regarding the instruments to be used to meet the objectives. Emphasis has certainly been put on science and technology policies (for example, the importance given to the European Research Area). However, it must be recognised that appropriate *technology* is a necessary, but not sufficient, condition for the successful development of an SKS.



Source: A. Pulido, E. Fontela (2004).

The two other necessary conditions are *values* and *prices*. These are more difficult to define and implement. The term *values* refers to citizens' preferences for cohesion, public services, quality, security, and so on. The term *prices* refers to the relative prices of 'quality' and 'quantity', of 'green' products and 'dark' products, and of 'income' and 'leisure'. Recent trends in 'values' and 'prices' have not necessarily been conducive to an SKS, and policies in these areas are not usually incorporated in the European `political agenda. However, only through a perfect matching of *prices*, *values*, and *technology* can a successful SKS develop. The stark reality is that an SKS is *not* in the mainstream of European society.

To bring it into the mainstream, other essential features of an SKS include the following:

- labour as a product,
- knowledge as a factor of production, and
- public services as a dynamic driver.

Each of these is briefly discussed below.

Labour as a product

Baumol (1967) perceived that human activities with little requirement for 'instrumental' labour represented the 'stagnant' productivity sector. These activities essentially use labour as a 'product'—as is the case with artists, scientists, and professionals of various sorts. In making this association between stagnant productivity and labour as a 'product', Baumol (1967) did not directly equate the stagnant sector with the services sector—and in this he has been proven correct, as the information technologies have demonstrated in enhancing the productivity of certain key services (such as trade and finance).

When labour is a 'product', its value and price is essentially determined by its *knowledge content*. Knowledge is therefore a production factor of increasing significance as an economy moves to higher levels of the 'Baumol disease'. An SKS is expected to be a society with knowledge workers ('brainworkers'), and some studies show that these workers are quite

different from traditional 'instrumental' workers in their individual behaviour and in their social behaviour (von Gizychi & Ulrici, 1988). An SKS thus requires a profound transformation of the concept of labour 'markets'—markets that were essentially designed for the instrumental work required in the industrial economy.

Knowledge as a factor of production

If knowledge is to be a main primary factor in the economy, subject to an accumulation process, the need for research, education, and continuous learning will place higher education at the heart of the growth process. Important innovations are expected to foster the productivity of the higher-education system in ways that are comparable to the productivity gains observed in the 'enterprise' system (EC, 2003).

Public services as a dynamic driver

The more 'intensive' knowledge products are public goods. This is clearly the case for science—which is, in a sense, 'owned by humanity'. But it is also largely the case in education, health, and environmental services. Whether these 'public goods' are to be provided by the public sector or the private sector is a question that is open to social choice. However, if Europe maintains the role of the state in these areas, public administrations will have to increase their productivity along paths comparable to those observed in the 'enterprise' system.

'Brainworkers', universities, and public administrations will play more dynamic roles in the SKS than they played in the industrial era or under the enterprise-driven 'New Economy'. As a consequence, 'brainworkers', universities, and public administrations are expected to provide substantial leadership in technologies, values, and prices. This leadership will be built on the production, distribution, and use of *knowledge*.

A perfect match between technologies and institutions in the SKS therefore requires the 'technological wave' (which is expected to follow the 'information wave' of the 'New Economy') to rely heavily on technologies and innovations associated with knowledge processes. This is the challenge implicit in the Lisbon strategy and the policies it requires.

Economic implications and policies for the new technology wave

European policies of science and technology

In the period of reconstruction after the Second World War, the European and Japanese economic models included the active participation of public administrations in the development of productive structures. In a context of market economies, it was still considered necessary that public administration took part, directly or indirectly, in investment processes—to reduce enterprise risks and to guarantee the good operation of infrastructure, basic industrial sectors, and general public services. This intervention was coherent with Keynesian policies of demand management, and with social protection and redistributive fiscal policies.

With the liberalisation of the capital markets from the 1970s onwards, economic policies began to favour privatisation, deregulation, and increasing competition. In these circumstances, the border between market and non-market activities was reconsidered. The institutional evolution of the European Union—with the creation of a single internal market, the Maastricht Treaty, and a single currency—also contributed to the redefinition of public functions.

Traditional post-war industrial policies have thus evolved with public intervention being concentrated on keeping a balance in the macroeconomic framework. This public role in the macro-economy continues in all countries of the OECD. However, new micro-economic support policies for some sectoral interests are being increasingly adopted—for example, policies for the promotion of the 'Information Society' (which have many aspects in common

with earlier industrial policies). These new microeconomic policies attempt to stimulate the competitive capacity of certain firms, but they do not include financial assistance that distorts the functioning of markets.

In this new context, scientific and technological policies, especially research & development (R&D) policies, have played a central role among public-policy instruments for enterprise development. The justification for these policies can be summarised in the following logical steps:

1. *Globalisation*: The well-being of countries depends on the capacity of companies to compete in global markets.
2. *Competitiveness*: The competitiveness of companies in these markets depends on constantly changing factors—especially rapidly changing supply and demand.
3. *Adaptation*: Success depends on the capacity of companies to promote or adapt to change, and the capacity to take reactive or proactive decisions with respect to innovation.
4. *Innovation*: Access to new processes and new products is the key to innovation.
5. *Technological change and human capital*: The technological changes that are required occur through the accumulation of technological capital and human capital.
6. *Research and higher education*: The scientific and technological policies of government with respect to research and higher education provide generic knowledge for the accumulation of technological and human capital within companies.

The results of 'pure' research in the basic sciences continues to spread without barriers to the scientific community worldwide—as it has always traditionally done. However, as 'pure' scientific research draws closer to applied technological innovation, the results of basic science become capable of being appropriated by individuals or particular groups, and the economic justification of public policies with respect to such appropriation becomes more difficult to establish.

OECD countries are presently approaching this subject pragmatically, and there is a certain degree of competition among national systems of incentive to innovation. There are thus constant fluctuations in scientific and technological policies—with ministries being created and disbanded, decisions being concentrated and decentralised, fiscal incentives being introduced and withdrawn, and so on.

Because evaluation of the results of such policies is difficult, decisions are often taken on the basis of suggestions from pressure groups, or on the basis of comparisons between countries. In general, these *ad hoc* decisions make little sense when the institutional foundations of countries are as disparate as those of the various European countries.

In addition to having responsibility for trade policy and agricultural policy, the European Union has policy responsibilities in the area of scientific and technical research. These policies, supported with relatively modest budgets, have promoted greater cooperation among national research institutions, and especially between universities and business. However, there is an increasing awareness that, compared with the United States, Europe has been tardy in developing information technologies and in applying these technologies economically. This has motivated concern regarding the role of science, technology, and innovation in European public policies.

In March 2000, at the Summit of Lisbon, the European Union established, as an objective for 2010, to become "… the most dynamic and competitive knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment". In support of this objective, the Lisbon Strategy developed a set of interdependent reforms for an SKS. Although the objective of the projected "knowledge-based economy" was not specifically defined, most interpretations

refer, in general terms, to an economy in which innovative companies stimulate dynamism and competitiveness.

However, the reality in 2005 (at the midpoint of the process envisaged by the Lisbon Strategy) is that the situation is not very different from what it was at the beginning: economic growth is slow, unemployment of human resources is high, and there is a large deficit in the technology trade balance. In response to this, the EC has prepared several documents that propose new policies for the future. These have included the following (all available on the Internet).

- *Kok report:* 'Facing the Challenge, a Report from High Level Groups', chaired by Wim Kok, November 2004—which recommended: (i) attracting and retaining world-class researchers; (ii) making R&D a top priority; (iii) promoting broadband communication to reach a penetration rate of 50% by 2010; (iv) reaping the full benefit of ICTs; and (v) protecting intellectual property to promote innovation.
- *Barroso Communication:* 'Working Together for Growth and Jobs: A New Start for the Lisbon Strategy', COM (2005) 24 February 2005—which recommended: (i) reform of state aid policies to support research and innovation by small and medium enterprises; (ii) support and encouragement for the development of 'innovation poles' designed to help regional actors move ideas from the laboratory to the workshop; (iii) the promotion of European technological initiatives in public–private partnerships; (iv) the promotion of 'eco-innovation'; and (v) the creation of a European Institute of Technology to attract 'brains', ideas, and activities to Europe.
- *i2010:* the new European program for the competitiveness of ICT, January 2005—which recommended: (i) a borderless European information space with an internal market for electronic communication and digital services; (ii) stimulating innovation through investment in R&D and encouragement of industrial applications of ICT; and (iii) making the European Information Society as inclusive and accessible as possible.
- *Strategic orientations for growth and employment (2005–2008):* COM (2005) 141, April 2005—which recommended: (i) increased investment in R&D (restating the objectives of Lisbon in terms of an R&D/GDP ratio of 3% and a private/total research expenditure of 66% by 2010); (ii) reinforcing centres of excellence; (iii) increasing fiscal incentives; (iv) promoting scientific and technical training; (v) improving the social status of researchers; (vi) stimulating innovation and the adoption of ICTs; (vii) developing business services, technological poles, and networks of innovation; (viii) transferring knowledge derived from foreign direct investments; (ix) financing risk capital; (x) improved definition of property rights; and (xi) the creation of a solid industrial base by developing public–private partnerships, encouraging European technological initiatives, and developing regional and local innovation poles.

This last orientation ('Strategic orientations') opens the door to sectoral and territorial mesoeconomic policies, and appeals to the development of new mechanisms for public action to compensate for the poor performance of some market mechanisms. Indeed, European scientific and technological public policies are often declared to be a high priority if economic growth and employment are to be stimulated. There might even be a reorientation of the sectoral priority of common European policies—such that expenditures and investments are moved from the primary sector (the common agricultural policy, CAP) to the quaternary sector. However, the definite lines for this possible profound transformation are still not decided.

In all of these European proposals, it is apparent that there is often confusion between the 'Information Society' and the 'Sustainable

Knowledge Society'. Although production information and data-processing are essential ingredients for a 'knowledge economy', a true SKS has other characteristics that have to be taken into consideration in a modern European competitive strategy. These aspects are concerned with the matching of *knowledge* with *quality*, and they require an in-depth revision of the familiar maximisation process that orients economic life. In an SKS, social cohesion and sustainability are fundamental concepts, and this means that the maximisation of utility and profit must be accompanied by a parallel maximisation of: (i) the quality of life; (ii) the creative capacity of individuals; and (iii) the development of intelligence.

Structured on the basis of 'work as a product', rather than 'instrumental work', an SKS thus requires a greater contribution from the social and cognitive sciences, in addition to the expected new technological convergence. In this respect, the concept of an SKS still lacks a comprehensive design.

Nevertheless, because progress towards an economy of knowledge implies technological developments in education, health, security, and protection of the environment—sectors that are all part of public responsibilities in European countries—a greater public role in R&D policies is justified.

Policies for a sustainable knowledge society

The previous sections have described a long-term future scenario for society (the SKS) and for technology (the 'new wave' of NBIC convergence). For convenience, this can be referred to as the 'SKS–NBIC' scenario. In this long-term scenario (of perhaps fifty years), the Lisbon Strategy can be considered as *the policy agenda for the first decade*.

In line with this scenario, four main policy fields that require consideration (and possibly urgent attention) can be identified:

- socio-technical systems,
- research production structures,
- cooperation processes, and
- measurement issues.

Each of these is discussed below.

Socio-technical systems

Under the SKS–NBIC scenario, socio-technical systems will be quite different from what they are today. Some examples can be provided of the way in which human needs will be met by the new technological structures of production.

The health of citizens is affected by many sectors—including the agro-food industry, leisure and tourism services, the pharmaceuticals industry, hospital services, and so on. Many of these are presently unconnected. Under SKS–NBIC, these sectors will probably interact in a different way to provide personal enhancement, longer life, knowledge for self-diagnosis, and so on. Similarly, the mobility of citizens is provided by a complex cluster of sectors (motor vehicles, energy, transportation services, communications, and so on). These will also be subject to reconsideration under the pressure of social and environmental constraints. Mobility in the future is likely to be significantly changed—for example, by involving short-distance mobility in the cities, or high-speed long-distance systems. Under the SKS–NBIC scenario, both health and mobility will thus need to become more efficient in terms of users' utility, objective quality, and environmental protection. It is hard to imagine that such massive structural changes could result from market forces alone—particularly when financial efficiency is only one of the components of the required economic and social efficiencies.

Europe already contains different socio-technical systems—such as those in the Nordic countries and those in the Mediterranean countries. The variations correspond to cultural diversity and to the varying roles accorded to the

market in different political systems. If alternative complex futures and their corresponding operational systems are to be properly understood, this diversity in socio-technical systems demands extensive multi-disciplinary research towards a comprehensive 'science of design'. Such a science of design will probably require a new research structure devoted to multi-disciplinary futures. This will facilitate optimum synergies among social scientists, engineers, and scientists from other disciplines—all working together with entrepreneurs, public administrators, and representatives of civil society.

Research production structures

Research is, itself, a service-production activity that utilises a large proportion of productive agents who could be described as 'labour as product'. This productive sector is essential for an SKS and, because research is the main input for knowledge, this sector will represent a growing share of economic production.

Research is performed in a variety of settings (corporate research departments, universities, private laboratories, public laboratories, and so on), and it requires particular forms of organisation and management that promote self-development and creativity. The productivity of research will be crucial to innovation in an SKS; indeed, such productivity should, itself, be the subject of research (so-called 'R^2').

In view of the fact that an SKS attaches special importance to the development of public 'goods' in such areas as education, health, and the environment, it is essential that public research capabilities be strengthened in these areas—in accordance with the planned multi-disciplinary approach described above.

Cooperative processes

In an SKS, the market process is driven by both economic objectives and knowledge objectives. Economic wealth and knowledge thus provide a dual process of evaluation of human activity. In this context, it should be possible to find ways in which competition and cooperation can interact positively (Fontela, 1998).

Competitive corporations and cooperative universities and administrations interact more positively in small territories that have strong cultural ties (such as regions and nations). The varying nature of these interactions (and the varying nature of the resulting processes of social capital accumulation) are already apparent in the territorial diversity of Europe.

For the 'demand-pulled' aspects of new technologies, the required synergies among corporations, universities, and administrations are best developed at the national and sub-national levels, whereas for the 'supply-pushed' aspects they are best developed at the supranational level (European, world).

Measurement issues

The post-war national accounting system was designed to measure an ageing industrial society, and it already has difficulties in accounting for the 'New Economy' model. When it comes to a proposed SKS model, the accounting system will be quite inadequate for the purpose. Key computations (such as constant price productivities and production aggregates) are rendered meaningless by the changing nature of outputs and inputs and by the emphasis on quality and environmental protection.

The increasing recognition of the limitations of current accounting and the unsatisfactory results of partial solutions (for example, hedonic prices in the US and satellite accounts in Europe) are encouraging the use of 'indicators' of doubtful relevance that are usually unable to identify knowledge as a factor of production and value aggregation.

An SKS requires a complete re-thinking of the economic, social, and environmental accounting framework. This represents another essential subject for research in coming years.

Final remarks

The 'Lisbon Strategy' for developing a European 'Sustainable Knowledge Society' (SKS) has to incorporate a long-term design. Such a design must describe aims and objectives that go well beyond the current expectations of the 'Information Society'. An SKS cannot be expected to develop merely through the extrapolation of current trends—which already point to unsustainable long-term social divides and ecological catastrophes.

Nevertheless, the 'New Economy' model *is* oriented towards the objectives of an SKS and it *can* provide an excellent economic framework for long-term growth and employment. But, to be successful, the orientation of the economic system will require conscious public policies in areas such as health, education, environmental protection, and security. Such policies should incorporate the potential benefits of the coming new 'technological wave' induced by nano-bi-info-cogno (NBIC) convergence.

What is often considered to be current European competitive handicaps—such as the lack of market size due to significant cultural diversity or the excessive weight of non-market activities in production and consumption—might turn out to be positive advantages for a post-industrial SKS–NBIC societal design.

References

- Adelman I. (1965), *Long Cycles, Fact or Artefact, American Economic Review*, 55, 444–63.
- Baumol W.J. (2002), *The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism*, Princeton University Press, Princeton and Oxford.
- Baumol W.J. (1967), Macroeconomics *of Unbalanced Growth; the Anatomy of the Urban Crisis*, American Economic Review, 57, 415–26.
- Baumol W.J., Batey Blackman S.A. & Wolff E.N. (1985), *Unbalanced Growth Revisited; Asymptotic Stagnancy and New Evidence*, American Economic Review, Sep, 806–17.
- Bruland, K. (ed.) (1998), *Technological Revolutions in Europe, Historical Perspectives*, Edward Elgar, Cheltenham.
- Buhigas Schubert C. & Martens H. (2005), *The Nordic Model: A Recipe for European Success?*, European Policy Center, Brussels, EPC Working Paper 20.
- Carter A.P. (1990), *Upstream and Downstream Benefits of Innovation*, Economic System Research, 2, 3, 241–57.
- EC (2005), *Creative System Description, Towards a Research Strategy Beyond Lisbon*, Key Technologies Expert Group http://www.cordis.lu/foresight/conference_2005.htm
- EC (2004), Converging Technologies, Shaping the Future of European Societies, New Technology Wave Expert Group:
- http://europa.eu.int/comm./research/conferences/2004/ntw/pdf/final_report_en.pdf
- EC (2003), *Measures to improve High Education/Research Relations in order to strengthen the strategic basis of the ERA*. Report on independent High Level Expert Group, EUR 20905, Brussels, November.
- Fontela E. (2000), *Perspectivas a largo plazo y Nueva Economía*, Revista Valenciana d'Estudis Autonomics, Número Monográfico 31, 1–12.
- Fontela E. (1998), *Enabling Macroconditions for Realising Technology's Potential*, in OECD, 21st Century Technologies.
- Fontela E. (1994), *Inter-industry Distribution of Productivity Gains*, Economic Systems Research, 6, 3, 227–36.

- Fontela E. & Pulido A., (1991), *Input-output, Technical Change and Long Waves*, in Peterson W., Advances in Input-output Analysis, Oxford University Press, NY, Oxford.
- Freeman C. (1996), *The Long Wave in the World Economy*, International Library of Critical Writings in Economics, Edward Elgar, Aldershot.
- Hieronymi O. (2002), Wilhelm Röpke, The *Social Market Economy and Todays Domestic and International Order*; in Hieronymi O., Jasson Ch. & Rovesi A. (eds) Wilhelm Röpke: The Relevance of his Teaching Todat, HEI-Webster University, Geneva.
- Jantsch E (1967), *Technological Forecasting in Perspective*, OECD, Paris.
- Nicholls A.J. (1994), *Freedom with Social Responsibility, The Social Market Economy in Germany*, 1918–63, Clarendon Press, Oxford.
- NSF, (2002), Converging *Technologies for Improving Human Performance*, National Science Foundation, http://www.wtec.org/ConvergingTechnologies/
- Pérez, C. (2002), *Technological Revolution and Financial Capital*, Edward Elgar.
- Pulido A. & Fontela E. (2004), *Principios del desarrollo económico sostenible*, Fundación Iberdrola, Madrid.
- Verspagen B. & Werker C. (2003), *The Invisible College of the Economics of Innovation and Technological Change*, Estudios de Economía Aplicada, 21, 3, 393–421.
- Von Gizycki R. & Ulrici W. (1988), *The Brainworkers, Typology, Background and Work Situation*, A Report to the FAST-Programme, Oldenbourg Verlag, Münich.
- Wolf E.N. (1997), *Spillovers, Linkages and Technical Change*, Special Issue of Economic Systems Research, 9, 1, 9–24.

6. European Integration, Innovations and Uneven Economic Growth: Challenges and Problems of EU 2005

by Erik S. Reinert [118]

At the end of 2005 the process of European integration seems to have reached a serious crisis. The rejection of the European Constitution by the French and Dutch voters indicates a strong distrust of the way the integration is proceeding. A survey conducted recently for the Polish *Rzeczpospolita* newspaper found widespread admiration for the achievements of winning freedom of speech and leading the country into NATO and the EU, but 85 per cent of those polled blamed the Solidarity movement for setting in motion the liberalisation that has put many Poles out of work. What went wrong? Why do workers not only in the old EU, but also in the new member states (NMS) feel betrayed? The fact that this change of mood surfaces after merely a year has passed since the euphoric celebrations of the enlargement of the Union makes it even more surprising. The aim of this paper is a preliminary exploration of factors rather than a complete analysis.

As a starting point I would argue that the EU Lisbon Strategy – the European Union economic strategy launched in 2000 – represents a healthy theoretical shift towards a dual emphasis on innovations as the basic engine of economic growth and on social cohesion in order to mitigate the uneven economic growth that necessarily follows in a dynamically innovative society. Europe left behind the neo-classically based standard textbook economics (STE) in favour of Schumpeterian evolutionary economics (Rodrigues 2003). As I see it, this shift, however, carried with it several problems; of theoretical, contextual and didactical nature.

First of all a problem of theoretical mismatch occurred. Jacques Delor's 1993 white paper on 'Growth, Competitiveness and Employment' envisioning an innovation-based Europe had been critically received by mainstream economists. Learning from this experience, the Lisbon process was carried through cautiously, avoiding the ministries of finance that had sunk the Delor paper, and this saved it from falling into the same trap. A victory of these tactics, however, may have backlashed, creating problems for the long-run strategy. Coupling innovation and social cohesion makes eminent sense: In an STE framework, however, both these concepts are exogenous elements, and above all they do not belong together. In STE the market is supposed to create economic harmony, and the losers in the game are an object of concern for social workers, not for economists. Both "innovations" and "social cohesion" are essentially alien elements in equilibrium standard textbook economics. The mainstream economic profession predictably reacted to this a bit like chess players would react if outsiders tried to introduce new categories of pieces into the game to change the rules: with indignation and an inclination towards sabotage.

In Europe economic policy-making is more closely tied to and dependent on STE than in the United States. This has its positive sides. It is difficult to envision that the fiscal irresponsibility exercised by the present Bush administration could ever have happened in Europe, as it would have been stopped by professional economists in the administration and in the central banks. When it comes to industrial policy, however, the strong dependence on STE clearly puts Europe at a disadvantage. The Chicago economists abhorring state intervention at any level does not prevent

118 This chapter paper is dedicated to Prof. Hans Singer – who taught us that innovation and technological change do not necessarily lead to higher real wages to the producers - on his 95th birthday November 29, 2005. The author is grateful to Christopher Freeman, Carlota Pérez and Rainer Kattel for perceptive comments. A special thank you goes to Wolfgang Drechsler for his assistance. The usual disclaimer applies.

Mayor Daley of Chicago investing heavily in high-tech incubators. It is also important to note that the kind of selective industrial policy not allowed in international agreements, in the United States tends to be carried out by the individual state governments rather than the Federal Government. For close to 200 years US industrial policy has been torn between Alexander Hamilton's theories and ideas of an active state and Thomas Jefferson's ideas that 'a government that governs the least, governs the best'. In reality this tension has been pragmatically solved by combining Jeffersonian rhetoric with Hamiltonian practices.

The very influential US economist Paul Krugman puts it this way: 'the view of trade as a quasi-military competition is the conventional wisdom among policy-makers, business leaders, and influential intellectuals…*It is not just that economics have lost control of the discourse; the kind of ideas that are offered in a standard economics textbook do not enter into that discourse at all…*' (Krugman quoted in Reder 1999: 6). If we ask ourselves *to whom* the economists have lost control in the US policy-making process, Krugman lists an alliance of 'policy makers, business leaders and influential intellectuals'. In my view, more attention should be paid to the qualitative differences between Europe and the United States in the policy-making process. If the goal is to create an innovative Europe, STE is a factor that prevents needed changes in the rules of the game more in Europe than in the US. In fact the 2005 version of the Lisbon Strategy is much closer to STE than its predecessors.

The most serious problem of the Lisbon Strategy is the context – a result of past political decisions – in which it is carried out. The shock therapy that was imposed on most of the New Member States in the early 1990s produced what in Schumpeterian terms could be called destructive destruction: a large-scale destruction of the existing industrial fabric which was not sufficiently replaced by new activities. The integration of former East Germany was an extremely expensive and economically unsuccessful strategy because – in spite of a model reconstruction of all kinds of infrastructure – the industrial fabric was not replaced. It became a 'region on the dole'. It is as if the vision of an enlarged Europe of 2004 considered this integration of East Germany as a huge success that should be uncritically copied on a larger European scale. Compared to the previous pace and form of European integration, I argue below that the recent integration processes have been unwise moves in terms of speed and timing. In order to repair the damages it is necessary to understand what went wrong.

What is the situation in 2006?

This paper suggests three parallel and complimentary explanations as to what created the present tensions within the European Union. Briefly, these factors are seen as having interacted to create a European Community *Zeitgeist* which by a large number of the populace has not been perceived as being in line with increased 'public happiness', the maximum goal of economic theory in the past.

I. **The deviation from successful principles of the past.** I argue that with the decision of the 2004 enlargement three important principles were abandoned that had been key to the previous successful building of the European Union, based on the principles of Friedrich List, since its very inception.

II. **The theoretical framework.** European innovation policies have been introduced on top of a Smithian-Ricardian standard theory, as a Schumpeterian icing on a solidly neo-classical cake. This has made 'innovation' too much of a cure-all, creating a discourse on a generalised and abstract level where 'innovation' and 'learning' have taken the places of 'savings' and 'investment' in the standard equilibrium framework. We argue that this approach prevents a sufficient discussion of the qualitatively different ways innovation impacts the economy – e.g. in terms of imperfect or more perfect competition – in the foresight exercise.

Probably the theoretical approach behind the Frascati and Oslo manuals, essentially counting R&D and innovations without much attention to their qualitative and contextual merits, has contributed to this. The alternative to this approach is to see innovation in a framework of uneven economic development where economic growth is *activity-specific*, policies necessarily *context-specific*, where the *windows of opportunity for innovation*[119] are a moving target and depend on the industrial structure of a nation, and where some innovations increase the welfare of the producers, whereas other innovations – particularly those produced by ICT – in fact may decrease the welfare of the same producers. We discuss why a learning- and innovation-based Europe should be discussed in the non-equilibrium tradition of Milanese economist Pietro Verri (1728-1797) and his continental contemporaries rather than in the Anglo-Saxon tradition based on how we today interpret Adam Smith (1723-1790), but is partly very different from what Smith actually preached.

III. **The wider context of innovation.** It is further argued that the approach taken has been excessively technical and economistic, void of a broader cultural and societal context. The spectre of American efficiency and productivity and European lagging has been held up to Europeans. It has not been argued enough that innovation is a way to preserve European quality of life, the Americanization of working life has been an underlying threat. We have not sufficiently integrated the high value of the European way of life into the discussion, although this aspect has been well expressed by US authors (Rifkin 2004, Reid 2004). There is not time or space in this paper to discuss this further, but I would recommend a very perceptive article in the *New York Review of Books* on this important subject (Judt 2005).

In the 42 points of the European Council Conclusions on the Stability and Growth Pact and the Lisbon Strategy from March 22 and 23, 2005, the underlying problems of the present situation of Europe are not raised. The discussion appears as a long list of good intentions which – it seems implicitly to be assumed – necessarily will lead to success. The Lisbon Strategy appears to have been superimposed on the neo-classical economic framework dominating in the 1990s, where the market is a great equaliser and creator of economic order and harmony. In many parts of the global periphery it is increasingly clear that globalisation creates more poverty, not less. It is reasonably clear that such trends – exemplified by East Germany – may be found within the EU. As I see it, the further debate ought to be based on an analysis of what went wrong in the past, and it should move away from the neo-classical tradition of discussing policy void of its context. A policy may be excellent in one set of circumstances, but counterproductive in another. I argue for bringing back the Continental European economic tradition that created *Rhine Capitalism*: a society where the market is a tool rather than a goal in itself, and where economics is defined as the study of the economy as a real object in a specific context, not defined in terms of the adoption of core assumptions and techniques.

Given the strong internal and external forces to which the Lisbon Strategy is subject – discussed under points 5 and 6 below – it is in my view overly optimistic to think that the Lisbon strategy can be successfully carried out with its present toolbox. Today's ideology also limits the use of policy tools that traditionally have been important in the construction of a united Europe.

119 As described by Carlota Pérez.

The global context: the backlash of globalization and the backlash of European integration as two sides of the same coin

In 1338 Ambrogio Lorenzetti finished his frescoes *Allegory of Good and Bad Government* in the Town Hall of Sienna. The fresco symbolising *good government* shows thriving shops, fine buildings and dancing citizens enjoying their leisure. *Bad government* is shown as ruin, rape, robbery and murder. To Lorenzetti and his contemporaries "public happiness" – as it later was called in Italy (Muratori 1766, Bidussa 1977) – was the result of conscious policy, of *buon governo*. We suggest that *buon governo* implies a qualitatively different understanding of the economy than today's 'good governance'.

German writers later coined their own terms for good policy: *Staatsklugheit,* 'state wisdom' (Justi 1741, Achenwall 1763) and *Staatskunst,* 'state art' (Justi 1761-64, Mauvillon 1776-1777, Müller 1809). Later this state art was built into the theories of Friedrich List (1841), an important part of which was to appreciate and draw policy conclusions from the fact that economic activities differed qualitatively as regards innovations (Reinert 1999). In the 20th century this economic tradition was continued in the works of Werner Sombart, whose path breaking works include how war and luxury historically have been key driving forces of innovation (Sombart 1913a and 1913b). Large parts of his masterly volumes on the capitalist system (Sombart 1927) have been translated into French, Italian and Spanish (see the bibliography of this paper).[120] The tradition of 'economic state art (*wirtschaftlicher Staatskunst)* was also continued (Wagemann 1937).

An important part of this 'state art' over the centuries was what Robert Wade calls 'governing the market' (Wade 1990), similar to what Alice Amsden calls 'getting the prices wrong'(Amsden 1992): employing market regulations and institutions that not only create an optimal balance of economic activities in the nation, but also secure a reasonable distribution of income and services. The regulation of foreign trade was a key variable in this policy. In was understood that the market would not, by itself, create neither spontaneous order nor an optimal economic structure.

Economic terminology often obfuscates rather than illuminates present problems. The frequently misused term 'competitiveness' adds to today's theoretical confusion (Reinert 1995). Originally defined by the OECD as a nation's ability to increase real wages while at the same time remaining competitive on international markets, the term is now seen in order to advocate the complete opposite effect. A nation is called upon to reduce wages in order for firms to remain competitive. Compared to the perfect competition of STE, the kind of Schumpeterian competition Europe needs – product innovations producing higher real wages – in effect represents a kind of market failure. What we want to produce are 'market failures', which combines very poorly with basic logic of STE.

In the historical debate on 'free trade', the term meant 'absence of trade monopolies'. Only recently the term came to signify 'absence of tariffs'. In fact, fine-tuning tariff policy has played a major role in the construction of post-was Europe. The European Union grew out of the extremely successful Marshall Plan, the main goal of which was to re-industrialise Europe after World War II. At the core of the Marshall Plan was a trade policy that rebuilt the industrial structure of all countries involved, often behind large trade barriers. Only after a symmetrical industrialisation had been achieved did full economic integration take place.

Up until and including the integration of Spain and Portugal, European Union policy has followed this Listian policy of opening up for free trade between *symmetrical partners all with a healthy industrial fabric*. A slow pace of

120 Since English speaking economists at the time tended to read German (German was a mandatory part of economics studies in the United States until after World War II), an English translation was not published. However, see an excellent book review by the leading historian of economic thought in the US at the time (Mitchell 1929).

integration, building down tariff barriers slowly, was done with the preservation and strengthening of the industrial symmetry in mind, in order to avoid the economic horrors created by the Morgenthau Plan – consciously de-industrializing Germany from 1945 to 1947 – in mind (Reinert 2003, 2004).

As the fact-based economics discourse slowly yielded to mathematization of the neo-classical synthesis in post-war Europe, the traditional continental tradition disappeared from the economics curriculum to be replaced by US standard textbook economics (STE). The curious thing here, however, is that in terms of economic policy the US STE tradition had more influence on actual European policy than on US policy (see discussion above).

Fuelled both by the Cold War conflicts and the push to mathematize economics, European economics in the post-WW II period slowly drifted back to the situation of the 1840s: Ricardian economic tradition came to dominate with its basic position of the market as a harmony-making machinery. The lag in this process is interesting: European integration policy continued its Listian principles until the end of the 1980s, much after Friedrich List and his teachings had been eradicated from Europe's faculties of economics. Only with the 2004 enlargement European integration was based on neo-classical/Ricardian/STE principles. This change to Ricardian principles of integration is, in my view, at the very root of Europe's problems today. From the point of view of many of Europe's citizens, there are more elements of Lorenzetti's 'bad government' present today that before this change of basic economic theory.

The vision of WTO's first director Renato Ruggiero on the operation of the world market may stand as a prototype for the new view that also penetrated European Union thinking. This global vision was centred around "the borderless economy's potential to equalise relations between countries and regions. At the global level" Ruggiero says, "old divisions between North and South are being superseded by new distinctions - between those countries embracing technology and globalization, and those that remain behind ..." (Ruggiero 1998: 130-131). As I see it, the European Union strategy is too simplistically based on this view: regardless of context, technology and innovation is enough to solve most problems.

At the global level, the most populated nations on the planet – China and India – had for more than 50 years followed a Listian economic policy protecting industry. They could benefit from globalisation, while many small nations, in Latin America, in Africa and in Asia were de-industrialised as if they had been subject to the type of Morgenthau Plan that devastated Germany between 1945 and 1947 (Reinert 2003). Ruggiero further talks about 'the potential for eradicating global poverty in the early part of the next century - a utopian notion even a few decades ago, but a real possibility today.'

Both in Europe and in the global periphery, the optimistic views based on STE were shattered. As I se it, our present collective failure to understand both Europe's problems and why so many countries stay poor is intimately tied to a number of blind spots on the retina of standard economics. These blind spots make it extremely difficult, if not impossible, to create a theory of uneven economic development. As Lionel Robbins wrote more than 50 years ago, the basic features of the neoclassical paradigm produce a *Harmonielehre*, a theory – one might add – where economic harmony is already built into the assumptions on which the theory rests. Today, this paradigm hinders rather than helps our understanding of the reasons behind poverty. As Thomas Kuhn says, 'A paradigm can, for that matter, even insulate the community from those socially important problems that are not reducible to the puzzle form, because they cannot be stated in terms of the conceptual and instrumental tools the paradigm supplies.' [121]

121 Thomas Kuhn, The Structure of Scientific Revolutions, p. 37.

Any long-term solution both for Europe and for the poor nations of the world will have to rest on a *theory of uneven development* – a theory which addresses these blind spots of economics which obfuscate our collective view. Such a theory once existed at a level complete enough to create successful economic policy for 500 years – from Henry VII's England in 1485 to the integration of Spain and Portugal into the European Union in 1986 – but is now virtually extinct in any faculty of economics.

Today's approach towards the Third World suffers from two main defects. First the balance is extremely tilted towards *palliative economics*, to ease the pains of poverty rather than to eradicate poverty permanently through economic development. Secondly, today's approach makes it possible to continue and even extend (as in the WTO negotiations) present practice without investigating what went so wrong with globalization in the periphery. Palliative rather than curative measures – debt cancellation and Millennium Goals – make it possible for the world economic order to continue to be based on the theory that created the problems in the first place. The same myths based on ideology rather than on experience, the same policies, and the same people that created the problems are still in charge. To use a medical metaphor: we are giving the patients – the poor countries – blood transfusions in terms of cash and debt relief without having asked the basic question as to why the loss of blood occurs in the first place. It has been a key mistake to keep the same people in power who brought in neoclassical shock therapy, the measures responsible for much of the problems. Just as in the case of Europe, this way of operating virtually guarantees that we do not face the quite fundamental discussion of what went wrong. What is needed is a theory that explains why economic development, in its very nature, is such an uneven process. Only then can the appropriate policy measures be put in place both in Europe and in the poor peripheries of the world.

Europe's deviation from Listian principles

The problems created by today's economic theory, where the market is seen as a harmony-creating machinery, are therefore found both globally and within Europe. In the case of the European Union, the alternative experienced-based theory was kept alive much longer in Europe's own policy than in Europe's approach towards the Third World. At the national level, most – if not all – developed nations experience increasing economic inequalities internally. The same type of problems is experienced on three levels: Globally, with the European Union, and within most developed nations. The basic causes behind these developments are the same: old theories that worked for centuries have been abandoned.

Tensions within the European Community that resulted in votes of *no* to the European Constitution are results of the same economic forces that create poverty in the world periphery. People in the old member states in the European Union feel betrayed because their welfare is being eroded, while people in the new member states feel betrayed because welfare is not arriving as fast as expected. Not unexpectedly, this completely new and unexpected situation causes people to ask in the same way as they ask about globalization: what went wrong?

German economist Friedrich List (1789-1846) is no hero in today's economics textbooks, but it was his economic principles that not only industrialized Continental Europe in the 19th century, but also built European integration from the early 1950s until and including the successful integration of Spain and Portugal into the EU in 1986. For a long time the division of labour in Europe was clear, Friedrich List ruled the field of practical policy, while neo-classical economics ruled in the economics textbooks. Not until the 2004 integration were List's principles abandoned in favour of the same textbook economics that dominates the Washington Consensus. The result was increased unemployment and poverty in

the old core countries inflaming the debate that produced the 'no' to the constitution.[122]

A worrying aspect of this is that even the countries that are hailed as success stories of the recent European integration have serious problems of social cohesion: successful urban centres contrast starkly with rural poverty. With my Estonian colleague Prof. Rainer Kattel, I have started looking at a new index for regional inequality. Based on the *monthly rent* of a city apartment of 100 square meters in the national capital, we measure the distance to the area where, with the same amount of money, you can *purchase a whole house*. In Norway this "monthly rental to full ownership index" lies at around 2.000 kilometers, from Oslo to Vardø at the Arctic Sea in the extreme North. In Estonia, this distance is down to less than 100 kilometres from Tallinn. Estonia is also the nation in Europe with the worst income distribution and where the demographic development suggests that the population will be halved by 2050. It is unfortunate that rather than Europe facing up to these problems, the present mood is to gloss over reality and present Estonia as an unmitigated European success story.

Below are three of List's key principles – they are in reality much older [123] – contrasted with standard textbook economics. The present neoclassical economic principles must be abandoned in favour of the old Listian principles.

- *Listian principle:* The preconditions for wealth, democracy and political freedom are all the same: a diversified manufacturing sector subject to increasing returns[124] (which would historically mean manufacturing, but also includes a knowledge-intensive service sector). This was the principle upon which the United States economy was built, this was the principle promoted by the first US Secretary of the Treasury, Alexander Hamilton,[125] and this same principle was rediscovered by George Marshall in 1947 and quoted above.
- *Neoclassical principle:* all economic activities are qualitatively alike, so it does not matter what you produce. Ideology based on 'comparative advantage' without an understanding that it is actually possible for a nation to specialise in being poor and ignorant, in economic activities that require little knowledge, operate under perfect competition and diminishing returns, and/or bereft of any scale economies and technological change.
- *Listian principle:* A nation first industrialises and is then gradually integrated economically into nations at the same level of development.
- *Neoclassical principle:* Free trade is a goal per se, even before the required stage of industrialisation is achieved. The 2004 EU enlargement went directly against Listian principles. First the former communist countries in Eastern Europe (with the exception of Hungary) suffered dramatic deindustrialisation, unemployment and underemployment. These countries were then abruptly integrated into the EU, creating enormous economic and social tensions. From the point of view of Western Europe, the factor price equalisation promised by international trade theory proved to be an equalisation downward.
- *Listian principle:* Economic welfare a result of synergy. Already in the 13th century Florentine Chancellor Brunetto Latini (1210-1294) explains the wealth of cities as a common weal ('un ben comune') (Reinert 1999). Investments in infrastructure, education and science are an integral part of this type of policy.

122 This negative development in Europe is discussed in Reinert, Erik S. and Rainer Kattel 'The Qualitative Shift in European Integration: Towards Permanent Wage Pressures and a 'Latin-Americanization' of Europe?', Praxis Working Paper no. 17, Praxis Foundation, Estonia: www.praxis.ee/data/WP_17_2004.pdf .

123 See several of the papers in Jomo & Reinert (2005).

124 The works of Jane Jacobs on the role of the cities arrive at the same conclusion as List from a different starting point (Jacobs 1984).

125 In his 1791 Report on the Subject of Manufactures.

- *Neoclassical principle:* 'There is no such thing as society', Margaret Thatcher (1987).

Just as Kuhn describes above, these Listian principles cannot be captured by the tools of the ruling economic paradigm. Understanding List requires understanding qualitative differences between economic activities, diversity, innovations, synergies and historical sequencing of processes. These are all blind spots in standard economics, especially in their interacting and cumulative totality.

Failure to understand the wisdom of the Listian principles which previously upgraded the common interests of Europe has produced what to many – economically and socially – becomes a race to the bottom. The same abstract theory has recreated the same type of 'social question' that plagued Europe during the 19th Century, also then a result of policies based on Ricardian economics. It was only by getting rid of abstract theories both left and right that the social problems of the 19th century were solved. Gustav Schmoller's speech on becoming *Rektor* of the University of Berlin in 1897 testifies to this process where fact-based economics wins over highly abstract models (Schmoller 1897). Two years later, Cambridge economist Herbert Foxwell describes the very same process of getting rid of Ricardian economics in favour of what Foxwell himself call 'the realistic school' (Foxwell 1899).

IST, different types of innovations and different effects on real wages

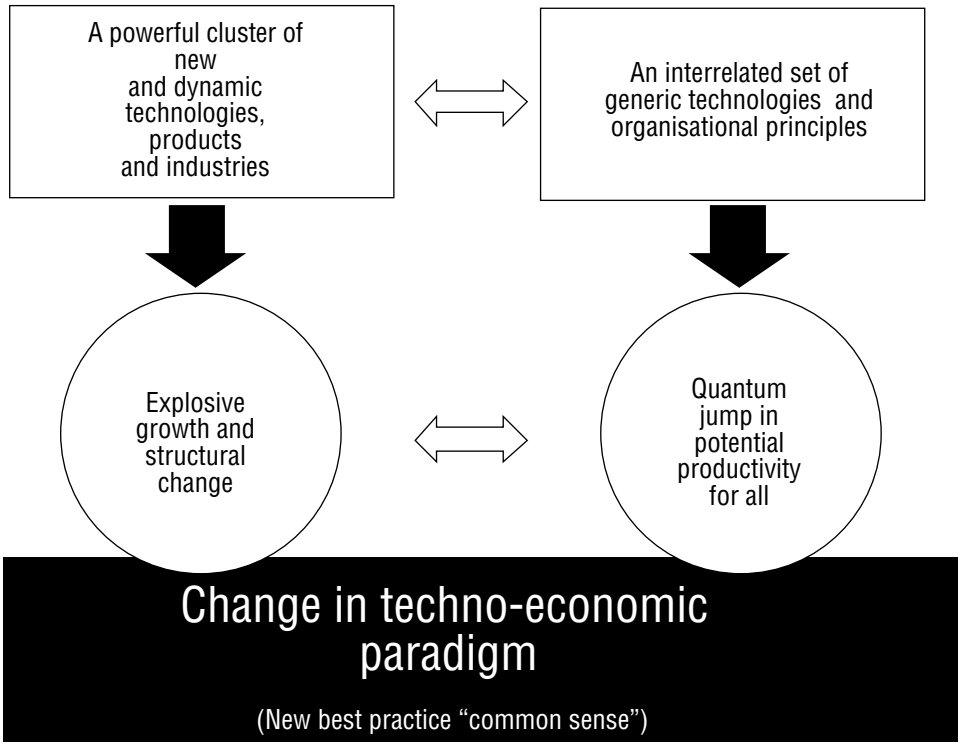
In my view the vision of the innovation-based society has been based on an insufficient qualitative understanding of the different ways innovations affect different businesses. Information technology creates very different results around Microsoft's headquarters in Seattle than what the same information technology does in the hotel industry in Venice or on the Costa del Sol. In the hotel business as well as in the used book business across Europe, IST has caused more perfect information leading to falling margins and increased downward pressures on wages and profits. Using the standard definition of the term 'competitiveness' – its ability to create higher real wages – in these industries in isolation, IST-based innovations have caused *decreased* rather than *increased* competitiveness. Although it is well known in innovation economics that product innovations and process innovations often have different effects on employment (see. e.g. Fagerberg, Guerreri & Vespagen 1999, Gambardella & Malerba 1999, Vivarelli & Pianta 2000, Reinert 2000, Pianta 2005), not enough emphasis has been given to the fact that innovations actually may reduce value added in certain industries and geographic areas.

Carlota Pérez considers that every techno-economic paradigm has two very different aspects: a) a cluster of new basic innovations creates distinct dynamic technologies, and b) the way these new generic technologies change the way the rest of the economy goes about its businesses. Figure 1 illustrates these two aspects of paradigm shifts.

The two aspects of the paradigm shift produce very different types of innovations. The paradigm carrying industries generally produce *product innovations* that create dynamic imperfect competition. In the rest of the economy the paradigm shift tends to produce *process innovations* that either do not shift the degree of imperfect competition, or – as in the case of the airline industry – may unleash a price and productivity competition that will benefit consumers rather than producers. Such innovations may produce lower rather than higher monetary wages in the industry affected, but will create higher real wages to the people consuming their services. Should one group of nations specialize in *product innovations* while the other specializes in *process innovations*, the standard of living is very likely to raise much faster in the *product-innovating* country compared to the *process-innovating* country.

This is because the increased wealth produced by innovations may reach us in two different ways, either through increased monetary wages or through lowered prices for what we

Figure 1: The two main aspects of a techno-economic paradigm shift.



Source: Carlota Pérez.

consume. To the classical economists, productivity improvements would show up in the economy as lowered prices for the goods which experienced these improvements (Smith 1776/1976: 269, and Ricardo 1817/1973: 46–7). This is the focus also of today's public choice theory which ignores the benefits coming from higher wages.

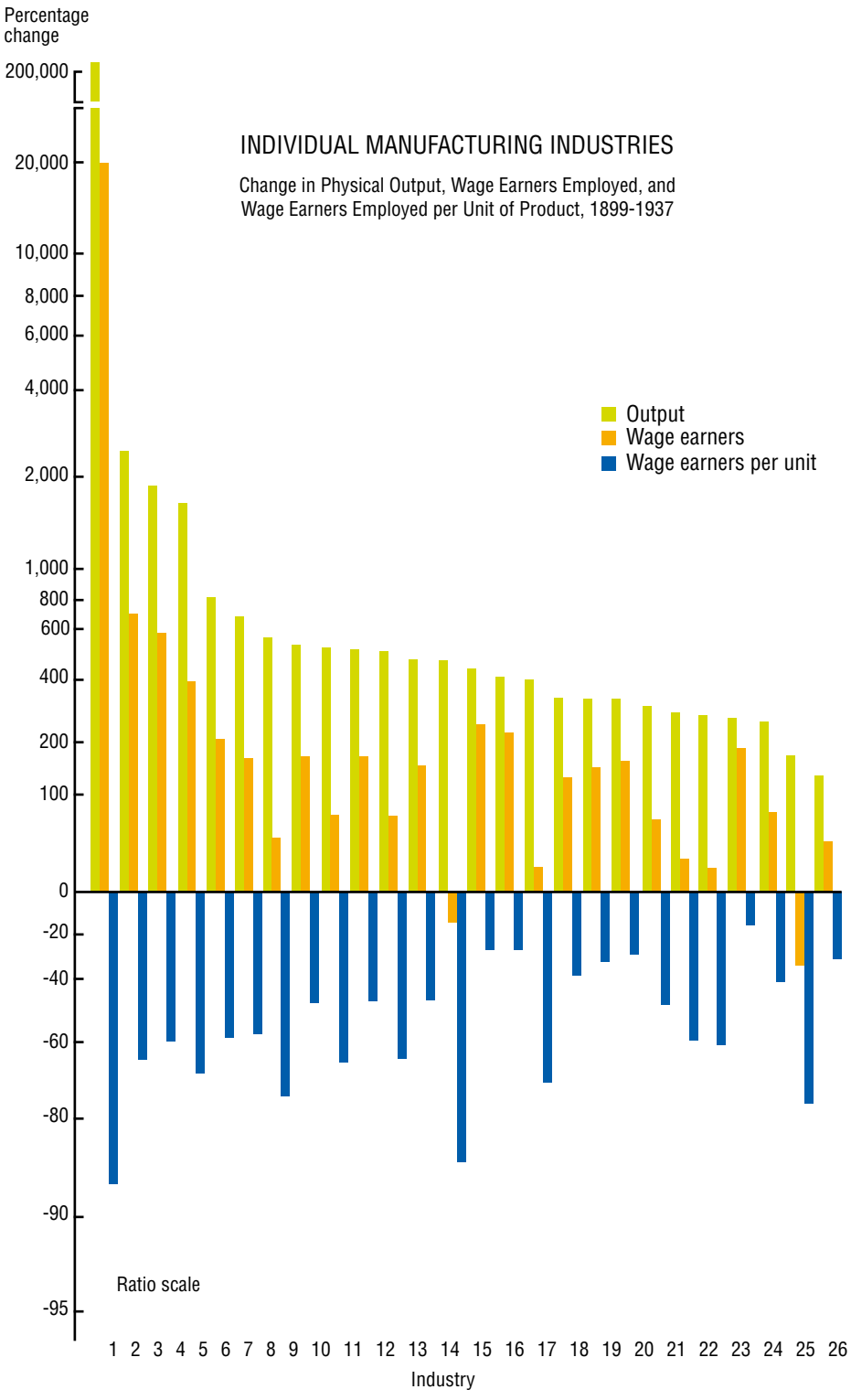
At the time of Smith and Ricardo, the gold standard facilitated the result they predicted. In a closed economy, holding velocity of circulation constant, the increase of goods in the economy resulting from technological progress would chase only the same amount of bullion. Prices *would have to fall*. Rapid technological progress would therefore lead to deflation – which in fact it often did until the gold standard was abolished.

When the gold standard was abolished, people in the industrialized countries got rich in a different way than before – instead of seeing the price of industrial goods fall as it used to, they now saw their monetary income rise. Previously deflation had caused awkward social problems: it was difficult to convince people who had to take continuous pay cuts that, in spite of these pay cuts, they were still getting richer, because the price of the goods they purchased fell at an even faster rate than their wages. The monetary policy which followed after the gold standard was abolished became, from the point of view of the industrialized nations, a more sensible one: money supply kept rising with the amount of goods in the economy, or slightly faster, creating a small inflation which seems to have served to oil the machinery of development. Now the producer in an activity not exhibiting productivity improvements – e.g. the barber – got rich by raising his prices at the rate everybody else had their salaries raised, not only by having the price of manufactured goods lowered.

As shown in Figure 2, from 1899 through 1937, within the US, labour productivity in the automotive industry increased by about 900%, and many other industries recorded productivity improvements exceeding 100%. However, in many US industries: meat packing, hats, railroad cars, lumber-mill products and others,

labour productivity did not change at all in the same period.[126] Yet, the workers in the industries which had no productivity increase at all over this 40-year period had their good share in the unprecedented growth in the US economy over that period. But, as opposed to what was expected in the classical model, this did not come through an improvement in their terms of trade.

Figure 2.



[126] Data from Fabricant (1942), pp. 90–91.

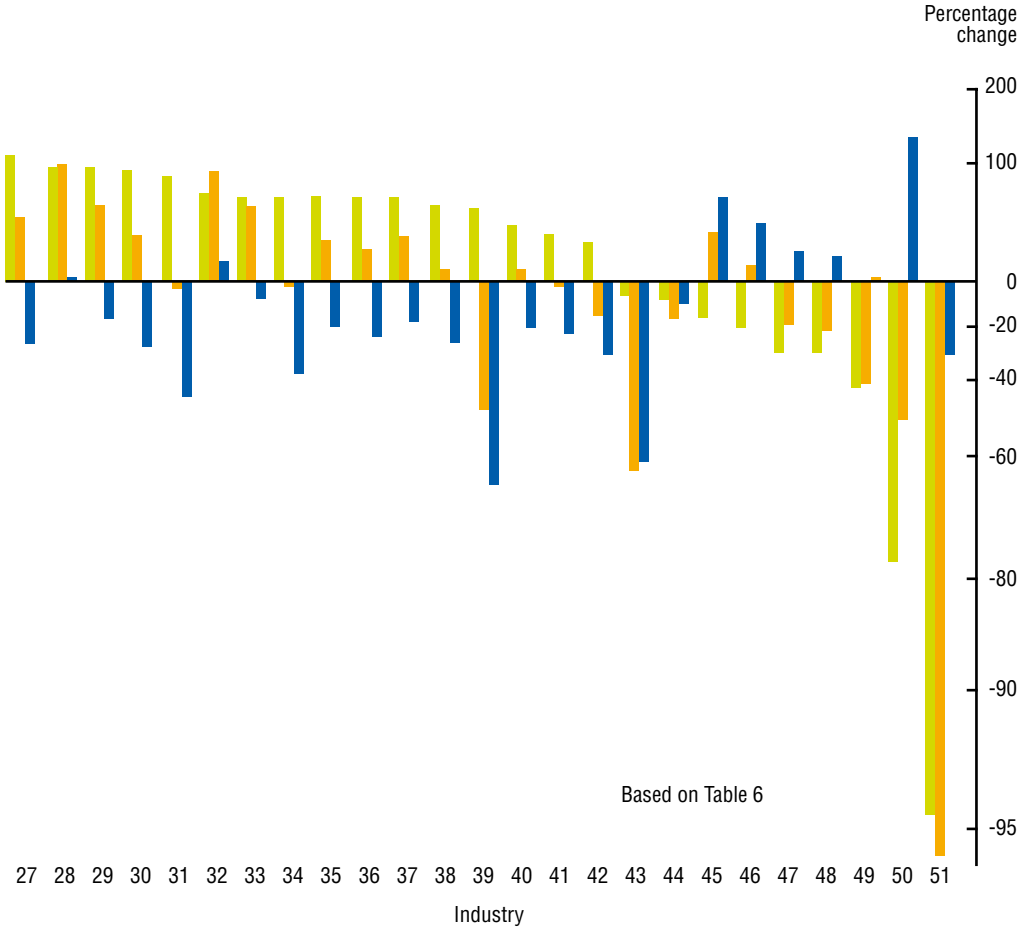
Figure 2. (Continued)

INDUSTRY

1 Automobiles, incl. bodies and parts
2 Chemicals, industrial, incl. compressed gases and rayon
3 Petroleum refining
4 Beet sugar
5 Fruits and vegetables, canned
6 Ice
7 Glass
8 Paper and pulp
9 Silk and rayon goods
10 Knit goods
11 Printing and publishing, total
12 Butter, cheese and canned milk
13 Cigars
14 Rice
15 Paints and varnishes
16 Coke-oven products
17 Zinc
18 Liquors, distilled
19 Steel - mill products
20 Tanning and dye materials
21 Copper
22 Explosives
23 Wood - distillation products
24 Fertilizers
25 Blast - furnace products
26 Jute goods

INDUSTRY

27 Cotton goods
28 Hats, wool - felt
29 Shoes, leather
30 Cane sugar
31 Salt
32 Meat packing
33 Cottonseed products
34 Leather
35 Woolen and worsted goods
36 Liquors, malt
37 Shoes, rubber
38 Carpets and rugs, woof
39 Lead
40 Cordage and twine
41 Gloves, leather
42 Hats, fur - felt
43 Chewing and smoking tobacco
44 Flour
45 Ships and boats
46 Cars, railroad
47 Lumber - mill products
48 Turpentine and rosin
49 Linen goods
50 Locomotives
51 Carriages, wagons and sleighs



The increase in real wages came essentially through increased monetary wages as the national stock of money grew, not through improvements in the terms of trade in the 'dog' industries. In this way the huge productivity advances in the 'star' industries spread to a much larger extent *inside the producing nation* than to customers abroad. A similar view on wage determination is held by the French regulation school (see Boyer 1988).

The benefits of technology clearly spread in the economy in a different pattern from what the classical and neoclassical economists expect. I call this the *collusive*[127] mode of diffusing the benefits from technological change: the benefits are divided among the capitalists, the workers, and the government *in the producing nation*. (The word collusive does not imply a conspiracy. This collusion comes about by the normal working of the economic, social, and political forces.) Inside a nation, social and democratic forces, labour mobility, and the distributive effects of a huge government sector ensure that the wage level and standard of living in the 'dog' industries do not lag too far behind those of the 'star' industries.

Inter-industry differences are, of course, much greater in a society like the US than in a 'wage solidarity' culture like the Scandinavian, but the same mechanisms are at work.

Faced with a *collusive spread,* the US during the period covered in Figure 2 would grow richer if it could move workers from the hat industry to the automotive industry. Importing hats and exporting cars will – under the collusive diffusion of technological improvements that in fact happened – improve the US welfare position as compared to autarky. This opportunity is created by the fact that not all economic activities are mechanized at the same time and to the same extent.

Figure 2 also very well illustrates Verdoorn's Law, another phenomenon that adds to the desirability of product innovations. This law shows that the products with the largest increase in output – i.e. new products like cellular phones today – are also the products that show the highest growth of productivity due to increasing returns. We can observe how the industries with the highest increase in physical output (the industries with the lowest sequential number) also tend to be the industries with the highest increase in labour productivity (where the number of wage earners per unit of output has been most reduced).

By increasing barriers to entry into the industry, the combination of technological change and increasing returns – a combination Schumpeter referred to as *historical increasing returns* – acts as a powerful boost for real wages. This 'catapult effect' of real wages is the mechanism that caused fast increases in real wages in the two last colonies of Europe – Ireland and Finland – over the last decades. The mechanism works both directly through labour power, tight labour markets and high demand for high-skilled workers, and through the foreign exchange markets where the currencies of successful nations increase in value (historically Germany, Switzerland and Taiwan are examples of this foreign exchange mechanism).

A *classical* spread of benefits from innovations is the result of the usual assumptions in neoclassical economics. However, with a Schumpeterian world view, a purely classical spread is hardly plausible. The dynamics of the system are generated by the technological change which creates disequilibria – and the higher profits created in the industries experiencing technological change are necessary in order to draw capital to these higher risk and more capital-intensive activities. In addition, a classical spread of the benefits – only in the form of price reductions to customers at home and abroad – would not be seen as fair and democratic in the producing country. That industrialized country workers receive their share in the productivity improvements in terms of higher wages is an integral part of the credo of industrialized societies.

127 This matter is discussed more in detail in Reinert (1994).

In this case as in so many others, economics is about reinventing wheels. Similar contexts give birth to similar ideas that have been lost for lack of demand. The problems of the 1930, e.g. how differently the crisis affected manufacturing and agriculture, raised this same questions on how technical change spreads in the economy. Thus, in the late 1930s, the Brookings Institution published a series of books aiming at 'nothing less than a general re-examination, in the light of modern developments, of the operation of the capitalistic system of wealth production and distribution'. The studies conclude that the benefits of innovation and technological progress may be spread in the US economy in two different ways:

1. *Raising money wages (my collusive mode)*. 'The most obvious method by which the income of the masses might be expanded... it is the method which has been steadfastly pursued by labor organizations... and it is the method which has been officially experimented with under the auspices of the National Recovery Administration.'. It is recognized, however, that this gives a disproportionate wage lead for manufacturing and railway workers.
2. *Price reductions (my classical mode)*. The series of studies concluded that 'the *most advantageous* means of broadly distributing the benefits of technological progress was by reducing prices in line with increasing efficiency in production'. The practical difficulties in achieving this were recognised and outlined in a volume entitled *Industrial Price Policy and Economic Progress* (Nourse and Drury 1938). The conclusion was that in a market where both the industry in question and the labour unions charge what the market can take for products and labour respectively, a large amount of what from an international trade point of view is a 'collusive spread' is inevitable in a market economy.

Clearly, in most industries, the benefits of technological development spread with elements of both modes. Distribution problems *within* a nation, which was the object of the Brookings Institution study, will be alleviated through competition in the labour market, through labour mobility, through the high government share in GNP, through the relocation of industry to areas in the country with less expensive labour, and, particularly in the case of Europe, through the 'wage solidarity' of labour unions. Internationally, these mechanisms work in a very limited way, as does the huge redistributive machinery of national governments. The inevitability of a 'collusive spread' makes a nation's *choice of economic activity* so crucial. As a result of the collusive spread of technological progress, the world's most efficient baseball producer – an economic activity which all the technology and capital of the US has not managed to mechanize – makes 30 US cents an hour in Haiti, and the world's most efficient golf ball producer makes 40 times as much in an industrialized country.

The two different ways innovation spreads was an important part of classical development economics. Hans Singer, a former student of Schumpeter, raised the distribution issue of technological progress in his paper to the 1949 meeting of the American Economic Association. Singer [128] pointed out unquantifiable factors, however, and in the ensuing debate his important insight drowned in the attention paid to the terms of trade argument presented by Raul Prebisch. Measuring prices – terms of trade – appealed to the traditions and static world view of the economics profession. The remarkable lack of change in terms of trade between industrialized and primary-producing nations over time, showed by Kindleberger and others, really served to reinforce Singer's point: each group of nations is able to keep its own productivity improvements as an increase in national welfare.

128 Published as Singer (1950).

Table 1. Characteristics of the two modes of diffusion of productivity improvements

Characteristics of mode	The Collusive Mode	The Classical Mode
Divisibility of investments **Degree of perfect information**	Indivisible, comes in 'chunks' Imperfect (e.g., patents, internal R&D)	Divisible Perfect (competitive market for technology itself)
Source of technology from user company point of view	Internal, or external in big chunks = high degree of economies of scale	External
Type of innovation	Product innovation	Process innovation
Barriers to entry **Industry structure** **Economies of scale** **Market shares** **How benefits spread**	Increase Increases concentration Increase Very important	No change Neutral No change Unimportant
GNP as measured	Highly visible	Tends not to appear (Solow-paradoxes)
Profits level	Increases stakes: possibilities for larger profits or losses	No change
Monetary wages **Real wages (nationally)** **Price level** **Terms of trade**	Increase Increase No change No change	No change Increase Decreases Turns against industries experiencing technological progress
Examples of innovations in the two groups	New pharmaceuticals, mainframe computers, automotive paint production	Electricity, telephones, sewing machines, use of PCs, dispersion paint production, containers
Where found	Mainly in industry, in recent products and processes	In primary and tertiary sectors, use of new generic technologies, mature industry

Source: Reinert (1994) slightly modified.

Table 1 shows the characteristics of the *classical* mode (price reduction) and the *collusive* mode (raising money wages). In a truly classical spread, the innovation immediately falls to the lower level of what I call *The Quality Index of Economic Activities* (Reinert 1994). The use of containers could be an example of such an innovation. The two modes are not mutually exclusive – in most cases they are both present to some degree. Under autarky, it makes no immediate difference to GNP whether the benefits spread in a classical or in a collusive way. In an open economy with restricted labour mobility it makes all the difference in the world.

The main point here is that the ability of *product innovations* (collusive spread) to create higher real wages in a nation is much larger than that of *process innovations* (classical spread). Process innovations tend to make all consumers of a product richer through lowered prices, while product innovations tend to enrich the producing countries though higher wages.

Internal factors that determine the feasibility of the Lisbon Strategy.

Standard textbook economics generally operates void of any context. However, the context in which the 2004 enlargement of the European Union took place was a very unusual one. During the preceding decade the new member states from the former communist block had been subject to a shock therapy that had severely changed their economic structure. With the exception of Hungary, all former Second World nations experienced de-industrialization – partly severe – after the fall of the Berlin Wall.

Table 2 shows the extent of this de-industrialization in the Second World, including in some new European Union member states. It is interesting to observe that in the most recently industrialized countries the labour shed by industry returned to agriculture, while in the more advanced countries industrial labour was incorporated into the residual service sector. A

Table 2. Integration and Deindustrialization 1990-2001: Employment Structure by Sector, Selected Transition Economies, 1990 and 2001 (per cent).[129]

	1990			2001		
Country	**Agriculture**	**Industry**	**Services**	**Agriculture**	**Industry**	**Services**
Armenia	17.7	30.4	38.3	44.4	14.1	37.2
Azerbaijan	30.9	22.9	31.1	40.0	10.8	49.3
Bulgaria	18.5	44.2	37.3	26.3	27.6	46.0
Czech Republic	12.3	45.5	42.2	4.8	40.4	54.8
Estonia	21.0	36.8	41.8	6.9	33.0	60.1
Hungary	8.7	30.0	58.1	6.2	34.7	58.9
Kazakhstan	22.3	31.5	40.7	22.0	18.3	59.8
Kyrgyzstan	32.7	27.9	39.4	52.4	11.6	36.1
Latvia	17.4	37.4	45.2	15.0	25.6	59.4
Poland	25.2	37.0	35.8	19.1	30.5	50.4
Romania	29.1	43.5	27.4	42.3	26.2	31.5
Russian Federation	13.9	40.2	45.6	11.8	29.4	58.8
Slovakia	10.1	39.6	50.0	6.1	37.6	56.2
Slovenia	10.7	44.1	45.1	9.8	38.1	50.8

Source: International Labour Office 2004.

turn to the service sector in a poor deindustrialized nation is qualitatively a very different process from the turn to a knowledge-intensive service sector in a wealthy country. Both when the people whose jobs were lost by fast deindustrialization go back to agriculture and when they go into the service sector we can assume that severe underemployment accompanied the process (Reinert 2004).

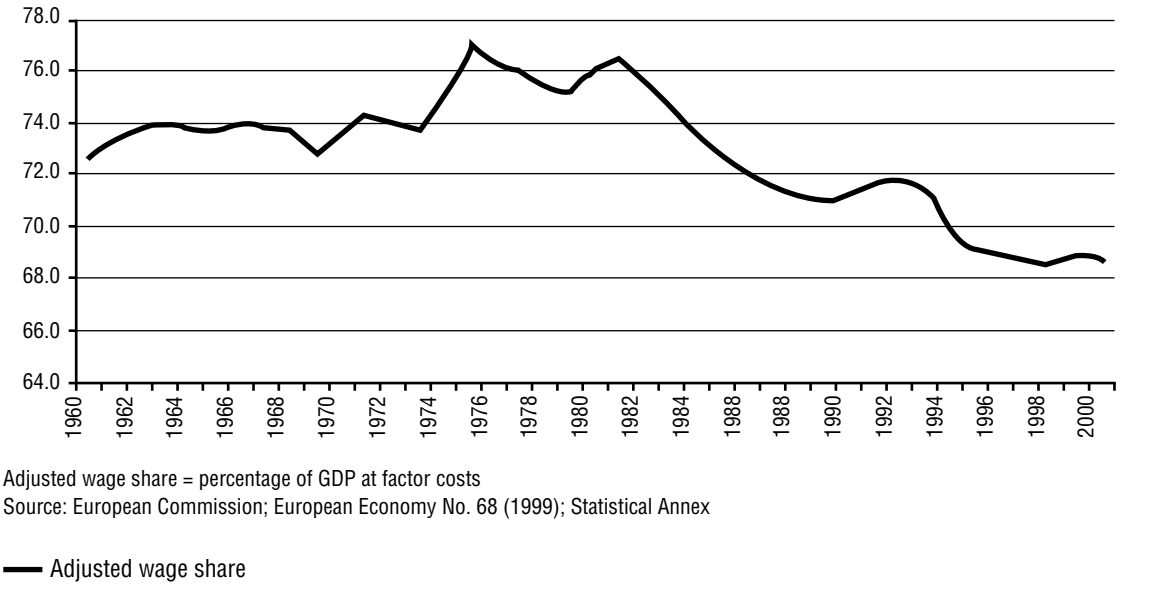
Creative destruction is an important term in Schumpeterian innovation economics. We have argued that this term entered economics via Friedrich Nietzsche and Werner Sombart (Reinert & Reinert forthcoming 2006). We also have to open our minds to the existence of *destructive destruction*. I have argued that the case of Mongolia in the 1990s is a particularly ugly case of destruction of human welfare (Reinert 2004). As Schumpeter, Nietzsche himself saw the process of creative destruction solely as a positive one. The eminent Renaissance historian Jacob Burckhardt – Nietzsche's teacher, friend and colleague at the University of Basel – was, however, of a different opinion. '…by no means every destruction entails regeneration…. there are (or at any rate there seem to be) absolutely destructive forces under whose hoofs no grass grows', writes Burckhardt (1943: 214). This is an aspect generally forgotten in economics.

Destruction and creativity produced by innovations may take place in entirely different parts of the globe, as when the textile mills of Manchester replaced the weavers of Bengal. 'The bones of the cotton-weavers are bleaching the plains of India' the Governor-General wrote home to England in 1835. In Europe the effects are less dramatic, but they are still there. In the case of the new member states the deindustrialisation of the 1990s had two lasting effects. First of all both employment and purchasing power were permanently lost, at least for the foreseeable future. Secondly, a main beneficial effect of the shift in techno-economic paradigm – the upgrading of already existing industry – failed much of its effect because there was little old industry left for upgrading.

An abrupt integration of these countries in the European Union put a heavy burden on the system as a whole. The integration of Spain and Portugal

129 Numbers do not add up to 100% because some industries are 'not adequately defined'.

Figure 3. Adjusted Wage Share in the European Union 1960-2000.



Source: European Industrial Relations Observatory On-line, http://www.eiro.eurofound.eu.int/2000/07/study/tn0007402s.html, based on European Commission 1999.

– following the old Listian principles – had been *win-win* situations. Several aspects of the 2004 integration are characterized by processes more of the *lose-lose* kind, the downward pressure of wages in Western Europe are not compensated by a marked increase in welfare in the New Member States. The set of forces governing this is outlined in point 6.

The free trade shock experienced by Eastern Europe in the 1990s had the same effect typically observed when free trade is suddenly opened between a relatively advanced nation and a relatively backward one. Experience shows that the first casualty of free trade, the first industry to close, tends to be *the most advanced industry in the least advanced country*. I call this effect the Vanek-Reinert effect or the 'winner-killing effect' of free trade. This was the case both in the nineteenth-century unification of Italy and in the Czech computer industry after the fall of the Berlin wall. This effect easily develops into a variation of destructive destruction (Reinert 1980). The last economic activity to survive in the poor country is generally subsistence agriculture.

The Vanek-Reinert effect is fully compatible with standard international trade theory: Under free trade each nation reinforces its comparative advantage – the wealthy first world reinforces its comparative advantage in higher skills in increasing-return industries, while poor nations fall back on their comparative advantage in diminishing-return industries. A comparative advantage in a diminishing-return activity is a 'natural advantage', based on nature's bounty, whereas a comparative advantage in an increasing-return activity is a 'created advantage', based on human innovation and skill.

Another factor which is adding to popular discontent is that an increasingly lower percentage of European GDP is allocated to wages (Figure 3). The share of wages in the economy peaked during the golden age of production capitalism, in the 1970s. This is a global trend accompanying the rise of financial capitalism, and reflects a number of interrelated factors including the loss of labour union power and the abolition of tariffs that could previously be used to protect national wage levels.

External factors that determine the feasibility of the Lisbon Strategy.

We would argue that the basic problem of Europe's economic strategy is that ruling economic

ideology has unlearned the logic and wisdom of Listian integration. A main characteristic of reigning standard textbook economics is a lack of consideration of *context*. My view is that a number of external factors – numbered 1 to 5 below – will determine the degree of success of the Lisbon strategy. Not paying enough attention to these external factors will jeopardize the process itself.

In evaluating these factors we must also qualitatively evaluate the degrees to which certain phenomena or certain factors are desirable. In human nature as well as in human societies, there can be both too little and too much of a good thing. Vitamin A is essential to human development. Excess doses of this vitamin may, however, be fatal. Economic dynamics that normally are quite healthy can, if they are too strong, also produce negative effects. Economic activities moving to low-cost areas is a completely normal, and even necessary, process in the history of capitalism, and is an integral part of capitalist dynamics. Too high wages in London was the reason why English textile industry moved out of that city many centuries ago. The same thing applies to the growth of the service economy. William Petty (1623-1683) formulated what is called Petty's Law, that economic development changes economic structure over time: first agriculture dominates, then industry, and then the service sector takes over. However, this does not mean that all de-industrialization is healthy. And, a knowledge-intensive service sector certainly needs high-quality demand from an advanced service sector. The inability to see these types of synergies is another important blind spot of standard textbook economics.

The external variables that cause these moves to be problematic and damaging or not to the creation and even maintenance of real wealth are the following:

1. **The degree of dynamics** in the wealthy core, relative to the other world players (US, China, East Asia). Here Europe scores relatively low, in spite of considerable efforts,
2. **The timing of this event in the techno-economic paradigm**. With the Fordist mass production wave near its crest during the 1950s and 1960s, a radical integration would have been easier almost anywhere than now, in the post-financial crisis, deflationary period of the paradigm, resembling in so many ways the 1930s, including politically (Pérez 2002, 2004). That financial capitalism, rather than production capitalism[130], is in charge during such periods further aggravates the problem (Hilferding 1910, Veblen 1914, 1919, 1921, 1923). Both the attention of economists and of financial markets is carried away from production to studying finance.
3. **The size of the poor/unemployed/ underemployed population** to be integrated compared to the population of the core countries. Here integrating Portugal and Spain was relatively easy, but again Europe now faces a problem.
4. **The ability of the industrial structure in the poor countries to upgrade.** Compared both to the post-WW II situation and to the integration of Spain, Portugal and Greece, the situation in the CEE is very problematic. Instead of the slow reduction of tariffs that made the Spanish, Portuguese and even Greek industries survive and upgrade, the CEE countries – with the exception of Hungary – had to varying degrees been subject to de-industrializing that had Morgenthau Plan-like effects, also creating havoc in the agricultural sector.
5. **The wage dynamics of the rest of the world.** Here the dynamics are generally strongly in disfavour of European wages. The Unites

130 The relationship between financial capitalism and production capitalism is discussed in Reinert & Daastøl (1998) providing an extensive bibliography on the subject.

States is an innovation powerhouse with creeping Wall-Martization of the labour market, increasing illegal immigration, and falling real wages. China is rapidly catching up technologically with minimal increases in real wages, and a virtually unlimited supply of labour from the interior at very low prices. The weakness of labour unions in both these countries will – combined with the other factors on this list – automatically lead to wage pressures in Europe. The efforts needed, and the bottlenecks that will appear, in order to upgrade the Chinese workforce fast enough will be a factor working in the other direction, in favour of a better European wage level.

In this situation both businesses and macroeconomic variables may be doing very well, but not the nations' inhabitants. Germany, for instance, is now getting into the situation of profitable businesses, jobless growth, and falling real wages. This is the same pattern of 'jobless growth' that for a long time has been typical of Latin America.

Conclusion: A plea for the return to Continental European economics.

As Paul Krugman says, there are periods when old economic wisdom is unlearned and has to be rediscovered (Krugman 1996). Or as John Stuart Mill expresses it, much stronger, 'It often happens that the universal beliefs of one age of mankind – **a belief from which no one *was*, nor without an extraordinary effort of genius and courage *could* at the time be free** – becomes to a subsequent age so palpable an absurdity, that the only difficulty then is to imagine how such a thing can ever have appeared credible...It looks like one of the crude fancies of childhood, instantly corrected by a word from any grown person.' (Mill 1848/1929: 3, emphasis added).

The first age of globalisation ended with a return to tariff protection. 'The Rise and Fall of the Free Trade Movement' was the appropriate title of a book published by Cambridge economist William Cunningham in 1905. Today it is clear that while the world took for granted that the factor price equalisation produced by free trade would mean an upward adjustment of real wages for all, in reality there are strong pressures the other way: for a factor-price equalisation *downwards* combined with increased unemployment. This produces a wake-up call both for the global economy and for the European economy.

'Because the private interest of each individual, *when it coincides with the public interests*, is always the safest guarantor of public happiness' says Pietro Verri (Verri 1771: 42)[131] Adam Smith's followers (more than Smith himself) changed this into a system where private interests – by definition and in any context – not only coincided with the public interest, but *alone* were sufficient to create public happiness. In the 1990s it looked as if Smith had been right, now it is increasingly clear that we have to modify this view.

The conclusions of the March 22 and 23, 2005, meetings of the European Council correctly and importantly state: 'Europe needs a solid industrial fabric throughout its territory' (point 15). In 1841 Friedrich List gave Continental Europe a theory on how to achieve this, how to industrialize against the fierce 'competitiveness' of England. As already said in section 3 of this paper, the tools, goals and formulas crated by List were followed loyally until and including the successful integration of Spain and Portugal into the European Union. Friedrich List told us that symmetrical integration, by industrialized nations where everyone's industrial structure survived, would be beneficial to all parties, a *win-win* situation.[132] Today Europe has crated a situation which to many of its inhabitants, both in the old

131 'Perché l'interesse privato di ognuno quando coincide col pubblico interesse è sempre il più sicuro garante della felicità pubblica

132 Today also advanced services play a very important part. These services, however, seem to depend on the demand from a strong industrial sector.

and new member states, appears as a *lose-lose* situation. As I see it, these are problems that will require the resurrection of some of the recently abolished tools from the policy toolbox, together with the factually based continental economic theories that created them.

Joseph Schumpeter provides a description of this type of economics, when he contrasts the work of German economist Johann Heinrich Gottlob von Justi (1717-1771) with that of Adam Smith:

> 'He (Justi) saw the practical argument for laissez-faire not less clearly than did A. Smith, and his bureaucracy, while guiding and helping when necessary, was always ready to efface itself when no guidance or help seemed needed. (Schumpeter's footnote here: 'This was not merely a dream. It will be pointed out below that the bureaucracy in the typical German principality actually tried to behave like this'). Only he saw much more clearly than did the latter all the obstacles that stood in the way of its working according to design. Also, he was much more concerned than A. Smith with the practical problems of government action in the short-run vicissitudes of his time and country, and with particular difficulties in which private initiative fails or would have failed under the conditions of German industry of his time. His laissez-faire was a laissez-faire plus watchfulness, his private-enterprise economy a machine that was logically automated but exposed to breakdowns and hitches which his government was ready to mend. For instance, he accepted as a matter of course that the introduction of labour-saving machinery would cause unemployment: but this was no argument against the mechanization of production because, also as a matter of course, *his* government would find equally good employment for the unemployed. This, however, is not inconsistency, but sense. And to us who are apt to agree with him much more than we do with A. Smith, his (Justi's) vision of economic policy might look like laissez-faire with the nonsense left out.'

In the 1840s the economic wisdom of Verri, Justi and their contemporaries had been replaced by Ricardian economics where the market was seen as producing harmony. Contrary to the predictions of Ricardian economics, what was then called 'the social question' shattered Europe and led to revolutions in all large European countries with the exception of England and Russia. However, Marx' spectre of communism sparked economic reform, where the *Verein für Sozialpolitik,* literary the Association for Social Policy,[133] produced economic and social institutions that created the European welfare state. Gustav Schmoller, quoted above, took the leadership of the *Verein* from the start in 1872. Chancellor Bismarck's support of this line of economic research was key to its success.

Following the 1848 upheavals, timely fact-based, context-specific and problem-oriented economics – rather than Ricardo's assumption-based, context-free and highly abstract theories – chased away the 'spectre of communism' and laid the foundations for democratic social market economies. As Keynes wisely said, the real issue was 'not one between collectivism and *laissez-faire*, but between targeted state action and a socialism which was out of date and contrary to human nature'.

In this long term perspective, however, today's political situation in Europe carries with it a strong sense of *déjà vu*. The August 22 (2005) cover of the influential German newsmagazine *Der Spiegel* shows a portrait of Karl Marx making a 'V' sign for Victory, accompanied by the text 'A spectre returns. The new power of the left'[134] Again Europe seems to be squeezed between two extreme economic models as in the 1840s, extreme liberalism and Marxism. It

133 Active from 1872 to 1932.
134 'Ein Gespenst kehrt zurück. Die neue Macht der Linken'

appears we may be doomed to repeat conflicts that we had previously managed to solve. One important reason for this retrogression is that the triumphalism following the fall of the Berlin Wall made us collectively forget the wise targeted state actions that modified the pure market economy. If communism failed, so Europe seems to have reasoned in the 1990s, the market had to be perfect. Based on this the 2004 enlargement was agreed.

The European mood carries with it an element of what Albert Hirschman – in a Latin American context – referred to as *fracasomanía,* a failure complex amongst the leadership who are convinced that everything is going wrong (Hirschman 1970). This gloom is particularly well represented in Germany (Steingart 2004, Prantl 2005, Sinn 2005), with the scattered analyst actually re-inventing Hirschman's point (Schumacher 2005). Compared to the rest of the world, many things are not really that bad. If we compare European productivity data compared to those of the United States and correct for the hours worked, we find that European productivity is in fact doing well. The biggest problem is self-inflicted: the downward pressure on real wages and the welfare system in 'old Europe' coupled with extremely low real wages and huge un- and underemployment in the new member states. These problems are two sides of the same coin. A widely proclaimed success story in the new member states, Estonia's electronic industry, produces hourly wages of about 1 Euro, only 10 per cent of the earnings of someone sweeping the streets of Paris or Frankfurt. Tensions are too big and the number of people involved is too high for the market alone to create a happy end. In fact what is missing is old fashioned *Staatsklugheit*, or experience-based wisdom among the political elites.

The present situation of Europe requires more than the Lisbon Strategy's list of good intentions focusing around innovations, it needs to bring back economic thinking and economic tools that had been abandoned with the 1990s. This includes bringing back the earlier focus on employment that dominated the period after World War II. It also means a qualitatively much more profound and differentiated analysis of technology and innovations and their economic consequences on both wages and employment, at company, national and community levels. Furthermore, studying the phenomena that create the economic differences that now haunt Europe is not meaningfully carried out in a framework of equilibrium theory. The now virtually defunct continental European tradition of economics is much better suited to such a task. Above all, the discussion of the Lisbon Strategy must be lifted out of the generic and context-free and into a context where present problems, many of them created by the shock therapies of the 1990s, are recognised as being real challenges.

References:

- Achenwall, Gottfried (1763), *Die Staatsklugheit nach ihren ersten Grundsätzen*
- *Entworfen,* Göttingen, Vandenhoeck.
- Amsden, Alice (1992), *Asia's Next Giant. South Korea and Late Industrialization*, New York, Oxford University Press USA.
- Bhagwati, Jagdish and Mathias Hirsch (1988), *The Uruguay Round and Beyond - Essays in Honor of Arthur Dunkel*, Ann Arbor, The University of Michigan Press.
- Bidussa, David, editor (1977), *Felicità pubblica e dottrine economiche in Italia (fra XVIII e XIX Secolo)*, Milan, Fondazione Feltrinelli, 1997.
- Boyer, Robert. (1988): 'Technical Change and the Theory of *Régulation'*, in Dosi, Giovanni et. al. (eds.), *Technical Change and Economic Theory*, London and New York, Pinter Publishers, pp. 67-96.
- Burckhardt, Jacob (1943), *Reflections on History*, London, Allan & Unwin.
- Cunningham, W (1905), *The Rise and Decline of the Free Trade Movement*, Cambridge, Cambridge University Press.

- Fabricant, Solomon (1942), *Employment in Manufacturing, 1899-1939: An Analysis of its Relation to the Volume of Production,* New York, National Bureau of Economic Research.
- Fagerberg, Jan et. al. (eds.) (1994), *The Dynamics of Technology, Trade, and Growth,* Aldershot, Elgar.
- Fagerberg, Jan, Paulo Guerreri & Bart Verspagen (1999), *The Economic Challenge to Europe. Adapting to Innovation Based Growth,* Cheltenham, Elgar.
- Foxwell, H. S. (1899), *Foreword* to Menger, Anton, *The Right of the whole Produce of Labour,* London. Macmillan (pp. v-cx).
- Gambardella, A., and F. Malerba (eds.) (1999), *The Organization of Economic Innovation in Europe,* Cambridge, Cambridge University Press.
- Hilferding, Rudolf (1910), *Das Finanzkapital. Eine Studie über die jüngste Entwicklung des Kapitalismus*, Vienna, Wiener Volksbuchhandlung Ignaz Brand & Co.
- Hirschman, Albert O. (1970), 'The Search for Paradigms as a Hindrance to Understanding', in *World Politics,* 22:3.
- Jacobs, Jane (1984), *Cities and the Wealth of Nations,* Random House, New York.
- Jomo, K. S. and Erik S. Reinert (editors) (2005), *Origins of Economic Development,* London, Zed.
- Judt, Tony (2005), 'Europe vs. America', in *New York Review of Books,* Vol. 52, No. 2, February 10.
- Justi, Johann Heinrich Gottlob von (1741), *Deutsche Memoires, oder Sammlung verschiedener Anmerkungen , Die Staatsklugheit, das Kriegswesen, die Justiz, Morale, Oeconomie, Commercium, Cammer- und Polizey- auch andere merkwürdige Sachen betreffend, welche im menschlichen Leben vorkomme,* Leipzig, n.p.
- Justi, Johann Heinrich Gottlob von (1761-1764), *Gesammelte Politische und Finanzschriften über wichtige Gegenstände der Staatskunst, der Kriegswissenschaften und des Cameral- und Finanzwesens,* Copenhagen & Leipzig, Auf Kosten der Rothenschen Buchhandlung, 3 volumes.
- Krugman, Paul (1996), *Development, Geography and Economic Theory,* Cambridge, Mass., MIT Press.
- Kuhn, Thomas (1962), *The Structure of Scientific Revolutions,* Chicago, University of Chicago Press.
- List, Friedrich (1841), *Das Nationale System der Politischen Ökonomie,* Stuttgart & Tübingen, Cotta.
- Mauvillon, Jacob (1776-1777), *Sammlung von Aufsätzen über Gegenstände aus der Staatskunst, Staatswirthschaft und neuesten Staaten Geschichte*. Leipzig, in der Weygandschen Buchhandlung. 2 volumes.
- Mill, John Stuart (1848/1929), *Principles of Political Economy with some of their Applications to Social Philosophy*, London, Longmans, Green & Co.
- Mitchell, Wesley C. (1929) "Sombart's Hochkapitalismus" in *The Quarterly Journal of Economics,* Vol 43, No. 2, February 1929, pp. 303-323.
- Müller, Adam (1809), *Die Elemente der Staatskunst,* Berlin, J. D. Sander.
- Muratori, Antonio Lodovico (1766), *Della pubblica felicità, oggetto dei buoni principi*, Parma, Fratelli Borsi.
- Nourse, E.G. & H.B. Drury (1938), *Industrial Price Policy and Economic Progress,* Washington DC, Brookings.
- Pérez, Carlota (2002), Technological Revolutions *and* Financial Capital: *The Dynamics of Bubbles and Golden Ages,* Cheltenham, Elgar.

- Pérez, Carlota (2004), "Technological Revolutions, Paradigm Shifts and Socio-institutional Change", in Reinert, Erik S. (editor), *Globalization, Economic Development and Inequality: An Alternative Perspective,* Cheltenham, Elgar.
- Pianta, Mario (2005), 'Innovation and Employment'. In Fagerberg, Jan, David C. Mowery and Richard R. Nelson, *The Oxford Handbook of Innovation,* Oxford University Press, Oxford, pp. 568-598.
- Prantl, Heribert (2005), *Kein schöner Land. Die Zerstörung der sozialen Gerechtigkeit,* Droemer, Munich.
- Reder, Melvin (1999), *Economics. The Culture of a Controversial Science,* Chicago, University of Chicago Press.
- Reid, T.R. (2004), *The United States of Europe: The New Superpower and the End of American Supremacy,* Penguin, London.
- Reinert, Erik (1980), *International Trade and the Economic Mechanisms of Underdevelopment*. Ph D. thesis, Cornell University, Ann Arbor, Michigan, University Microfilms.
- Reinert, Erik (1994) 'Catching-up from way behind - A Third World perspective on First World history'. In Fagerberg, Jan et. al. (eds.) *The Dynamics of Technology, Trade, and Growth,* Aldershot, Edward Elgar, pp. 168-197.
- Reinert, Erik (1995), 'Competitiveness and its predecessors - a 500 year cross-national perspective', in *Structural Change and Economic Dynamics*, Vol. 6, pp. 23-42.
- Reinert, Erik (1999), 'The Role of the State in Economic Growth', in *Journal of Economic Studies*, vol. 26, No. 4/5, 1999, pp. 268-326.
- Reinert, Erik (2000), 'Compensation Mechanisms and Targeted Economic Growth – Lessons from the History of Economic Policy', in Vivarelli, Marco & Mario Pianta (editors), *The Employment Impact of Innovation*, London, Routledge.
- Reinert, Erik (2003), 'Increasing Poverty in a Globalised World: *Marshall Plans* and *Morgenthau Plans* as Mechanisms of Polarisation of World Incomes', in Chang, Ha-Joon (editor), *Rethinking Economic Development*, London, Anthem.
- Reinert, Erik (2004), 'Globalisation in the Periphery as a Morgenthau Plan: The Underdevelopment of Mongolia in the 1990's, in Reinert (ed.), *Globalization, Economic Development and Inequality: An Alternative Perspective*, Cheltenham, Elgar.
- Reinert, Erik and Arno Daastøl (1998), *ProductionCapitalism vs. Financial Capitalism – Symbiosis and Parasitism. An Evolutionary Perspective*. Norsk Investorforum, Oslo (downloadable on www.othercanon.org)
- Reinert, Erik & Hugo Reinert (forthcoming 2006), 'Creative Destruction in Economics: Nietzsche, Sombart, Schumpeter' in Backhaus, Jürgen and Wolfgang Drechsler (eds.): *Friedrich Nietzsche 1844-2000: Economy and Society*, series *The European Heritage in Economics and the Social Sciences,* Boston, Kluwer. Downloadable on www.othercanon.org
- Reinert, Erik S. and Rainer Kattel (2004), *The Qualitative Shift in European Integration: Towards Permanent Wage Pressures and a 'Latin-Americanization' of Europe*', Praxis Working Paper no. 17, Praxis Foundation, Estonia http://www.praxis.ee/data/WP_17_2004.pdf .
- Ricardo, David (1817/1973), *The Principles of Political Economy and Taxation,* London, Dent.
- *Rifkin, Jeremy (2004),* The European Dream: How Europe's Vision of the Future is quietly Eclipsing the American Dream, *Penguin, London.*
- Robbins, Lionel (1952), *The Theory of Economic Policy in English Classical Economics,* London, Macmillan.

- Rodrigues, Maria João (2003), *European Policies for a Knowledge Economy*, Cheltenham, Elgar.
- Ruggiero, Renato (1998) "Whither the Trade System next?" in Jagdish Bhagwati and Mathias Hirsch *The Uruguay Round and Beyond - Essays in Honor of Arthur Dunkel,* The University of Michigan Press, 1998.
- Schmoller, Gustav (1897), *Wechselnde Theorien und feststehende Wahrheiten im Gebiete der Staats- und Socialwissenschaftlichen und die heutige deutsche Volkswirtschaftslehre. Rede bei Antritt des Rectorats,* Berlin, Büxenstein.
- Schumacher, Hajo (2005), *Kopf hoch, Deutschland. Optimistische Geschichten aus einer verzagten Republik,* Blessing, Munich.
- Singer, Hans (1950), "The Distribution of Gains between Investing and Borrowing Countries", in *American Economic Review* 40: pp. 473-485.
- Sinn, Hans-Werner (2005), *Ist Deutschland noch zu retten?,* Berlin, Ullstein.
- Smith, Adam (1776/1976), *An Inquiry into the Nature and Causes of the Wealth of Nations,* University of Chicago Press, Chicago.
- Sombart, Werner (1913a), *Krieg und Kapitalismus*, Munich & Leipzig, Duncker & Humblot.
- Sombart, Werner (1913b), *Luxus und Kapitalismus,* Munich & Leipzig, Duncker & Humblot.
- Sombart, Werner (1927), *Der moderne Kapitalismus,* Munich & Leipzig, Duncker & Humblot. 6 volumes. Partial Spanish translation: *El Apogeo del Capitalismo*, Mexico, Fondo de Cultura Economica, 1946, 2 volumes. Partial Italian translation, *Il Capitalismo Moderno,* Torino, Unione Tipografico-Editrice Torinese, 1967 partial French translation, *L'Apogée du Capitalisme,* Paris, Payot, 1932. (2 volumes).
- Steingart, Gabor (2004), *Deutschland - Der Abstieg eines Superstars,* Munich, Piper.
- Veblen, Thorstein (1914), *The Instinct of Workmanship,* New York, Macmillan.
- Veblen, Thorstein (1919), *The Vested Interests and the State of the Industrial Arts,* New York, Huebsch.
- Veblen, Thorstein (1921), *The Engineers and the Price System,* New York, Huebsch.
- Veblen, Torstein (1923), *Absentee Ownership and Business Enterprise in Recent Times,* New York, Huebsch.
- Verri, Conte Pietro (1771), *Meditazioni sulla economia politica,* Genova, Ivone Gravier nella tamperia di Adamo Scionico.
- Vivarelli, Marco and Mario Pianta (eds.) (2000), *The Employment Impact of Innovation: Evidence and Policy,* London, Routledge.
- Wade, Robert (1990), *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*, Princeton, Princeton University Press.
- Wagemann, Ernst (1937), *Wirtschaftspolitische Strategie. Von den obersten Grundsätzen wirtschaftlicher Staatskunst*, Hamburg, Hanseatische Verlagsanstalt.

7. The Business and Economic Implications of ICT Use: Europe's Transition to the Knowledge Economy

by Jeremy Millard

The policy background

Globalisation, rapid technological change and extensive knowledge innovations and exchanges are the hallmarks of the transition to a knowledge-based economy at the start of the 21st Century. At the Lisbon European Council in March 2000, Europe's Heads of State and Governments set an ambitious strategic goal for the EU in order to strengthen employment, economic reform and social cohesion as part of this knowledge-based economy over the next decade (European Commission, 2000): *"…to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion."*

This so-called Lisbon Strategy went on to outline a series of reforms at national and European level designed to achieve these goals. However, unsatisfactory progress over its first four years led the High Level Group chaired by Wim Kok to issue a wake up call In November 2004 (Kok, 2004, p. 39): *"The Lisbon strategy is even more urgent today as the growth gap with North America and Asia has widened, while Europe must meet the combined challenges of low population growth and ageing."*

This was quickly followed by the Mid-Term Review of the Lisbon Strategy which concluded that a refocus of tasks was necessary. The February 2005 Communication to the Spring European Council "Working together for growth and jobs – a new start for the Lisbon Strategy" proposed a re-launched Lisbon Strategy focussing on two priorities (European Council, 2005): *"delivering stronger, lasting growth and creating more and better jobs."*

This more precise prioritisation arose from the realisation that since 2000 the policy agenda had become overloaded and sometimes had conflicting aims. It also reflected an emerging consensus that economic growth is necessary to promote competitiveness and jobs, as well as for providing the foundation for social cohesion and environmental sustainability. In one sense, therefore, the original three pillars of the Lisbon Strategy and its follow-up by the Göteborg Strategy in 2001 (economic, social and environmental) were re-ordered with a sharper, stronger and more immediate focus on economic growth in order, in turn, to provide the means to realise the other two. Thus, the EU and Member States are advised to (Kok, 2004, p.39): *"focus on growth and employment in order to underpin social cohesion and sustainable development."*

It is now commonly accepted that economic growth relates to more than just the idea of markets. The Renewed Lisbon Agenda links it directly to competitiveness and employment, which are in turn supported, amongst others, by knowledge and innovation, institutional reform and better regulation (European Council, 2005, p. 10).

Competitiveness was also an issue that was prominent in the original Lisbon Agenda, and the more recent plans for a Competitiveness and Innovation Programme and the Commission's action plan for the Renewed Lisbon Agenda outline the way in which Community support programmes can be brought together for "boosting European productivity, innovation capacity and sustainable growth, whilst simultaneously addressing complementary environmental concerns." European Commission, 2005a, p. 2)

The role of ICT in Europe's economic revitalisation

Kim Kok's High Level Group linked its recommendations concerning the economy strongly and directly to the role Information and Communication Technology (ICT) could play in meeting the Lisbon goals (Kok, 2004):

> *"In order to ensure future economic growth, the EU needs a comprehensive and holistic strategy to spur on the growth of the ICT sector and the diffusion of ICT in all parts of the economy."*

This reflected the emerging evidence, after a long period of uncertainty and conflicting views, that economic development generally and productivity growth specifically were strongly linked to innovations in and the application of ICT, coupled with organisational and market innovations. (OECD, 2004b)

The Spring European Council Review itself explicitly lists four Information Society policy areas, i.e. involving ICT, each of which is translated into specific 'work programme' topics in the Review (European Council, 2005):

- ICT research and innovation
- content industry development
- security of networks and information
- convergence and interoperability.

Research and Development (R&D) investment and innovation are seen as the main tools to achieve growth, whereby the emphasis seems to be on exploiting Research and Technology Development (RTD) results to develop value added products and services. In this context innovation is defined as the transformation of RTD and technology (including ICT) into commercial activity.

In addition to these broader policy developments, a specific European policy focus has also been developing in relation to employment, skills and work organisation. In the context of Lisbon, there is awareness that Europe is increasingly dependent on both the effective use of ICT for industrial and business processes and on the knowledge, skills and competencies of the workforce. At the same time, it is necessary for Europe to respond to global competitive pressure by focusing – more strongly than before – on its strengths and assets, including a thriving R&D base and the availability of a breadth and depth of skilled labour, performing well with the latest ICT tools and services.

To achieve this, policy efforts are being made to increase investments in education and training, improve cooperation between the public and the private sectors, and ensure a seamless framework linking basic eSkills training and more advanced vocational training, higher education and professional development. (European eSkills Forum, 2004b and 2004c).

Context and purpose of this paper

This paper is one of a number arising out of the FISTERA thematic network of researchers (FISTERA, 2005),[135] which aims to offer insights on the prospects of ICT through an understanding of the underlying factors and environments that influence ICT research, development and deployment. The main factors examined by FISTERA are technological (e.g. miniaturisation), social (e.g. increasing demand for mobility), economic (e.g. reduction of the cost per unit of functionality), and political (e.g. governmental efficiency and security), although these are not often easily reconciled.

The present paper explores some of the economic factors of relevance to FISTERA, and specifically focuses on the role that ICT can play in assisting Europe to re-vitalise its economy. Much of the evidence used is derived from research projects sponsored and supported by the European Commission, including those funded

135 FISTERA has been established by the European Commission's DG Information Society and Media to support the creation of a European Research Area (ERA) in ICT by providing new elements for the definition of a European vision and approach in the field.

by the Information Society Technologies (IST) Programmes between 2000 and 2005.

This paper examines both the micro- and macro-level economic impacts of ICT, with a focus on the European realm, and examines the burgeoning empirical evidence that ICT can be an extremely important component of economic vitality, and why this is so. First of all it summarises some of the main features of economic development in the 'new' knowledge economy as compared to the 'old' economy, and analyses the increasing role that ICT plays in value chains, networks and markets. It then summarises the main features of knowledge and skills in the new economy, and analyses the impact ICT has on jobs and the organisation of work. Next, it focuses on the use of ICT at the level of the firm, the business impacts of this, and specifically on innovation in a knowledge economy context. The paper analyses how ICT can lead to the de-localisation of economic activities, including the local and regional contexts, and the implications this has in the context of economic globalisation. Finally, the paper examines how the role of ICT in the economy is analysed and measured, the difficulties and debates surrounding this, and why Europe has not been exploiting ICT as well as it might over the last ten years, particularly by comparing its performance in this regard with the performance of some of its main competitors. The paper concludes by summarising the main factors important for achieving economic benefits through ICT use, and highlights a number of issues which it is suggested are important in a European policy context.

The new knowledge economy

'Old' and 'new' economies

Although the fundamentals of economic growth and competitiveness do not change themselves, it is becoming increasingly clear that their context and parameters are currently changing quite dramatically. This arises out of the expansion of economic competitive systems from regional or national to global scale, the greater sophistication and differentiation of markets, and the need for economic players to focus on completely new combinations of factors in order to retain or generate comparative advantage.

In the context of examining economic growth in the EU compared to the US, the recent Sapir Report summed up some of these changes: "It has now become clear that the context in which economic policies have been developed changed fundamentally over the past thirty years. A system built around the assimilation of existing technologies, mass production generating economies of scale and an industrial structure dominated by large firms with stable markets and long term employment patterns no longer delivers in the world of today, characterised by economic globalisation and strong external competition. What is needed now is less vertically integrated firms, greater mobility within and across firms, more retraining, greater flexibility of labour markets, greater availability of external finance, in particular equity finance, and higher investment in both R&D and higher education. In other words, what is required is a massive change in economic institutions and organisations, which has not yet occurred on a large scale in Europe." (Sapir, 2003, p. 2)

This seismic shift reflects a wider change from the so-called 'industrial' economy to a new 'knowledge' economy. All economies have, of course, always been based to a greater or lesser extent on information and knowledge. What is different in the knowledge economy is that commercial processes are increasingly based on the conscious extraction, creation, manipulation and embedding of knowledge in new products and services, and coupling this with much greater knowledge about markets, consumers, competitors, and regulatory and other contextual conditions. The result is often that several economies exist side-by-side, depending on location and context, including knowledge, industrial and agrarian types, but the balance across much of the world is shifting inexorably towards the knowledge end of the spectrum.

For example, one of the clearest signs is the shift from manufacturing to service jobs in advanced economies, *The Economist* recently reported on the "great jobs switch" (Economist, 2005) in which manufacturing jobs now account for less than 10% of total jobs in the US, compared with 25% in 1970, closely followed by many other rich countries such as Britain (from 35% to 14%) and Japan (from 27% to 18%). However, in these countries manufacturing output continues to expand because workers have been replaced by new technology (including ICT) to boost productivity, and have shifted production from labour-intensive products such as textiles to higher-tech, higher value-added, sectors such as pharmaceuticals. At the same time, within firms, low-skilled jobs have started to move offshore, whilst higher value R&D, design and marketing have stayed at home.

It has generally been much easier to automate manufacturing than services, replacing men by machines. However, the *Economist* argues that the distinction between manufacturing and services is, in fact, no longer very helpful, especially given the fact that many so-called manufacturing firms include a large number of service-type jobs from cleaners to designers. A more sensible split now is between low- and high-skilled jobs. And, increasingly, even many aspects of service jobs are also becoming subject to automation. There is some evidence that we are on the edge of a major move towards the commoditisation of business processes in which many types of business processes, from developing software to hiring a CEO, are being analysed, standardised and quality checked, as more and more knowledge becomes codified and facilitated by ICT (Davenport, 2005). This could lead to process commoditisation and outsourcing on a massive scale in the future.

As outlined above, economic growth, competitiveness, jobs and innovation are now seen as constituting a holistic foundation for European policymaking in a knowledge economy. In essence, the competitiveness of an economy has two complementary dimensions which may in some cases appear as contradictory (European Commission, 2005b, p. 7):

1. the ability of firms to compete in the global market place, leading to overall economic growth
2. general increases in living standards and employment opportunities across the population.

Meeting global market requirements, where cost is often a key factor,[136] while simultaneously achieving rising real incomes, is a real and pressing challenge. The key to simultaneously achieving both low costs and high wages is productivity, not only labour productivity but also the productivity of other factors such as capital, resources, knowledge, etc., hence total factor productivity. (European Commission, 2005b, pp. 7-8). Productivity growth is thus the key driver for economic competitiveness and growth. Apart from the element of potential trade-off between global market requirements and living standards, they are of course also mutually supportive, given that the growth in international competitiveness will itself tend to lead to a growth in real incomes as more market share and trade are achieved.

Transaction costs, value chains and flexible specialisation

Many of the impacts ICT has on the economy are driven by dramatic reductions in so-called transaction costs, which result from the rapidly falling costs of information and of communication, making it much cheaper to interact both within and between organisations. Low transaction costs also make it possible to outsource or insource certain functions to highly

136 However, as implied, and although cost is a very important component in international competitiveness, other factors are also crucial, including user-driven and R&D/research driven competitiveness and innovation. See section 7.3, and Danish Technological Institute, 2004.

specialised units or firms. By serving a large number of clients, such units or firms can achieve high levels of economies of both scale and scope through specialisation, compared to a situation where such functions are retained in-house by each company. (See Williamson, 1986a and 1986b). This is possible because instantaneous transactions and low or negligible transaction costs also lead to very low resource switching costs, and thus to easy resource switching to alternative suppliers or processes which are cheaper, more efficient or closer to markets.

The OECD (2004b) showed that ICT, by lowering transaction costs, can also improve the functioning of markets by improving the matching process, and make new markets possible. ICT also has an impact on knowledge creation and innovation as it enables more data and information to be processed at a higher speed and can thus increase the productivity of the process of knowledge creation. A greater use of ICT may thus gradually improve the overall functioning of the economy through such spillover effects, as already seems to be the case in the US, but not yet in other countries.

According to Porter (1985), macro-economic systems consist of a complex system of value chains linking together the different steps in the economic process, so that each step adds new value to the whole chain. For example, possible steps include extractor, supplier / transporter, manufacturer / producer, transporter, customer / buyer, etc. A basic hypothesis is that, whilst the industrial economy was based on the use of specific technologies in specific steps in such a chain (and mainly in the production step), in the knowledge economy, technologies (especially ICT) are used, in principle, in all steps of the value chain and (perhaps more important), in all transactions between the steps, such as management, marketing, administration, sales, R&D, etc.

This can lead to what Sabel (1994) has called a flexible specialisation strategy to be adopted, in which ICT enables new links between different steps of a given chain, and new linkages between different chains, to be established. The result can be economies of scope through specialisation within and between relatively complex chains, rather than economies of scale through mass replication in relatively simple chains. This, in turn, goes hand in hand with dynamic and networked organisational structures, no longer hierarchically fixed but based on flexible intra- and inter-organisational collaboration and competition.

Vertical disintegration within and between firms is part of this process, so that one link of the value chain may be geographically removed from central firm activities, such as marketing, administration, production, ICT management, etc. Such strategies tend to be internally integrated and holistic in their approach, i.e. not focused on one factor only, and often rely on digital networks and digital integration across different economic sectors and types and sizes of firms, as well as across public, private and civil sectors. Flexible specialisation also implies being able rapidly to change or deepen the specialisation to meet new needs, to change roles within a value chain, change value chains or create new value chains, often by rapid resource switching. It must also be seen in the context of diversification strategies which many countries and especially regions have pursued.

Although informational linkages, enabled by the falling costs of information and communication, provide the 'glue' in flexible specialisation, this does not go even half way to explaining why firms (dis)integrate, so that it is necessary to look "beyond the firm or the sector to all institutions involved in the complex process of 'making markets' in national and regional economies. These institutions include industry associations, labour unions, consumer organisations, the local and central state, all of whose regulatory activities have a direct bearing on the level of transaction costs and, more importantly, how these costs are distributed between firms (large and small), between firms and government, between capital and labour, between labour and government, between

different parts of the labour force, and also between producers and consumers." (Hepworth, 1989, pp. 213-4).

The OECD also showed that firms using ICT may not be the largest beneficiaries of investment in ICT. Consumers may extract a large part of the benefits, in the form of lower prices, better quality, improved convenience, and so on. In other cases, firms that are upstream or downstream in the value chain from the firms using ICT might benefit from greater efficiency in other parts of the value chain. For example, productivity impacts seem to accrue to firms purchasing through computer networks, not for firms selling through networks (OECD, 2004b, p. 15).

Networking and markets

Networks provide positive exponential benefits because every time a person or an organisation joins a network or system to gain certain benefits, this act simultaneously increases the interaction potential (the networking benefits) of all existing network members. ICT networks exploit this potential even faster and more cheaply than traditional infrastructures. These additional benefits (i.e. over and above those accruing to new members) amount to externalities, and in this case these can be termed positive.

ICT has enabled the speed of economic transactions to increase enormously. Information is more easily available, at a lower price, and it covers a much larger proportion of the market than before. (Horlings et al, 2002). The Internet allows consumers to search the market more completely (on a global scale) in less time and at lower costs than ever before. Conversely, suppliers can collect information on their customers and can adjust their marketing and prices accordingly.[137]

Transaction costs have declined considerably due to negligible marginal costs. The construction of the Internet infrastructure (cables, connectors, computers, modems, etc.) and the purchase of software account for the largest proportion of fixed costs. The marginal costs of providing an additional unit of information are very low, if not zero.

ICT has significant economies of scale and scope that enhance the network and system effects of economic interaction on the demand-side of the economy. Network effects occur if demand for a good depends on the number of people that purchase it. There is a distinction between direct and indirect network effects, where direct effects relate to the good or application itself and indirect effects occur in the interaction between the good and its applications (Varian 2001). System effects occur when a product is useless unless it is combined with other goods, services or applications: for example hardware needs software, DVD players need content, and broadband needs applications that feed off the specific advantages that broadband has to offer.

On the supply-side the development of global computer networks has created a highly volatile 'virtual' market. This market is characterised by intense competition between suppliers who aim to build market share and attach customers to their service (to 'own' them), for example by providing customised or personalised services. ICT has reduced the minimum efficient scale of operation in many markets (e.g. in desktop publishing). Part of the rapid technological progress in ICT and the volatility of the market is the development of new products and services with a higher value added per unit of labour and capital input.

The specific features of ICT, particularly their pervasive nature and their network externalities, can make the application of ICT a self-reinforcing process. The long-term impact of the application of ICT on macroeconomic development is that "if ICT makes the innovation process itself more productive then productivity growth rates could be permanently faster over the long term." (Wiel, 2001). ICT can affect productivity growth but conversely firms that experience

137 This is referred to as mass customization or personalisation (Varian, 2001).

strong productivity growth may invest more in ICT to reinforce their performance. Strong ICT-driven growth can create the financial room and willingness to pay for more ICT investments.

The realisation of the economic and social benefits of ICT, and of networking in particular, depends crucially on the development of market structures and pricing mechanisms. This is also where the threats are located.

Changing technologies or software environments involves time, effort and high costs, sometimes even infrastructure upgrades, consultancy, and retraining (Varian 2001). Switching costs can be so high as to become prohibitive, which is referred to as a 'lock-in' effect.[138] Lock-in effects often occur when users are obliged to invest in complementary products without which their good or application is useless (e.g. training or software).

Open standards allow many firms to interconnect and benefit from economies of scale and scope, whereas proprietary standards, such as exist in software, can create a situation where a single firm dominates the market due to lock-in effects and at the expense of lower consumer welfare. Suppliers try to bind their customers to them by customizing their services, for example by monitoring their purchases and adjusting their offers and prices accordingly. A combination of (i) applications barriers to entry (e.g. proprietary standards in software), and (ii) increasing returns to scale as sales increase, prices fall, and the appeal to new customers grows, can result in strong market dominance which can be detrimental to technological and institutional innovation.

The de-localisation of economic activities

Flexible specialisation and vertical disintegration, coupled with the networking possibilities presented by ICT, can lead to the de-localisation of economic activities. (Millard, 2002). A spatial re-sorting of value chain functions can take place if significant cost, efficiency, quality or other advantages can be found in other locations. This is possible because ICT is increasingly able to bind together many (though almost certainly not all) parts of the value chain no matter where they are located.

On the one hand, this can favour the spatial de-concentration (dispersal) of economic activities previously co-located. Such de-concentration most typically occurs where dispersed sites can offer labour and/or production cost advantages, pools of excess labour supply for activities confronting labour shortage or high labour competition in existing sites, proximity to significant markets or clusters of activity, etc.

On the other hand, spatial concentration (centralisation or agglomeration) can occur when activities previously dispersed find that the advantages of new forms of geographic proximity outweigh the need for physically close links in their present locations.

For example, the benefits of building highly specialised teams involved in R&D, business services, high-tech manufacturing, access to specialised and fast changing knowledge, etc., not just within a given company but, often more important, between similar or complementary companies, can be decisive. In such situations, high levels of face-to-face interaction, spanning commercial, social and cultural contact, can add much value, particularly where there is high risk and uncertainty, and where the advantages of collaborative learning and collaborative action to influence the territorial milieux are significant.

In such zones of concentration, so-called organisational reflexivity tends to be an important characteristic of the regional economy: "…unlike transactions of standardised and substitutable goods, factor inputs and information, transactions associated with many kinds of organisational reflexivity involve

138 Also referred to as path dependency: once a technology or software environment has been selected, vested interests accumulate in the shape of human capital, physical capital and other investments, to the point where a switch to another environment or technology becomes extremely difficult and costly or even simply impossible.

mutually consistent interpretations of information which is not fully codified, hence not fully capable of being transmitted, understood and utilised independently of the actual agents who are developing and using it. (Storper, 1996). The regional and global consequences of ICT-supported de-localisation are looked at in more detail in sections 6 and 7 below.

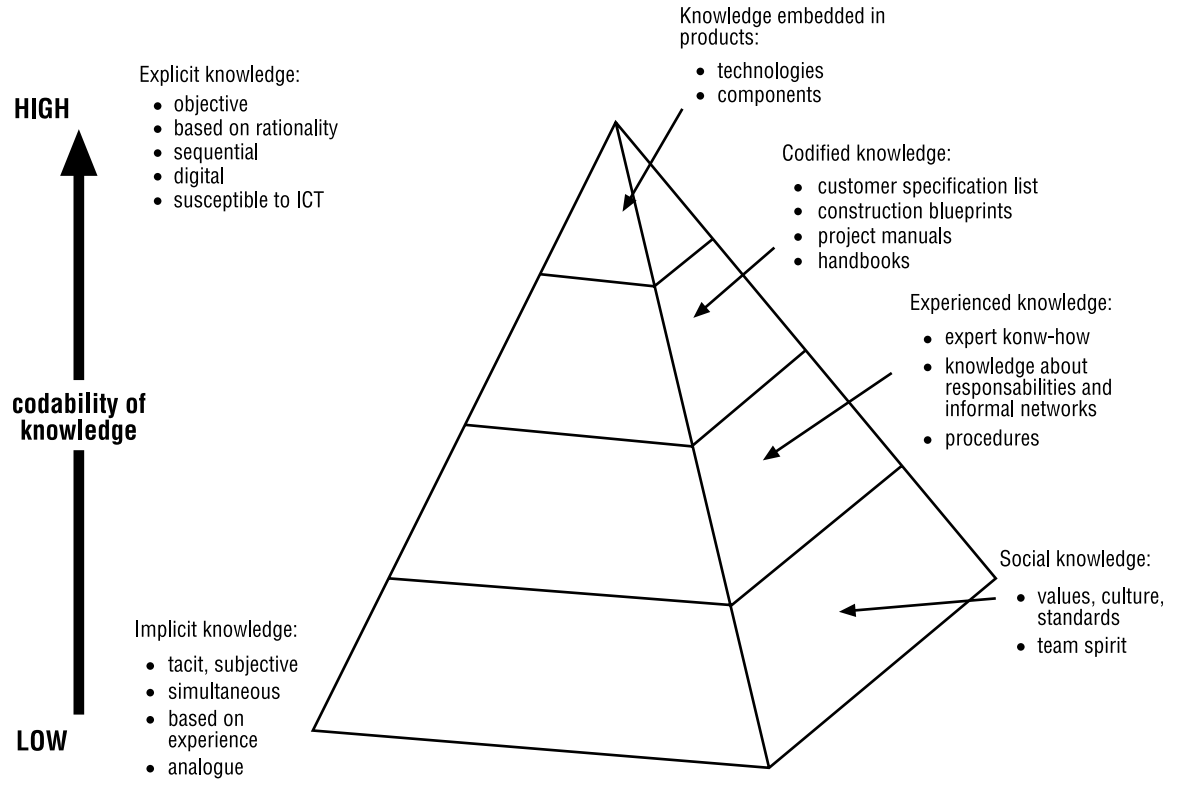
Knowledge and skills in the new economy

Knowledge and learning

As mentioned above, distinction is frequently made between explicit (or codified) and implicit (or tacit, non-codified) knowledge, the latter being highly contextual, not lending itself to codification (Polany, 1966, and Amin and Wilkinson, 1999). Tacit knowledge is argued to be organisationally and locationally specific, reinforcing the need for face-to-face contacts to ensure its successful transmission. However, Breschi & Lissoni (2001) have contended that interpersonal knowledge sharing does not point to physical proximity as a necessary requirement, arguing that non-spatially defined knowledge communities can be important. Here, of course, the role of ICT is important. Antonelli (1999) stresses the difference between information and knowledge, where knowledge is the result of a creative process involving information, "localised in a tacit learning process embedded in the background and experience of each innovator". It is this fact which, he argues, makes the use of knowledge both excludable and non-rivalrous.

However, it is the explicit end of the implicit-explicit knowledge spectrum which is most directly, most easily and most often susceptible to digitisation, and hence capture, manipulation and transmission by ICT (see diagram below). The use of ICT relates primarily to the process of knowledge creation and diffusion within the economy. Codified knowledge is easily transmittable in formal and systematic language

The knowledge pyramid



(such as words, diagrams, models, data, software, etc.), whereas tacit knowledge always has an implicit or individual character, often strongly based on individual experience and/or on shared organisational experience, which makes its formalisation and exchange difficult to others or outside the organisation. The Retine project (2001) represented the distinction between explicit and implicit knowledge in the so-called 'knowledge pyramid', which also emphasises that the two are complements rather than substitutes for each other. In fact, they tend to co-evolve: the process of codification generating new tacit knowledge in a type of virtuous circle in which knowledge transforms along the explicit-implicit knowledge spectrum (see diagram on page 142).

The dichotomy between explicit and implicit knowledge is also reflected in the creation and dissemination of the two types of learning identified by the OECD (2001b) when examining the notion of the learning economy and its implication for economic development at European, national and regional levels. (See table below). When related to the ability to innovate (understood as the creation of new knowledge), the necessary interaction between individuals and organisations is much more likely to occur in locations with high physical densities of skills and specialised firms.

For example, in a study of the 50% of firms in the East Sweden region which innovated, 76% of these did so in collaboration with other firms and organisations within the region (Edquist et al, 2001). Clearly, the scale of analysis and where the borders of the region are drawn are important in this context, but the message is clear that geographic proximity and interaction, although far from universally necessary, can often be decisive for sustained innovation. The authors conclude that the relationships between actors in a successful innovative system are just as important as the individual actors themselves. ICT, as we have seen, is the most powerful tool for establishing, developing and maintaining relationships between actors, whether or not these are in geographic proximity.

An OECD study (1997) looked at the concept of regional competitiveness to explain why some regions successfully develop clusters and networks, a wide variety of manufacturing activities and of services for businesses and consumers, along with educational, research and cultural institutions, and why some must grapple with industrial and institutional imbalance and a lack of resources necessary to adapt. A territory's indigenous capacity for development is linked to the productivity of enterprises, their ability to join networks, the skills of the labour force and the strength of institutional resources. Such an approach stresses the (mainly) endogenous task of creating networks, partnerships and cooperation within the region as well as more widely. These elements were incorporated into the OECD's learning region concept (OECD, 2001b), which underlines the essential role of human resources, skills and competencies, in addition to infrastructures (ICT and others), in network creation and the enhancement of innovative capacity and competitiveness.

The learning region concept is seen as a heuristic framework for analysing key relationships and developing effective strategies

Categories of learning

	Dissemination of existing knowledge	Creation of new knowledge
Individual learning (resulting in human capital)	e.g. schooling; vocational training; "learning-by-doing" in the workplace	e.g. university-based research by PhD student; "learning-by-doing" in the workplace
Organisational learning (resulting in structural capital)	e.g. building data bases, creation of routines and manuals; appropriation of technological licences from other firms; recruitment of highly qualified staff by firms	e.g. ["learning by interaction"]; R&D in universities by research groups; R&D within firms; collaborative R&D between firms and research institutes

Source: OECD (2001b, p. 15).

for national and regional policy. At base, economic competitiveness is determined by the quality of social capital, defined as the institutions, relationships, and social norms impinging upon the quality and quantity of social interactions within a society. In a broad sense it includes the social and political framework that shapes both these norms but also the relevant social structures. Social capital, in turn, moulds the types of learning and the use and creation of knowledge which take place in the economic sphere, resulting in economic competitiveness, but also in social inclusion if long term sustainability is to be ensured. See the diagram below.

The essential point about the learning region is that policy can in fact address organisational change in a region as well as more widely, which itself has implications for the use and development of ICT. Such organisational change can promote regional actors' abilities to learn, imitate and innovate. Asheim (1996), Morgan (1997). Maskell and Törnqvist (1999) define a learning region as one where an industrial cluster becomes a collective learning system, a concept drawing heavily on Lundvall's concept of national systems of innovation, fleshed out at local and regional levels. Asheim (1966) argues that in such regions, learning organisations develop at three levels:

i) at intra-firm level (with flatter organisational structures)

ii) at inter-firm level between firms interacting within a cluster

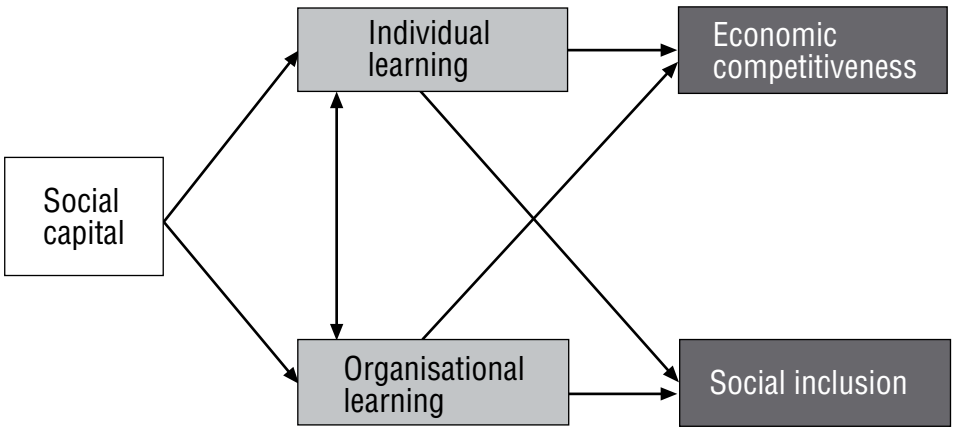
iii) at the institutional level, through public intervention to support organisational innovation in business services, research and training.

It is argued by some that the learning region need not necessarily be high-tech (Maskell and Törnqvist, 1999), and that a learning region can be based upon one or more traditional manufacturing sectors. The learning region is alleged to have many advantages over traditional industrial districts, particularly the avoidance of being locked-in to a path-dependent and increasingly obsolete technological trajectories. Permanent innovation based upon learning and knowledge creation is the means by which regional comparative advantage can be preserved and enhanced in a globalised economy. It is essentially a non-mobile resource.

Malmberg and Maskell (1999) argue that the learning region permits the acquisition of monopoly rents, so that they become the basis of comparative advantage based on three characteristics of resource immobility:

i) asset-mass efficiency (clusters with a large stock of knowledge produce more innovations)

The learning region model



Source: OECD (2001), p. 31.

ii) time compression economies (it takes a long time for a learning region to develop, so by locking in to an existing learning region much time can be saved)

iii) the interconnectedness of asset stocks (single components of a learning economy cannot be easily imitated or detached from the whole).

eSkills and eLearning

According to the European eSkills Forum (2004a), as education and training become more flexible and available on demand and in smaller and more-tailored packages, so the rapid changes in technology and the economy (products, legislation, working methods) make greater demands for an extensive basic education to enable future flexibility. It is no longer enough to assume that the initial full time education of those entering the labour market will serve workers adequately for the rest of their working lives. Training, retraining, and lifelong learning, are needed to enable skills to remain up-to-date, and to enable mid career changes and continued employability. In the knowledge economy, not only are new types of skill sets required, but lifelong learning, often supported by ICT itself (i.e. eLearning), is already becoming a prominent feature of work in the 21st Century.

The EU has identified eight key competence domains (covering knowledge, skills and attitudes) which should be acquired by the end of compulsory education, and achieved (if absent), maintained and updated in lifelong learning:[139]

1. communication in mother tongue
2. foreign languages
3. mathematical literacy and basic competences in science and technology
4. ICT skills
5. learning-to-learn
6. interpersonal and civic competences
7. entrepreneurship
8. cultural awareness.

Of these, eSkills are critical, and do not only encompass ICT skills but also other skills necessary for optimising the use of ICT and working in a knowledge economy context. The European eSkills Forum (2004a) defines three main types of eSkills:

- ICT practitioner skills: the capabilities required for researching, developing and designing, managing, producing, consulting, marketing and selling, integrating, installing and administrating, maintaining, supporting and servicing ICT systems.
- ICT user skills: the capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in most cases, not ICT. User skills cover the utilisation of common generic software tools and the use of specialised tools supporting business functions within sectors other than the ICT industry.
- eBusiness skills: the capabilities needed to exploit the opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and organisational processes, and to establish new businesses.

The STAR project (STAR, 2001) looked *inter alia* at the impact of ICT on applied skills and work content in the Information Society, and found clear distinctions between higher- and lower-skilled jobs. At the higher end of the skills/qualification spectrum, there has been a clear trend to enable the employee to gain more responsibility over structuring his/her work. As boundaries of work relationships become

139 http://europa.eu.int/comm/education/policies/lll/lll_en.html

blurred and management by objectives instead of instructions is introduced, skilled employees gain freedom of action, but have to pay for this by taking on greater responsibility for organising their own work and ensuring that it is effective, often in the form of 'project' work where they take responsibility for the whole project. These changes do take place inside existing, traditional employment relationships, although they may to some extent prepare employees for working as self-employed or as free agents. (Pink, 1997) At the lower end of the qualification spectrum, deskilling can be observed as the know-how that was formerly embodied in employees has often been codified and automated in ICT systems. Such deskilling benefits companies because they can now draw a greater share of their staff from the contingent workforce which enables them to cut their payroll. So, in the case of the lower- and unskilled workforce, ICT increases only company-centred flexibility, ´whilst such workers lose bargaining power.

Skills and knowledge management

As described above, among the direct affects of ICT are impacts on skill requirements and the skill acquisition process, which are of vital importance for the competitiveness and efficiency of organisations. Basic ICT skills (such as use of a PC, mobile devices, standard programmes) are a precondition. More advanced ICT skills (e.g. software development, web-design, database design, the use of specialised programmes, etc.) can be required depending on the type of work to be performed.

In addition, however, modern working conditions often require further mixes of generalised and more advanced skills and competencies. In a fast changing work environment, with a wide variety of work forms and contractual arrangements, there is an increasing need for individuals to take responsibility for their own work and skills development. This includes fostering abilities like self-organisation and management, inter-personal skills, dealing with unexpected rather than routine situations, greater initiative and self reliance, etc.

Much work is increasingly being organised on a 'project' basis, i.e. individuals or teams are given a specific task or project, some resources, quality requirements and a deadline. How, where and when the work is carried out in detail, as long as these requirements are met, is left to the workers themselves. Coping with the extra responsibility, and perhaps stress, this can cause needs to be acquired as a skill in its own right. Although many work processes remain routine, most workers are being exposed to these new demands on their abilities. Indeed ICT can, in the best circumstances, take over routine functions leaving workers free to undertake more interesting work.

ICT thus has a somewhat paradoxical effect on skills and competencies, leading to both de- and re-skilling depending on the initial skill set. the market conditions and organisational and labour market strategies. It often also requires both more and less independence on the part of the individual worker at the same time. On the one hand, ICT contributes to placing more responsibility on individuals to enhance their own skills profiles, especially in contexts where there is more independent working (including at a geographical distance), and where each employee has specific responsibility to complete her or his work successfully. On the other hand, the complex nature of new types of work, and the knowledge needed to successful complete it, often requires greater inter-working, cooperation and team work, i.e. more reliance on others both within and outside the organisation. (Millard, 2002)

Thus, although companies are increasingly pressured to provide continuous learning for individual employees in order match the fast changes taking place in the competitive environment, they also need to enhance organisational learning, i.e. the management of knowledge in a company or organisation as described above. (OECD, 2001b) Only if organisations are able to systematically preserve

and exploit the collective and interchangeable know-how of their workforce, thereby reducing the threat posed by departing employees as well as ensuring that the competitive potential of the organisation is fully exploited, will they be inclined to invest in training activities. Thus, knowledge management is closely related to the continuous learning of the workforce. (Senge, 1990, and Nonaka, Takeuchi, 1995)

The impact of ICT on jobs and work organisation

Creating jobs in the knowledge economy

According to the European eSkills Forum (2004b), sustainable jobs are created mainly by growth in economic activity. Government can also create jobs, for example by financing public infrastructure, or increasing defence or regulation workforces. Increasing the availability of skilled people may itself create jobs, by removing constraints on 'creative destruction',[140] or increasing competitiveness by reducing excessive wage levels in areas of shortage.

As also demonstrated in section 8.2, ICT is a major driver of economic growth and can contribute to more and better jobs under certain conditions. This takes place not only through the development of new products and services, but also by enabling existing tasks to be performed more efficiently or to a higher standard. Considerable scope remains for applying ICT to existing tasks which requires specialist eSkills initially to develop the application, and then requires both specialist and user eSkills across all sectors for on-going operation and maintenance. This has created the need for those with sector expertise to develop eSkills as well, and for professionals from other sectors to move into ICT.

There is a multiplier effect creating jobs in other sectors (from packaging to education to retailing). Job losses also occur, but the net effect appears to be positive where the right conditions are created. These conditions include (European eSkills Forum, 2004b, p. 14):

- access to high level skills, expertise, training and research
- environments that attract exceptional people and encourage innovation and collaboration
- clusters of a critical mass of related organisations and services
- access to resources, facilities and markets.

The EU's main policy response is mainly through the so-called Luxembourg Process[141] in which Member States prepare an annual Joint Employment Report focusing on (European eSkills Forum, 2004b, p. 14):

- increasing adaptability of workers and enterprises – eSkills and eBusiness clearly have important roles in this
- attracting more people to the labour market, and making work a real option for all – eInclusion may provide the means to accessing disadvantaged groups and teleworking can reach remote locations
- investing more and more effectively in human capital – ICT skills will figure strongly amongst required skills, and eLearning will contribute to their delivery
- ensuring effective implementation of reforms through better governance – eGovernment is important in this context.

The use of ICT and the digitisation of work process

How ICT is used in organisations and how precisely it impacts work depends, of course, upon the type of economic activity involved and the way the work is organised. Specially, it depends upon the extent to which the work

140 A term first coined by economist Joseph Schumpeter; see OECD (2003), OECD (2004), Economist Intelligence Unit (2004), Department of Trade and Industry, UK (2005).

141 Agreed at the Luxembourg European Council, November 1997.

can be standardised (codified) into digital form. The distinction between explicit or codifiable knowledge, on the one hand, and implicit or tacit knowledge on the other can be important in understanding the potential application of ICT. ICT, as a medium of digital communication and manipulation, is often eminently suitable for the successful handling of highly-codified knowledge. The greater the codification of knowledge into digital format, the more likely it is that (Flecker, Kirschenhofer, 2002):

- the de-localisation of work takes place, i.e. the work can easily be done in many places
- the monitoring of staff and the work they do will be undertaken by the employer
- the transformation of tacit, experiential knowledge into more formalised objective knowledge, documentation and digitisation will be encouraged
- a formalisation of work processes will take place which itself could become a trigger for work de-localisation.

ICT's success with tacit knowledge is, however, considerably less. Despite constant improvements in the ability of ICT to support intimate communication between individuals and groups (e.g. through video-conferencing, shared digital workplaces, etc.), it seems unlikely that ICT will ever be able to fully replicate the quality of physically interactive group work when such work relies upon the large amounts of unstructured, intuitive, creative and specialised knowledge necessary for functions like research and development, innovation, consultancy, strategic management and decision-making, etc. ICT can, of course, supplement such work and enrich it (for example via databases, knowledge management systems, expert systems, regular communication with similar knowledge-rich groups in other parts of the world, etc.), but it cannot completely replace it. Neither will ICT be able to totally replace the cultural and social frameworks of such knowledge-rich work regimes which are just as important as economic factors in ensuring the successful development and exploitation of highly tacit and experiential knowledge. (Millard, 2002)

Despite this, many aspects of service jobs are today becoming subject to codification and hence automation. So the boundary between what can be codified and captured by ICT and what cannot is constantly moving. There is some evidence that we are on the edge of a major move towards the commoditisation of business processes in which many types of business processes, from developing software to hiring a CEO, are being analysed, standardised and quality checked, as more and more knowledge becomes codified and facilitated by ICT. (Davenport, 2005) This could lead to process commoditisation and outsourcing on a massive scale in the future.

In addition, improvements in ICT within a highly codified knowledge context can also lead to the spinning off of activities requiring more tacit knowledge and skills. For example, call centre customers can be provided with increasingly sophisticated ICT-based self-service facilities directly accessing larger amounts of standardised information. This has the potential to reduce existing routine call centre functions and jobs, but in turn gives greater scope for the development and use of higher tacit skills by the call centre operatives who remain. Call centres could thus become more like help desks in the future with fewer staff but more highly paid and less routine jobs. Such call centres/help desks are likely to become re-concentrated into core and urban areas where the necessary skills are more readily available. Further into the future, when ICT assists in codifying and digitising even some of these higher level functions, de-localisation is again likely. In the right conditions, ICT plays an interesting role overall, helping to drive around a virtuous circle which feeds, in turn, both explicit and tacit knowledge/skill developments. (Millard, 2002, and Gillespie et al, 2001).

The flexibilisation of work organisation

There are many examples of how ICT has made possible totally new models of how to

organise work processes in both space and time (See, for example, EMERGENCE, 2002). These are also related to new contractual employment forms and changes to the content of work. This has put into question 'traditional employment relationships', often characterised, in their broadest sense, by full-time, permanent jobs with a contract of employment, even and stable distribution of working hours over a fixed number of days per week, stable skill requirements and long job tenures. (Handy, 1995, and Dostal, 1999.)

Above all, ICT seems to be contributing directly to the greater flexibility of working processes and the organisation of work. Here, it can be useful to distinguish between two types (Rowntree Foundation 1999, FAMILIES 2002):

- worker-centred flexibility – this involves adapting regulatory frameworks and work organisation in order to give workers more choice, such as the ability to fit working hours around family life.
- company-centred flexibility – this tends to require workers to adapt to the changing requirements of companies regardless of the effect on working conditions.

Both types are, of course, interrelated, and can arguably only be increased in a socially sustainable way if a balance is struck between the two, as in attempts to develop a work-life balance approach to work flexibility.

The overall effects of ICT on work processes and organisation can be summarised as (BISER, 2002):

- Flexitime and part-time working models, as ICT has gradually lessened dependence on routine communication and workflow in organisations using face-to-face interaction and, by implication, on fixed and universal working times.
- Decreases in transaction costs, such as those caused by the application of ICT, tend to result in the increasing importance of self-employment compared to working for an employer, for example, through outsourcing, i.e. the transfer of activities formerly undertaken in-house to the free market.
- The increasing number of innovative business models (especially for small companies) based on ICT, and the falling barriers of entry into sectors that have traditionally been protected by requirements for major capital investment and by heavy state regulation, again attributed in part to the application of ICT.
- The 'distance-bridging' potential of ICT which increases the de-localisation potential of work functions as well as of workers. This makes it possible to choose locations for work processes more freely, thus enabling companies to become more adaptable to changes in their environment.

The STAR project (STAR, 2001) looked at the impact of ICT on working time, working place, type of contract and applied skills (work content), and generally found much more flexibility overall but (in 2001) little evidence of profound widespread changes to existing arrangements. There was no clear sign that employee status is eroding, but rather that dependent employment arrangements are adapting to new flexible requirements. Similarly, although there was some increase in self-employment in the European economies overall, this did not appear to be driven by ICT or so-called eLancing (i.e. free-lancers selling their services and work over the Internet).

STAR also reported that job tenure has remained largely unchanged in almost all OECD countries (with the exception of the USA). This may be explained by the increasing need to tap the tacit knowledge of the workforce and develop work environments that foster innovation. Both are made easier by a workplace culture in which trust and experimentation can simultaneously occur. The need for trust within groups of cooperating individuals acts as a limit to the spread of atypical employment forms such as short-term work contracts, but also freelancing. Labour markets

that rely on electronic representation of market participants in general present a magnified 'trust dilemma' because obtaining the information needed to assess someone's characteristics is even more difficult due to the diminished information richness of the electronic medium as compared to face-to-face communication.

Overall, STAR (2001, pp. 54-55) concluded that there is no evidence for the extinction of the regular employment relationship, and foresaw a gradual change towards a redefinition of regular employment models which then will encompass patchwork careers, stints in self-employment as well as dependent employment, different work time models, etc., without sacrificing basic social insurance standards. One argument against a proliferation of freelance work is that European economies (as well as individual companies) will increasingly rely on highly-skilled human capital as their main competitive advantage, and will thus try to keep and nurture such resources inhouse. While there can be no doubt that trends point towards increasing self-dependence and managerial participation, this might also occur inside regular employment relationships ('intrapreneurs', see Pongratz and Voß 1998). Traditional employment contracts have proven to be adaptable to rapid changes in company environments; they have also proven to be able to allow a considerable degree of flexibility without becoming superfluous.

Organisational and workforce factors

In the context of the re-organisation of work and jobs in the knowledge economy, the findings of the EMERGENCE project (2002) clearly show that existing and/or internal organisational and workforce factors are highly significant in determining new economic or spatial configurations, and are often more important than locational or geographic characteristics. EMERGENCE examined three important company and organisational factors:

1. relocations supported by parent companies, alliances of associations of firms, etc.
2. concentration within a group of companies
3. outsourcing of specific functions or tasks.

In the first two situations, the existing locations of the actual companies concerned are powerful inertial determinants of both the source and destination of any work relocations. In the third situation, normally one in which a specific function or task is relocated without affecting the source company organisation (except maybe the loss of a function), decision-making focuses upon finding the right company to do the work regardless of where that company is located (so that regional characteristics are not directly considered).

In each of these three situations, but especially in the first two, a successful relocation often seems to depend on an organisational learning process taking place. In this context, EMERGENCE identified a number of important organisational facilitators:

- Existing contacts and support from parent or partner companies.
- Clearly delineated tasks or projects, including a high degree of standardisation, codification and formalisation, plus as exact as possible specification and documentation of the eWork to be undertaken.
- Worker involvement in the preparation and implementation of the relocation.
- Adaptation of work routines, organisation and technology to the new relocated environment.
- Organisational change in the source region, as well as at the destination, to adapt to the new overall division of labour.
- Dedicated and extensive efforts regarding knowledge transfer and training through as much codification as is possible and desirable.

It is also important to take account of the actual workforce involved for successful eWork relocation, particularly characteristics like gender, age, skills, career stage, wages, etc. However,

when relocation is due to cost savings this can result in a worsening of working and employment conditions through the imposition of longer hours, more flexibility for the employer, greater workload, and a likelihood of more stress for the workers. One somewhat surprising finding from EMERGENCE is that eWork relocations can result in the increased geographic mobility of personnel. Apart from increased commuting (which is only relevant for short distance relocations), this can take one of two forms:

- a permanent move by staff to stay with their relocating job – this sometimes also means a new employer for the staff member if outsourcing is involved
- temporary moves of, for example, managers and trainers to set up the relocated facility, plus of staff members generally who require more travel to meet colleagues in the new locations for regular or occasional face-to-face encounters.

Organisational collaboration

A particular feature of globalisation which derives from ICT developments is the dramatically increased ability of organisations to collaborate across both internal and external boundaries in new forms of e-enabled value chains and knowledge networks. In this context, and through extensive case-based research and literature review, the Virtual Smart organisations (VSO, 2003) study made some of the following observations:

1. The ability of the virtual smart organisation to understand its own processes and re-configure these in relation to their overall purpose is the key to competitiveness. The ability to re-configure systems and processes and behaviours is based upon the intra-network of the organisation and its flexibility. This is enhanced through the use of corporate knowledge-based systems, which becomes the organisation's repository of learning.
2. The ability of the virtual smart organisation to turn collective information and tacit knowledge into operational, tactical and strategic knowledge and insights, is critical to its competitiveness. We need a deeper understanding of how these knowledge flows are enabled, for example what is system (ICT) specific, what is determined by the economic milieu, what is tied to the social and cultural fabric, and to which extent can these be enabled by policy and institutional interventions?
3. Inter-corporate relationship management is vital to the organisation's ability to position itself within e-enabled communities. Creative interaction between employees, systems and extra-corporate entities facilitates the competitiveness and the uniqueness of the organisation.

It should be remembered that the discussion of globalisation is much more than just outsourcing and offshoring, although this is very a important component. It is also about a focus on:

- The change from a situation 10-20 years ago where specific, relatively self-contained functions could be relocated to exploit other location's advantages (whether price, skills, (lack of) legislation, grants, etc.), and could be centrally coordinated through simple communications structures and pre-determined production and service agreements, and then brought together in finished products.
- To the situation today where coordination is complex and real time involving advanced ICT-based communications enabling intimate integration and dynamic reorganisation of processes and value chains between global facilities, both serving and collaborating with local markets but also exploiting the global resources, knowledge and skills of the entire organisation or partnership – the latter is itself constantly changing to reflect

changing market signals, new production and process innovation and global political and economic events.

- This transformation from simple coordination to deep collaboration also typically involves the development of highly specialised clusters which both have a global place in the international division of labour, but at the same time also reflect and exploit the local labour and demand markets and the politico-economic situation.
- The instantaneous global flows of capital, knowledge and decisions, global value chains (supply and demand chains), insourcing and offshoring.

Firms, business impacts and innovation

ICT impacts at firm level

The OECD (2004b) study on the economic impact of ICT showed very clear and unambiguous impacts on the economic performance and the success of individual firms, in particular when it is combined with investment in skills, organisational change and innovation. These impacts can be observed in firm-level studies for all OECD countries, but have not yet been translated into better economic performance at the industry or economy-wide level in all OECD countries. The OECD points to some factors that may explain this gap between firm-level and aggregate performance, such as aggregation effects, time lags and measurement.

Moreover, the use of ICT by firms is only part of a much broader range of changes that helps them enhance performance. This includes complementary investments, for example in appropriate skills, and organisational changes, such as new strategies, new business processes and new organisational structures. ICT use by firms is also often linked to the ability of a company to innovate. Users of ICT often help make their investments more valuable through their own experimentation and innovation, such as through the introduction of new processes, products and applications.

Main firm level ICT impacts found by the OECD (2004b) include:

- Positive links between ICT use and productivity growth (especially in certain sectors such as finance and insurance, but also in many other manufacturing and service sectors as well), but that these taper off over time, so that the ultimate productivity effect from adoption of ICT is thus a step up in levels, rather than a permanent increase in the rate of growth. (Evidence from Australia.)
- ICT capital deepening raised labour productivity in service firms. (Evidence from the Netherlands, Germany, Canada and Switzerland). In Finland, labour productivity increased between 8% and 18%, and is much higher in younger firms and in the ICT-producing service sector itself. Overall, the higher productivity induced by ICT seems to be somewhat greater in services than in manufacturing. Manufacturing firms benefit in particular from ICT-induced efficiency in internal communication, which is typically linked to the use of local area networks (LANs), whereas service firms benefit from efficiency gains in external (Internet) communication.
- Positive effects on firm productivity associated with the use of computer networks for trading. However, there is an important difference between eBuying and eSelling, with the former having positive impacts on output growth and the latter typically having negative impacts. This is likely due to pricing effects, since at least part of the gain from investment in electronic procurement by firms comes from the ability to use the price transparency offered by eProcurement to secure more competitive deals. Part of this comes from efficiency gains, but part is likely to be at the expense of suppliers. Overall, it seems that the effects of reduced search costs, price transparency and rapid supplier reaction

associated with electronic marketing and sale of goods are likely to have a negative impact on prices. However, there is a great deal of variation across industries depending on market conditions. (Evidence from the UK.)

- In another study of the effect of computer networks, this time in the US, Denmark and Japan, the estimates show that labour productivity in US manufacturing plants with computer networks is about 5% higher than in plants without computer networks if the productivity measure is based on gross output. Estimates based on a value-added measure show that labour productivity is about 11% higher in plants with computer networks. It also finds that a plant that would move from "less likely to having a computer network" to "more likely to having a computer network" would increase its labour productivity by 6.3%. This effect persists when controlling for a range of firm conditions.
- In an Italian study, there was growth in multifactor productivity (MFP) positively related to the increased intensity of ICT use. These impacts are not only found in high-technology sectors or sectors that are intensive users of ICT, but also in the construction sector and other community and social services, sectors that are not particularly intensive users of ICT. Despite the positive impacts of ICT, the overall performance of Italy over this period was characterised by negative MFP growth, which the study attributes to the limited scale of investment in ICT and the costs of adjustment to the new technology.
- The use of both intra-firm and inter-firm computer networks is positively correlated with MFP levels at the firm level. Positive and statistically significant coefficients are found for several types of computer networks, including open computer networks (the Internet), CAD/CAM technologies and electronic data interchange (EDI). In Denmark, firms with computer networks achieved higher growth of value added, particularly after computer network introduction. In Japan, firms with computer network use achieved a less sharp drop in labour productivity growth after computer network introduction as compared to non-users.

Business impacts

The SEAMATE project (SEAMATE, 2003) provided a comprehensive summary of the main business benefits associated with ICT, based on their own surveys and analyses, but which tend in most cases to corroborate other findings, such as those above from the OECD.

SEAMATE found that overall business impacts encompassed:

- The overall transformation of production and value chains from traditional to digital business is clear, as is the importance of new forms of collaboration, like business networking, and how ICT affects productivity, firm performance and innovation, although company size and time aspects for ICT adoption are important. The degree of the impact of ICT on enterprises is also dependent on the product area and sector in which the new technology is integrated.
- An important motor of ICT adoption is the competition between actors in a given market sector. The higher the competition is (for example, in the automotive sector), the greater are the efforts to optimise logistical processes within the supply chain. However, in most cases, eCommerce was implemented as a response to a problem, rather than as a strategic tool in its own right.
- The knowledge economy is driven by new factors of production and sources of competitive advantages such as innovation, design, branding and know-how. These factors are valid for all industries from retailing and car manufacturing to finance and software. As ideas, information and knowledge for the production of, for instance, a car are

seldom held by one single person or a single company, collaborative networks are fast becoming the basic units for innovation and production in this new economy. Companies are embedded within networks, such as the supply chain, technology transfer brokers, board members, and investors, which all contribute to corporate knowledge.

- Traditional ingredients to the networked economy have been innovation and R&D, efficient processes, permanent productivity gains and optimised allocation of resources, management of human resources and others. Neither knowledge nor networks are new concepts per se. The new factor is the rapidly evolving technological environment, which changes the rules of many approaches and paradigms and thus poses new opportunities, but also many threats.
- However, there is still significant lack of knowledge about the basic benefits of ICT and how to exploit them, which means that ICT investment is not generally utilised optimally. For many European companies, in particular SMEs, especially when they belong to the more traditional manufacturing sectors, this new rapidly evolving business reality and the need for these technical and relational tools are often poorly understood. Many enterprises have not yet perceived the importance of knowledge assets as a crucial factor of value and competitiveness. Many are still wary of new ICT and remain within the old paradigms. Managers are often distrustful of collaborative actions and they frequently lack the necessary human and technical resources and knowledge to access these resources or to undertake such actions. SMEs in particular appear to prioritise the establishment of simple solutions rather than none at all.
- Most eCommerce solutions are not yet integrated into production and administrative systems (for example, ERP – Enterprise Resource Planning), and the introduction of eCommerce often fails to be followed by the necessary reorganisation of existing procedures (business process reengineering).
- The next stage and challenge in the eBusiness (r)evolution, which many companies will have to manage, is to integrate the 'e' into their general business processes, instead of conducting eCommerce as a separate business activity.
- Technical issues alone are no longer the focus of investment decisions, but rather the economic use of the technology. The most important factor for staying competitive within the next few years seems to be the enhancement of customer care, for example through CRM (customer relations management). Although now essential to business strategy, the Internet and other advanced ICT do not appear to create dramatic short-term changes in competitive positions. The new technologies are providing another outlet for conducting business, which has its own distinct advantages and drawbacks.

SEAMATE found quite significant ICT impacts on productivity and investment:

- Measuring the direct effects of ICT on productivity is difficult. However, there is ample evidence for such effects at the micro or company level.
- Several studies at the company level showed that investments in ICT will only result in an increase in productivity after a certain time delay, as it takes time to introduce and implement ICT investments in a business environment.
- Most companies argued that investment in ICT is not the sole solution to obtain efficiency gains or productivity growth, and that particularly organisational change needs to take place in order to make investments in ICT profitable. Such changes are typically needed to complement the investment in ICT.

SEAMATE also found important ICT impacts on employment:

- Human beings are simultaneously the most important players in the entire game and pose the greatest challenge.
- Extra training is needed in many cases, and the quality of staff training is seen as a major element in a firm's ability to remain competitive. However, most industries do not offer formal training but instead rely on self-learning.
- Digitisation considerably changes the workflow and value chain within companies. Certain activities become obsolete or are taken on by other actors. These workflow changes reduce the need for employees with specific knowledge in some cases, but require training in new tasks and technologies for other employees.

Innovation in the knowledge economy

Innovation is notoriously difficult to define precisely and tends to be an unhelpful term when not used with care. At its simplest, it means the creation of new knowledge, particularly which can be exploited to give commercial or other tangible benefits. It encompasses an important aspect of socio-economic change, being a vital foundation for economic growth and development, and is highly susceptible to the application of ICT.

Innovation is not a single undifferentiated entity: it arises in many different ways, in many different places, and it evolves over time. Many 'theories of innovation' have been formulated to enable understanding in different contexts. Particularly significant here is the work of Tuomi (2002) and Granovetter (1973). Naturally, theories differ, but there is a good deal of common ground that is well established and well evidenced. For example, innovation is most generally seen as taking place in environments with the greatest number of combinatorial possibilities, i.e. the greatest number of available knowledge sources in the context of relevant and applicable human skills, combined with appropriate conceptual and technical tools (Jensen-Butler, 1996). Innovation is also seen as the application of new knowledge to produce economic or public value. In the process of knowledge development, there are two main assets that can developed ad infinitum (United Nations, 2005):

i) people (all people everywhere, even 'the others' who, like poor people, hitherto have been treated as dangerous deviants) as creative beings and carriers of tacit knowledge

ii) information (explicit knowledge) that triggers people's creative reflection, and specifically the role of ICT which allows the addition of the prefix "mass-" to the production, diffusion and utilization of knowledge.

From this well-accepted core of theoretical work with its accompanying empirical evidence (see Ducatel & Millard, 1996, Aichholzer et al, 1995, VOS, 2003, Edquist et al, 2001), it is possible to construct a specific classification particularly suited to the present phase of development of the knowledge economy. Two dimensions of innovation are proposed with particular emphasis on the adoption and exploitation of ICT, each with three distinct types. Firstly, a life cycle dimension with three basic stages, early, middle and late stage. Second, an economic value added dimension, also with three basic types of innovation ranging from low to high value-added. Note, this approach is based largely on market competition, but can also apply to the public sector if the concept of 'public value' is substituted for 'economic value'. In such a context, we should note that the public sector is subject to many of the same economic imperatives as is the private sector, although (in principle at least) outputs should be in terms of 'public value' rather than 'economic value' (i.e. profits). In addition to contributing to, or providing an enabling framework for, economic growth, jobs and competitiveness, public value

and public governance include many intangible public goods, such as inclusion, quality of life, citizenship, trust, continuity and stability.

Taking the life cycle stage first:

1. Early stage: process innovation. In the earliest stages of adoption of ICT the innovation focus tends to be very much on process innovation during which existing things are done cheaper, faster and better, typically through so-called BPR (business process re-engineering), resulting in increased efficiency and productivity. Process innovation tends to reduce employment (by increasing productivity); it provides a short-term competitive advantage until it becomes the sector norm, at which point it becomes essential to survival in the market, without conferring any long-term competitive edge. In most sectors in mature markets this type of innovation is the current baseline position. Similar innovations are seen in the public sector, although often lagging behind their private sector counterparts, in which BPR tends to be seen through so-called back-office reorganisation, workflow automation using new technology and the offer of eServices to public service users such as citizens and businesses. (The latter is also a form of product innovation).
2. Middle stage: product innovation. In the next stage, once some experience of the impact and usability of ICT has been gained, innovation starts to focus more on doing new things rather than just doing existing things better. Product innovation (both new tangible products and new services) can typically lead to market leadership (rather than market survival) and, in the case of truly radical product innovations, can even create totally new markets. Analogous effects can arise in the public sector.
3. Late stage: organisational innovation and transformation. In the most mature stage, in addition to doing new things, the technology has penetrated sufficiently deeply into organisational structures and cultures that innovation results in new organisational arrangements and forms, both internally within given organisations as well as between organisations and institutions. This can result not just in new markets but in completely new value chains, as well as new governance arrangements involving networks and clusters of economic entities. Again, the public sector can experience similar effects but normally at a slower pace than under market competition.

Cutting across the life cycle stages of innovation, is the dimension that distinguishes the degree of economic value added by the innovation process, which also has three distinct types:

1. Low value-added: cost-driven innovation. This results from seeking improvements in profitability by increased sales of existing products/services, lower costs per production/delivery per unit, cheaper labour and other factor inputs, etc. This can result, for example, from keen price differentiation, maximising the efficiency of supply chain delivery and logistics, automation through the application of ICT, etc. Such innovation is often associated with highly explicit (or codified) knowledge activities which are locationally quite footloose and thus more spatially dispersed, thereby prevalent in both peripheral and core areas (at whatever scale these are defined). Here the economic value added chain is likely to be embedded mostly in the ICT technology and systems themselves. In the public sector context, the search for increased profitability can be replaced by improved cost-benefit ratios where benefits may also include intangible public value goods.
2. Low to high value-added: user-driven innovation. Here the primary focus is stronger branding typically by differentiating from main competitors through a combination of new

products, individualised services, product adaptation, and testing, marketing, customer relationship management (CRM), etc. Strategic knowledge about new or existing markets and about customers drives innovation, often with direct input from customers or employees with their own particular understanding of market developments. This type of innovation is driven by constant inputs of customer intelligence and knowledge (rather than R&D), partially derived from customer behaviour data in which case it can be codified and automated within data warehouse and data mining systems, though it also needs to be interpreted in the context of strategic decision-making. (Høgenhaven, 2003) In the public sector as well, user input to service design is becoming increasingly important in both service design and use stages, as when based on citizen-relationship-management (CRM) in which services are tailored to individual citizens and/or new services are designed on the basis of strong user demand or input. There is also a significant burgeoning of new public information and knowledge systems in which information derived from users (citizens and businesses) and new knowledge creation, already potentially in the public domain, can be developed into new valuable content which has both economic and public value.

3. High value-added: R&D-driven innovation. This is based mainly on commercial and societal exploitation of R&D which takes places within firms, research institutions and laboratories, as well as in networks and clusters. It may arise from deliberate incubation activities, the patenting of new products, launching of new value chains and organisational arrangements, but could also involve process innovation or new delivery mechanisms and services. Such innovation is often associated with highly tacit knowledge activities (i.e. experiential and highly social, often requiring a large degree of face-to-face contact) which are locationally quite 'sticky' (i.e. not easily moved around) and which tend to concentrate in core areas (at whatever scale these are defined) with a high premium placed on organisational learning, but which may also function as a network of specialised distributed collaborative units. Such innovation is typically attained through a knowledge transfer process enabled through the use of learnt norms and conventions among people, researchers, companies and government. The so-called 'triple-helix', or regional innovation system, is the spatial expression of this approach, involving a tripartite collaboration between the private sector, academia and government. The 'intangible assets' involved in such tacit knowledge generation range from know-how (managerial, scientific, technical, logistical, etc.) to networks, trust and goodwill that are valuable but difficult to measure. Here the economic value added chain tends to be embedded mostly in people and organisations, rather than in ICT systems, although the latter are necessary supports for the former. Again, the public sector can potentially offer examples of this type of innovation through public financed R&D into public services such as eGovernment, eHealth and eLearning, both at national and at EU levels. Research driven by policy objectives to improve public governance (so-called innovative governance) is also becoming increasingly important. (European Commission, 2004b)

Crossing the two dimensions, results in the matrix of innovation table below. Each cell can contain specific examples of innovation, but given the characteristics of the two dimensions, there is a tendency for economic value added to increase through the life cycle stages, as the matrix illustrates.

These two dimensions of innovation are proposed to capture the complexity of innovation

Matrix of innovation

		ECONOMIC VALUE ADDED DIMENSION		
		cost-driven innovation – low value-added	user-driven innovation – low to high value-added	R&D-driven innovation – high value-added
life cycle dimension	process innovation – early stage	✔	✔	✔
	product innovation – middle stage	✔	✔	✔
	organisational innovation – late stage	✔	✔	✔

in a knowledge economy context. Whereas the life cycle dimension is more inward looking and focused on the organisation as a unit of production, the value added dimension focuses outwards on the unit's competitive economic and societal milieu within which innovation takes place, as well as on the different types of knowledge being used.

Local and regional milieux

The distribution of the benefits of ICT is important. Even looking at the most simple distribution, between profits and wages, the RISESI project (2004) found that countries where wages are lower have lagged in the development of demand for ICT, while countries (Sweden in particular) where inequalities in distribution are limited have had better performances in all ICT-related indicators. Taking this one step further, ICT leads to new dynamics of regional imbalances and economic exclusion. The nature of the employment and distribution mechanisms operating in ICT-related activities is opening up new imbalances, new opportunities and new threats across and within regions, cities, towns and rural areas.

National convergence, regional divergence?

According to the European Commission, there are striking differences in economic performance between different parts of Europe, particularly between the central and peripheral regions. As the economic position of countries converges, the divergences tend to be located increasingly within individual countries rather than between them (European Commission, 2001). For example, there is a clearly delineated core super-region within Europe, whether measured in terms of employment, GDP, research expenditure, etc., which stretches as a band from north-west Italy through the south and south-west of Germany, up the Rhine/Ruhr west German corridor, into Flanders, Belgium, southern and central Netherlands, to the Isle de France and south-east England. The Digital Europe project (2003) calls this the 'blue banana' super-region and their research concluded that, measured at the national scale, ICT adoption has tended to weaken this core. At the sub-national scale, however, they found a clustering effect associated with the so-called 'new economy' and the adoption of ICT which is stronger than that seen with traditional economic activities, although this is often better explained by industry characteristics, such as skill intensity, than purely ICT intensity.

Other research also points in the same direction, i.e. that, even though countries in the EU 15 may to some extent be converging in terms of economic indicators, at the regional level the picture is more mixed and divergence is still often likely to take place. Some of this may be due to ICT adoption, although the effects of this must

be seen together with wider economic forces, such as globalisation, increasing competition, de-regulation of markets, etc. For example, Martin (2002) found that between 1994 and 1998, although the standard deviation of GDP per capita at national level (EU15) decreased from 12.7 to 11.2, it increased at regional level from 23.0 to 25.0. There were however marked differences between Member States, so that in the UK the regional standard deviation increased from 18.3 to 33.9, but decreased marginally in Germany and France. Indeed, there is evidence that regions with the lowest levels of development supported by Objective 1 of the Structural Funds have experienced a modest but real reduction in disparity in terms of GDP per capita in relation to all regions between 1988 and 1999 (Leonardi, 2004). This finding lends support to the notion that Structural Funds support for the weakest regions has had some success. However, no such convergence effect was observed for Objective 2 or Objective 3 regions in terms of employment and participation rates.

At the sub-national level, the clustering, or concentration process, seems often to be driven by both the demand and supply sides simultaneously (Bennett et al, 1999). On the demand side, positive externalities for information flows and inter business exchanges are gained in larger markets, where the intensity of networks of exchanges also reduces the effects of risk from shocks. Other accounts extend traditional observations of the continuing importance of face-to-face contact in high-order business exchanges (Casson, 1998). From a policy perspective, there is also an important supply-side to the concentration process, including the role of education and labour skills, land and site availability and the supply of innovation, new knowledge and finance. Supply-side effects also result from institutional structures, which are also strongly influenced by the wider state-administrative apparatus: competition law, regulatory structures and compliance frameworks. Indeed, the role of central government is vitally important and does not seem to be being squeezed to insignificance between the jaws of a new local-global dichotomy as some would have it.

Some proponents of the new knowledge economy paradigm have argued that the importance of urban centres as primary business locations is being challenged by the growth of company downsizing and decentralisation, outsourcing and a greater role for SMEs in the economy. These developments have, it is postulated, allowed a more flexible and footloose pattern of location for many types of business, and the contention is made by some that ICT actually leads to the 'death of distance' (Carincross 1997). Others, however, see new or adapted types of both spatial centralisation and decentralisation taking place, with the former, in many important respects, often dominant over the latter. (Millard 2002, 2004) This would help to explain some of the increasing divergence in Europe's regional map.

Thus, although there is some decentralisation of overall economic activity at the European level, this tends to be restricted to either the edge of core cities and regions in the case of high value-added R&D type activities, or to more peripheral regions in the case of lower or medium added value activities in manufacturing or more routine and standardised service activities (Millard, 2002, 2004; Digital Europe, 2003). Other research shows that these latter more 'footloose' activities are often attracted to non-core locations by lower wage costs, pockets of flexible and more stable labour, and the existence of special skills and expertise (Flecker and Kirschenhofer, 2002), as typified by the cost-driven innovation paradigm.

However, it is also clear that there is strong spatial clustering in core regions of high-level (tacit) knowledge activities, including advanced business and financial services, media, R&D and innovation activities, universities, research centres and other specialised educational institutions, etc., and that this goes hand in hand with strong knowledge networking effects, including those on

a global scale. (This is typified by the R&D-driven innovation paradigm). It does not seem to be the case that specific economic sectors (particularly when these are classified using the standard taxonomies) are being moved around very much by new knowledge economy dynamics. Rather, a new type of spatial sorting seems to be taking place, which is to some extent dependent on the type of knowledge created and exploited and the role of ICT in this, regardless of economic sector.

Spatial divides

In this context, Castells (1996) charts an increasing separation of what he terms the space of flows from the space of places, leading to severe spatial, social and economic dislocation. This is exemplified when large metropolises, whilst becoming bound more tightly together on a global scale through exclusive high speed electronic networks, become disconnected from their local hinterlands leading to the splintering of physical networks and communities and increasing geographic polarisation. According to Castells, capital is, at its core, global, whereas labour is local. Thus capital and labour increasingly tend to exist in different spaces and times:

- space: capital in the 'space of flows', and labour in the 'space of places'
- time: capital in the instant time of computerised networks, and labour in the clock time of everyday life.

In his most recent work, Castells (2001, p. 226) re-emphasises the continuing predominance of cities when he describes our increasingly urbanised world of sprawling metropolises. Mobility is enabling people to concentrate in cities more and more in order to improve their life chances, and to gain direct access to rewarding work and to high quality services and cultural enhancement. Economic production and management depend increasingly on knowledge and innovation, and, although this is directly enhanced by large scale and global networking, the importance of territorial complexes of 'milieux of innovation' is also at the heart of the ability of cities, and particularly of large cities, to become the sources of wealth in the Information Age. Although Silicon Valley is the obvious example, the logic applies to all societies and is often tied up with the 'cultural creativity' which only cities can offer.

In this work, Castells also returns to his previous theme of disconnected locales by pointing to the global trend towards building dedicated ICT networks which bypass the general public systems and directly link major business centres. This he describes as 'splintering networks', taking the cue from Graham, and Marvin (2001) who describe how networks (both ICT and physical) can splinter (or polarise) places and societies. This includes so-called 'glocal nodes' as specific areas within, normally, large cities that link up around the planet with equivalent areas anywhere, whilst being loosely integrated, or not integrated at all, with their surrounding hinterland. (See also Millard 1995).

Thus, geographies of both social inclusion and exclusion can develop, depending on the value attached by socially dominant interests to any given place, and partly driven by the privatisation and deregulation of telecommunications in the 1990s and the loss of the earlier principles of universal service. Castells does point out, however, that this is only a structural tendency as people do react against their exclusion and assert their rights and their values, often using the Internet to do so. Yet, in the absence of social mobilisation and policies guided by the public interest, the splintering networks threaten to contribute to a new, and fundamental, economic, social and spatial cleavage: the digital divide. Graham and Marvin earlier developed two models (1996) analysing the processes of differentiation both within and between regions and cities in a context of enhanced ICT:

i) between regions and cities:
   - uneven development
   - virtuous and vicious circles

ii) within regions and cities:
   - social polarisation
   - spatial polarisation.

These spatial digital divides constitute some of the most profound challenges for European regions in the knowledge economy. As shown above, the success in meeting these challenges has, to date, been mixed with most success achieved in relation to the very weakest regions, though with much variation between Member States, and still strong evidence of increasing clustering in the largest cities while other areas are tending to continue to slip behind in terms of relative income and employment levels.

Proximity still matters and accessibility is important

Thus, despite the apparent potential for economic decentralisation riding on the back of ICT adoption and increasing knowledge intensification in Europe's economy, most empirical research is pointing strongly the other way, certainly in the context of high value-adding business activities. Whilst corporate decentralisation, outsourcing and SME development may be giving greater scope for development outside the main centres, the extent of spread of many of these developments tends to be restricted to within 50-80 kilometres from the headquarters or from major centres.[142] Indeed, Bennett et al (1999) conclude that in Britain a very high proportion of external sources of supply to firms, particularly business services, is sought within the nearest 10-25 kilometres.

Distance thus does appear to matter a great deal to the location of all businesses, and to business service firms most of all (Bennet et al, 1999, pp. 415-416). Hence, proximity to major urban centres continues to be significant even if location within them may be less important. New agglomeration economies are apparent, suggesting that there is a continual concentration on existing major centres, especially for high value added activities, such as specialised (non routine) business and financial services, research and development, media, etc.

This importance of business concentration throws emphasis on policy interventions that focus on improving local factor conditions as a means of enhancing competitive advantage. Most local factor conditions depend on local markets: for factor inputs, local demand and supply, industrial interdependencies and the structure of firm strategy and competition. Policy initiatives can play an important role in improving these conditions. At a local level, major efforts can be devoted to improving education, training, public research and infrastructure, including transport infrastructure. Exchange of information can be stimulated and common approaches can be developed to improve synergies between businesses, and between public and private agents. Barriers to market entry or growth can be reduced, particularly for small firms, by improving access to 'business supports', for example through provision of information, advice and improved access to venture capital.

The significance of distance for the location of businesses can also be reduced by increasing physical accessibility to and from specific locations. This can be done, for instance, by focusing on the improvement of transport infrastructure and other accessibility conditions.

Networks and clusters

In the global arena of innovation and competitiveness, metropolitan regions are developing as independent actors competing for resources and competencies, and, at the same

142 This process is also been seen in Finland – personal communication from Nina Mustikkamäki, Research Unit for Urban and Regional Development Studies, University of Tampere, Finland

time, collaborating for visibility and recognition (Jensen-Butler et al, 1997). These metropoles create and are sustained by a series of powerful milieux built around high-tech, high value-added and highly innovative associations of firms and institutions, in which there is a successful and self-reinforcing relationship between technology development and use, research and innovation, highly competitive products and services, high-level decision-making, political and cultural institutions, specialised and highly educated human resources, and, very often, visible regional branding and identity marketing. Where such associations consist of geographically proximate companies and associated institutions, Porter (1998) coined the term 'cluster' encompassing four key elements:

- Geographic concentration – even where advanced ICT can enable some dispersion of activities, persistent face-to-face and social contact between actors appears to remain critical for highly innovative and competitive clustering, especially where research and technology development and other high value-added activities are concerned.
- Specialisation – clusters are normally groups of actors specialising in particular markets, products, processes, technologies or R&D.
- Associations of both firms and other institutions – typically firms across more than one narrow sector cooperate or interlink together with public and non-profit institutions, including those concerned with R&D, education and training and policy making.
- Connectivity – intense and close interaction, interconnectivity and inter-linkage between actors and processes are defining features of clusters, for example along the supply chain and with business and R&D support services.

In the European context, we can see clusters based on portfolios of science and technology based competition, marketed as R&D 'hot spots' (Herbig, 2002), 'creative cities' (Landry, 2000), economic 'growth poles' (Morgan 1997), 'innovation spaces' (Storper, 1993) and 'technopoles' (Castells and Hall, 1994). This is typified by the R&D-driven innovation paradigm, and is likely to accelerate in the future, leading to a European (as well as global) reallocation of R&D resources to regions with high innovative capability in specific business and science/technology areas (such as ICT, biotech, materials, etc.). Clusters of R&D activity, with their accumulated resources, multiplicity of science-based competencies and global connectedness, are the very spearheads of the networked knowledge society (Castells, 2000), with a profound impact on regional as well as national growth and welfare.

Given the above, there is a renewed research interest in the potential benefits of clusters (Gordon and McCann, 2000). At the same time, many, possibly exaggerated, claims are made concerning the existence and economic role of clusters (Martin and Sunley, 2001). Probably many supposed and frequently identified clusters do not exist (Engelstoft, Jensen-Butler and Winther, 2002). Furthermore, there is considerable confusion and disagreement about whether or not clusters represent the spatial expression of localisation economies, i.e. formed around one type of dominant industry (Acs *et al*, 1999, Henderson, 1986), or whether they really should be subsumed under urbanisation economies, i.e. based upon inter-industry spill-overs in cities (Jacobs, 1969).

The policy implications of the resolution of this disagreement are potentially profound. There is thus need for a considerable research effort on the links between ICT use and the dynamics of clusters. Romano et al (2001) argue that ICT can enable what they call 'organisational proximity' to substitute for 'geographic proximity'. But, ICT is not stand-alone; it can reinforce positive aspects of clusters where these exist, and can have little or no effect where they are incorrectly presumed to exist (Castro & Jensen-Butler, 2002). ICT can serve to widen regional economic disparities in Europe, rather than promote convergence.

Clusters tend to be more discretely spatially defined types of networks. The basic differences between clusters and networks have been generalised as:

CLUSTERS	NETWORKS
Open membership	Limited membership
Attracts specialised services to the region	Access to specialised firms at lower cost
Social values fostering trust and reciprocity	Contracts
Clusters generate demand for more firms with similar and related capabilities	Easier for firms to engage in complex business
Co-operation and competition	Based on co-operation
Collective vision	Common business goals

Source: Jensen-Butler (2000)

The strongest and most successful networks are based upon human relations, with economic, social and cultural components. As pointed out by the OECD's research into the 'learning region' (OECD, 2001b, p. 77), networking is a social process and hence dependent upon social capital as well as infrastructure. This means that there is often an element of spatial proximity in network creation and development. Networks grow faster and are stronger when there is a social and cultural component, which is why regions are important for network creation and growth. Thus, ICT networks are most successfully when based upon real local or regional communities characterised by trust, risk sharing, common learning, imitation and social interaction.

ICT is a network-based technology. This means that when critical mass is attained, revenues will grow in an exponential manner. As these networks have a regional component, then first movers will have a substantial and growing advantage. It is easier to be a first mover and attain critical mass in regions that have (Castro and Jensen-Butler, 2002):

- large populations (both people and enterprises)
- higher incomes, as willingness to pay to join a network is higher
- large numbers of ICT proficient enterprises and households (which lowers the costs and risks of implementation of ICT and eCommerce).

Regions having these characteristics will, in general, reach critical mass before regions that do not, although other types of regions can become first movers if they act quickly and act properly. As the growth processes involved are cumulative, gaps in regional income per inhabitant and regional labour productivity levels will grow, rather than decline. Reaching take-off and critical mass are thus questions of prime concern. There is a key role for regions and regional authorities in ensuring that:

- critical mass is achieved. This is easiest to do in a regional context. Then, linking regional networks will make European networks as large as possible, which will bring maximum benefits to Europe. Exclusion of regions means loss of revenue not only for the excluded, but also for Europe as a whole. The market, left to itself, will not maximise inclusion.
- the benefits of the knowledge economy are experienced in all regions of Europe, reinforcing cohesion and self-supporting growth.

Despite globalisation, most firms (and particularly SMEs) develop their primary networks within the region, for example by:

- membership of common supply and value chains
- exploiting and developing regional markets
- sharing and discussing information on markets, technologies, pay scales and profits
- similarity in processes and techniques among firms so that one can understand and judge the other's behaviour
- experience of being helped by another firm
- long-term relationships even with intermittent contacts
- rotation of real leadership

- similar financial rewards
- firms collectively experience the economic advantage of increased sales and profit margins
- an awareness of a bounded community of fate generated by trade and professional associations, municipal service groups and unions.

Strong regional ICT-based networks are themselves a prerequisite for the development of strong external links to national, European and global levels. According to Jensen-Butler (2000), there are three critical aspects of successful regional SME networks in the knowledge economy:

- access to and use of ICT
- trusting, delegating and visionary management
- a learning, competent and flexible workforce.

Because of the substantial positive externalities provided by networks (e.g. the fact that a large network is much more valuable to an individual member than a small one), and because these are much easier to achieve in regions with higher populations and greater incomes, the public sector has a particularly important role in building networks in less central regions. Regional public authorities have a special role in network promotion because of their close knowledge of the regional economy and its actors.

The need for new regional development models and policies

An underlying assumption of much of this kind of analysis is that a major problem for 'less successful' regions is that they either lack the type of institutional capacity present in more 'successful' areas, or, if they do exhibit some degree of institutional thickness, the local institutional milieu is conflict-ridden and dysfunctional (Gibbs et al. 2001). This agenda has been taken up in the European regional policy model with an administrative bias towards developing public-private-partnerships and capacities observed to have 'worked' in more successful regions, including the shift from local 'government' to local 'governance', in which local authorities appear to be just one player amongst many, having become 'strategic enablers' rather than direct deliverers of services and policy.

Apart from the democratic deficit problem in this approach, these assumptions are far from being universally tenable across all European regions, and the political question of how regional development should best proceed remains open. "In the Humber (UK) case, the most effective form of development might well involve strong leadership from the public sector. It may not be the case that (sub) regional prosperity could be easily achieved if only the appropriate private sector partners could be found. Institutional capacity might be appropriately directed and shaped by those local authorities which have had experience in grappling with, for example, the history of economic decline in the Humber sub-region." (Gibbs et al, 2001, p. 116).

The prevailing European regional development model, generally termed the 'Regional Innovation Systems' approach, is largely predicated on developing specific types of regional institutional structures and public-private-partnerships, and is often typified by the 'Triple Helix' approach, i.e. close collaboration between the public, private and academic sectors. The archetypal Triple Helix region in Europe is Tampere in West Finland, which is a high growth region built around a public-private-partnership with Nokia's R&D facilities and a joint technical university. But, to use this as an ideal development model for most other European regions seems misleading, especially given the fact that, as Tampere officials readily admit, "how successful really is Tampere – what if Nokia decided to move out?"

A Similar conclusion was reached by the Tigers project (2000) which examined six European regions or small countries away from Europe's core. The common factors for success in such areas are not always based on public-private partnerships nor a declining role for the local

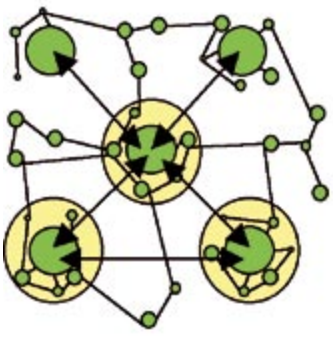
authority, but upon strong public policy, a solid education system in the broadest sense (i.e. much more than ICT skills), case specific investment policy, and conducive regulatory frameworks. Furthermore, the development of these regions capitalised upon regional-specific strengths, such as human capital skills and industrial structures.

Developing an appropriate regional strategy requires a more nuanced, subtle and bottom-up approach than that suggested by the standard model of regional development. Two of these are currently being discussed, not just in a theoretical context but also based on empirical evidence. Firstly the 'digital business ecosystems' model which sees a local or regional economic landscape like a biological ecosystem which is self-organising, evolutionary and adaptive, and where the survival of the system as a whole is more important than individual entities.[143] This model builds on the traditions of industrial districts, growth nodes and clusters, and the EU is already supporting active digital ecosystems pilots in Tampere (Finland), West Midlands (UK), Aragon (Spain), Piedmont (Italy) and Extremadura (Spain).

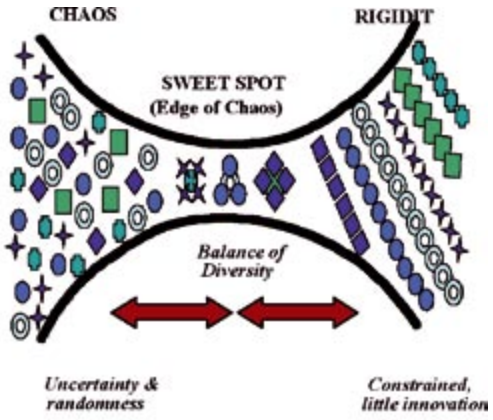
The second and more advanced type is the 'complex adaptive systems' approach, which like the ecosystem model also draws on the natural selection metaphors of survival of the fittest and diversity. In addition, however, it allows for a public sector role if it too can be creative, self-organising and innovative and thus provide a conducive milieu to help find the 'sweet-spot' between too much chaos and too much order. Finding this balance, the sweet spot, means enjoying the advantages of both a centralised controlled approach and decentralised uncontrolled approach, while avoiding the disadvantages of each.

For example, although this is ultimately a political question, minimum standards must be guaranteed while avoiding bureaucratic homogeneity and unresponsiveness; local needs must be taken into account while avoiding parochial and isolationist tendencies. Standardised centrally-agreed structures ensure overall efficiency, a minimisation of negative externalities and transparency, whilst local adaptation delivers on the ground impact and subsidiarity.

Digital Business Ecosystems and Complex Adaptive Systems



Digital business ecosystem



Complex adaptive systems

Source: adapted from presentations at the "Knowledge-Based Economy, Regional Innovation Systems, Digital Business Ecosystems and Complex Adaptive Systems" IANIS Conference, in Brussels, 14 September 2004(http://www.erisa.be)

143 Existing and new regional development models in a knowledge economy context were reviewed at the "Knowledge-Based Economy, Regional Innovation Systems, Digital Business Ecosystems and Complex Adaptive Systems" IANIS Conference, in Brussels, 14 September 2004, inter alia by Gareth Hughes (Erisa), Jeremy Millard (DTI) and Francesco Nacchira (European Commission, DG INFSO. For example, Gareth Hughes' paper for the conference 'Complex Adaptive Systems, the Knowledge Economy and Government'. See www.erisa.be and www.prelude-portal.org

Regional job creation and economic development

The BEEP project (BEEP, 2003) examined a large number of case studies of local and regional economic development using ICT, and found a number of 'good practices' or guidelines for creating jobs and promoting economic development:

- Local physical, institutional and human assets must be linked directly into the process of competitive knowledge creation. To do so effectively, regional policymakers need to understand the types of knowledge and innovation activities their locality can use to develop and compete. For example, cost driven and R&D driven innovation rely on different types of knowledge and supportive environments.
- The local recycling of economic and social benefits, rather than excessive asset leakage out of the region, can help build local strength. This requires achieving a balance, finding the 'sweet spot', dependent upon each specific region, between endogenous and exogenous growth and between tradable and non-tradable goods and services.
- Although institutional thickness is important, the new approaches focus more on the need for institutions to be dynamic, creative and evolving rather than having a particular structure or type of stability. Although they must focus on local needs and opportunities (subsidiarity) they must also be 'joined-up' with institutional arrangements in adjacent regions and with wider national and international frameworks. Again, they must find the 'sweet-spot' between the local and the global.
- Depending upon the existing patterns of organisation and support in the region, changes in governance traditions might be necessary. There is a real challenge of the transition of (regional) governance from bureaucratic governance (now being left behind), to 'best practice' governance (now the norm and based on benchmarking, league tables and a focus on measurable outputs), to networked, 'joined-up' and learning governance (based as much on supporting processes, as well as output, by focusing on flexible evolution and knowledge creation and flow). Such transitions require not only process re-engineering, but also mindset and cultural re-engineering. Much greater emphasis needs to be placed on policy learning and evidence-based policy making if localities and regions are to design strategies appropriate to their own needs and potentials within wider national and global networks.
- Inward investment is often attracted by quality life styles, environment, pockets of skilled labour, the chance to develop niche products, and the like.
- Particularly in more disadvantaged rural and peripheral regions:
  - There is a need for branches of local/regional governments to work together (be 'joined-up'), so that they can better attract investment and support the regional private sector.
  - Local pro-active innovation is essential, coupled with determination and strong leadership (often via champions) in using and developing local assets.
  - Vigorous marketing, often in-person, is needed to sell the attractions and skills of the region, including regional branding. The fact that telework (eWork) or eOutsourcing are being used is not a sales argument. In a commercial context, it is price, quality and delivery, perhaps coupling qualitative and lifestyle factors, which are important. eWork and eOutsourcing are purely a means to an end.
  - Economic sustainability, especially in rural and peripheral regions, often rests upon two different strategies for exogenous job growth:

i) For obtaining work through telework or eOutsourcing, the general characteristics of the area are not important as long as the commercial requirements of the transaction are met by the company concerned (normally price, quality and timely delivery). Compared with strategy ii), such work seems relatively easy to obtain, but can also be quite easily lost again, and also has the disadvantage that it tends to lead to a smaller number of jobs than strategy ii).

ii) For attracting inward investment, the general characteristics of the area do tend to be important (particularly social, cultural, environmental and infrastructural characteristics) in addition to the normal commercial requirements. The reason for this is that investment, and thus the relationship with the investor, tends to be longer term than an outsourcing arrangement, and workers from the investing company may move to the area to live. Compared with strategy i), the work and jobs derived from the investment in strategy ii) seem relatively more difficult to obtain, but once they are obtained they do tend to be more stable and permanent. Strategy ii) also has the advantage that it tends to lead to a larger number of jobs than strategy i).

ICT and economic globalisation

One of the major drivers, offering both profound opportunities and threats, to the 21st Century European economy is globalisation, i.e. the increasing reality of markets, investments, value chains and trade being created and destroyed within the context of the global system as a whole. This does not, however, imply a corresponding decrease in importance of European, national or even regional systems. On the contrary, these typically remain vital to economic growth and competitiveness, especially in terms of their legal, institutional and socio-cultural frameworks and milieux. What it does mean, however, is that these systems are now joined by powerful and truly global systems, including multi-national companies as well as multi-national institutions (like the WTO, the World Bank, the IMF, the UN, etc.), which the territorially-bound systems must accommodate and interact with. It remains to be seen which set of systems becomes dominant in future, or indeed whether or not this is a sensible question at all.

Tradable versus non-tradable goods and services

First of all, we need to put globalisation in context and look at the types of economic goods and services which are most likely to be affected. (Turner, 2001, inspired by Krugman, 1997) has re-evaluated the relationship between so-called tradable (or more tradable) and non-tradable (or less tradable) goods and services.

Tradable goods and services are those likely to be subject to inter-regional, large scale or globalised competition. These tend to be goods and services which can be automated and/or subject to large productivity increases by using new technology, including ICT. They thus tend to be in manufacturing, in the more routine aspects of services using codified knowledge (e.g. back-office functions like information sorting and mediation), and in highly creative but, at the same time, information/knowledge-rich, digitisable services (like web-design, software development, etc.). Because of massive productivity increases and intense competition in these goods and services, prices tend to fall dramatically and employment is often sucked out (depending on how rapidly the sector is growing in relation to productivity increase). So, although these are important for global trading and competitiveness, their value (as measured by their falling prices) and their employment levels tend to remain static or even fall, certainly in relative terms.

Non-tradable goods and services are those not likely to be subject to globalised competition, but which tend instead to be anchored more closely within local or regional competitive milieu. These goods and services tend to rely on face-to-face contacts which are difficult to automate or to subject to significant, sustained productivity increases. They are thus mainly in the human services sectors, both those which are more routine and relatively low value, like hairdressing, and those which are more complex, high skilled and high value, like counselling, teaching, medical services, etc. These services tend not to be traded outside the locality/region and are often seen, compared to the tradable sector, to be increasing in relative value (as prices do not fall) and in relative employment (as the quality of service can often be improved by more manpower, not less). Some aspects of these services can be automated using ICT (e.g. in health and education) where access to codified knowledge can improve efficiency and decision-making. However, value and quality is essentially enhanced, not by ICT substituting for people, but by using ICT to support human capital quality improvements.

In relation to employment and income, conventional wisdom tends to rate tradable more important than non-tradable goods and services, particularly because of the former's 'competitive' and global-trading potential. However, a re-assessment, particularly in the context of the knowledge economy at national and regional level, should take account of the non-tradable sector's importance for employment, income and quality of life, and the way in which many such non-tradable services are dependent on high and growing disposable incomes spent locally. These issues are especially important in advanced economies as in Europe.

According to Turner (2001, p. 35) "A far larger proportion of what is produced in a city or region is now consumed in that city or region than was the case fifty or a hundred years ago: a bigger share of economic activity occurs in the retail outlets, schools, hospitals, restaurants, sports centres and the like whose output is consumed in that location: a smaller share occurs in the factories which produce goods which are then shipped to other cities, regions or countries." Krugman (1997, chapter 13) estimates that Los Angeles today is a 75 per cent 'local' and only 25 per cent 'traded' economy, whereas late nineteenth century Chicago was more than 50 per cent traded and less than 50 cent local. This debate also harks back to the old discussion in urban geography about the relative importance of basic (cf. tradable) and non-basic (cf. non-tradable) activities. The lesson here is also that fast growing sectors, in terms of unit value-added and productivity, may not be the ones which provide the greatest turnover or the most jobs.

However, although the above reflection on jobs and income is important to consider, it is also true that more and more goods and services are now becoming potentially tradable, so the picture is increasingly complex and dynamic with ever changing configurations of functions and jobs previously thought 'safe' now subject to competition, both nationally and internationally. Trading in services is an aspect which is now subject to WTO discussions, even though such discussion may have been stalled within the EU.

A great deal of useful research and analysis has already been undertaken into different dimensions of economic globalisation, or internationalisation, in the context of ICT activities (production and use), including mapping, developing typologies and policy analysis, despite the intractable problems of definition and the dearth of reliable and meaningful data. Much of this research has taken place within the context of the Fifth Framework Programme IST socio-economic research, by DG Employment and Social Affairs, DG Enterprise, the ILO and the OECD. Many of these studies have, however, only focused on specific dimensions, such as the de-location of work and changes in skills demands, and there is still much controversy about such issues. This is exemplified in a speech made by former Commissioner Liikanen, who at an international conference on international

competitiveness held in Limerick Ireland in April 2004 stated:

> *"Outsourcing, offshoring and de-localisation are complex, difficult and important political issues. They deserve a well informed debate and conclusions. First we have to get our analyses right, then it will be time to take political decisions."*

Spatial sorting along the value chain

Though there are many strategies for competitiveness, one of the more predominant theories of business strategy,[144] suggests that companies will want to focus on those specific activities along the total value chain that are closest to their core competencies and add the most value to their products, since this will place them in a position where their offer will be hard to imitate by potential competitors. The portfolio of activities along the value chains of a particular product or service should therefore be seen as a continuum between low value-adding activities and high value-adding activities, along the spectrum: cost-driven, user-driven, and R&D-driven types of innovation.

Clearly, most business activities (including ICT-related activities) will be a combination of these three types of innovation. The relative importance of each, however, appears to have distinctive locational consequences. The manner in which different types of knowledge seem to be undergoing new types of spatial sorting gives rise to the observation that "a given activity may well evolve over time and we might anticipate product and service life cycle effects, whereby 'new' activities tend to agglomerate until routinisation takes place and the activity, or at least elements of it, are decentralised and outsourced in order to reduce costs" (Gillespie et al. 2001). The EU Economy 2005 Review also points out that "The use of ICT allows knowledge to be codified, standardised and digitalised which, in turn, then allows the production of many goods and services to be fragmented into components that can be located in other countries to take advantage of costs differentials, economies of scale, etc. (European Commission, 2005d, p. 15.)

One way to envisage this value-added continuum is to unpick the main business process steps along the value chain, as shown in the diagram below.[145] In the first column (on the extreme left), the different steps of the value chain are listed by diminishing level of economic value-added. Subsequent columns are examples of other characteristics linked to these steps.

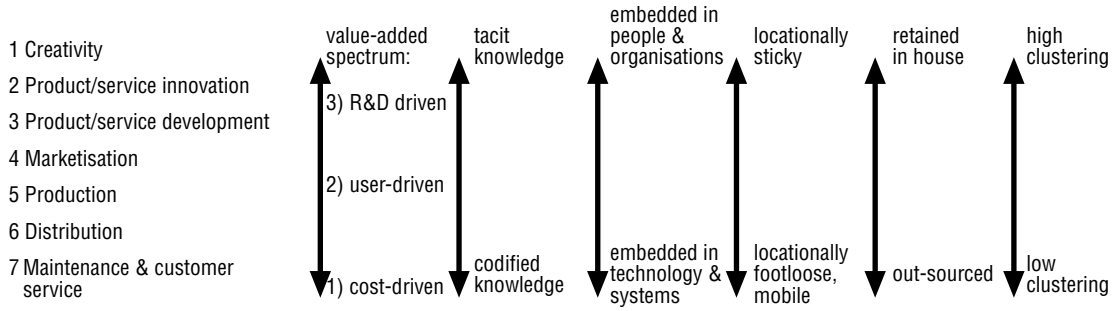
When we add a specific geographic dimension to these economic activities, there is a wide range of concepts, terms, and models in use. Terms such as offshoring, delocalisation, insourcing, and nearshoring, are often used without any explicit references made to their exact meaning and function. The most elaborate descriptions define activities related to outsourcing in two-axis models related to location and control (McKinsey 2003, OECD 2004a). One such model was presented in a recent OECD paper (2004a), in which the geographic aspect focuses on the location of the provider of the outsourced good or service, i.e. whether it is supplied from within the same country or outside the country (offshoring). The control element in the matrix highlights the corporate control of the good or service provider, i.e. whether the good or service is supplied internally from an affiliate or branch (insourced), or whether the good or service is supplied from external suppliers (outsourced).

While this seems to be a very robust model, used in a national perspective it does not have the ability to address the specific themes that arise when the object of analysis is the European Union. This is because the EU as a union of countries requires another geographical dimension. Seen in an EU perspective, the nearsourcing of ICT

144 The most prominent representatives of such theory would Michael Porter's "five forces" (Porter, 1985).

145 This diagram draws on Millard (2002) and on the BEEP project analyses of regional development in the Information Society, BEEP (2003).

Characteristics of business process steps along the value chain



activities within the EU might pose challenges for certain regions or nations, but can also foster regional specialisation and positive economic development that will contribute to the long-term economic integration of the EU.

From an EU perspective, the most important distinction related to outsourcing therefore seems to be whether the activities are moved outside Europe or moved within Europe, although the latter category could also at this point in time be divided up into EU15 and the New Member States. This is reflected in the terminology used in the "Employment in Europe 2004" report (European Commission, 2004a), where the generic term used (parallel to the OECD term of 'outsourcing') is delocalisation of activities. In geographical terms, the document distinguishes between relocalisation, which refers to the delocalisation of activities to countries within the EU, and (offshore) outsourcing, which refers to the delocalisation of activities to countries outside the EU. So, here we depart from the terminology used in the OECD paper by including a within EU dimension to the model.[146] This within EU dimension can be called 'nearshore outsourcing', which is outside the country of origin, but within the EU, as shown in the following diagram:

The three value-adding activities introduced above (cost-driven, user-driven, and R&D-driven innovation), are confirmed by a recent study (Danish Technological Institute (2004), which used the equivalent terms when examining the drivers of outsourcing:

i) reducing costs (both through economies of scale and by flexible outsourcing of functions which only add low value to the business)

ii) seeking access to new markets (users)

Outsourcing defined by control and locational aspects

Control	*Outsourced*	Onshore outsourcing	Nearshore outsourcing	Offshore outsourcing
	Insourced	Internal Domestic supply	Internal nearshoring	Internal offshoring
		National	*within EU*	*Global - outside EU*
			Location	

Source: based on a model from OECD 2004a

146 To complete the picture a fourth geographical dimension could be implemented; the sub-national regional dimension. There are indications that most outsourcing in EU takes place within a given country from one region to another. The consequences at national level thus are neutral, while there may be serious consequences at regional level.

iii) seeking access to new high-level knowledge

These three drivers seem to be the most important drivers of outsourcing in an ICT context on a company level and seem to stimulate different kinds of outsourcing activities. The figure below sums up the relationship between the three drivers and the six types of outsourcing activities which are interesting from a European perspective (see diagram below).

In addition, this study also identified a number of strategic and policy drivers, such as strategic decisions at company level, national labour market and education policies, international trade agreements, etc.

The impact of ICT on internationalisation activities

In principle, the use of ICT can mean that any task involving the processing and/or transmission of digitised information can be carried out anywhere where the right infrastructure is present in combination with the right workers at the right price. This (in theory) opens up new opportunities for development all over the world. (JANUS, 2004)

This internationalisation of ICT-enabled economic activities is accompanied by new forms of competition and collaboration between and within regions, companies and people. It is thus a driver of regional specialisation and cluster formation, as well as the development of distributed value chains, virtual organisations and knowledge networks (VSO, 2003). If you can produce and deliver services anywhere you can become more selective about where you actually do locate activities. A small difference can thus make a big difference, and could lead to winner-take-all situations. The interplay of dynamism and inertia in shaping new geographies and a tension between centralisation and decentralisation leads to a new regional mosaic of critical success factors. By a seeming paradox, the ICT-induced 'death of distance' thus increases the importance of locality. However there are no universal or inevitable trends. Patterns are shaped by strategies of players on both the supply and demand side as well as by specific features of the local environment including cultural, political and geographical patterns as well as economic ones.

In the 1960s and 1970s a global division of labour in manufacturing industries developed. ICT played a role in managing global production lines and some 'white-collar' work was also involved (e.g. typesetting in Hong Kong, Malaysia and Malta for UK customers). In the late1970s the export of bulk data entry started, e.g. from the US to the Caribbean, the Philippines, China. The 1980s saw large scale 'body-shopping', for example from India to more developed countries in the software sector.

Relationship between outsourcing drivers and outsourcing activities

Drivers \ Activities	Onshore outsourcing	Nearshore Outsourcing	Offshore outsourcing	Internal domestic supply	Internal nearshoring	Internal Offshoring
Cost: economies of scale				x	X	X
Cost: flexibilisation		X	X			
Access to new Markets (users)					x	X
Access to knowledge					X	X

x marks an area where some sourcing activities have been documented or are expected to be documented.
X marks an area where significant sourcing activities have been documented or are expected to be documented.
Source: Danish Technological Institute, 2004.

In the 1990s the internationalisation of ICT accelerated with the global liberalisation of telecommunications and the rapid spread of ICT including the Internet. Simultaneously there was a dramatic growth in outsourcable forms of employment. Call centres provide the most celebrated examples of this, but many other ICT-mediated economic activities are also affected.

For example, the EMERGENCE study (EMERGENCE, 2003), which examined telework or eWork, showed that the incidence of individual forms of eWork, such as individuals working at home rather than commuting to the office each day, is significantly lower than the incidence of collective forms of eWork, i.e. where the work of organisational units each containing two or more employees is relocated due to ICT use, regardless of whether or not the same individuals carry out the work. According to the eWork definition adopted by EMERGENCE, nearly half of all establishments in Europe (49%) were already practising some form of eWork in 2000.[147] However, of this total, only just over 2% of establishments employed people to work exclusively from home on an individual basis using ICT, compared to the two types of organisational eWork examined by EMERGENCE:

i) In-house eWork, taking place within the same organisation but at different sites within that organisation, undertaken by 11.8% of all EU15 establishments (i.e. insourcing)

ii) Outsourced eWork, taking place on the premises of another independent organisation and thus involving a contractual relationship between the organisation out-sourcing the work and the organisation receiving the work, undertaken by 43% of all EU15 establishments. In geographical terms, however, much of this outsourced eWork is carried out within the region where the outsourcer is based (34.5%) but substantial numbers (18.3%) outsource to other regions within the same country, whilst only 5.3% outsource across their national borders.

These data tend to gainsay the growing apprehension that the European economy is moving towards the 'death of distance' (Cairncross, 1997) in which whole industries in specific countries or regions could be wiped out. On the contrary, this seems to happen rarely, at least in the fundamentalist way envisaged by the idea that you can locate anything anywhere. As shown above, much depends on the types of knowledge involved in a particular activity as well as the specific characteristics of each location. Previously, locational assets like relative proximity, raw materials and nearness to markets were determining factors in regional prosperity. In the knowledge economy, on the other hand, knowledge, creative talent and innovation, based upon the local development of human resources and institutional structures, are more important. Thus, location is still vital, but now depends much more on how local assets (both existing and latent) are perceived and developed. It depends on government and enterprises thinking and acting both locally and globally at the same time. Locally because vital assets like people and institutions largely remain local, and globally because competition, trade and investment now take place on an increasingly global scale. (See also Castells, 1996) It is, in fact, new types of interplay between the local and the global, including the role of ICT in this, which make up the ingredients of the new regional agenda and the new international division of labour.

There remain, however, concerns about the effects of the delocalisation of ICT related services, mainly in relation to unemployment as a short term effect, and on the re-distribution of wealth as a longer term effect. (Danish Technological Institute, 2004) The primary concern is loss of jobs (mostly jobs per se or low-skilled jobs). This concern tends to focus on the short term effects

147 Note these EMERGENCE data are only for establishments with at least 50 employees, although samples from several EU countries of all establishments show similar overall incidences of eWork.

of cost-driven outsourcing (both nearshore and offshore). A medium term effect of cost-driven outsourcing, recognised by the trade unions, is the downward pressure on working conditions following from exposure to global competition. This effect is felt regardless of whether there have been lay offs or not. There is also concern about the risk of loss of the skill base due to outsourcing of knowledge intensive activities. It is remarkable that the positive aspects, i.e. access to new knowledge through outsourcing and the greater efficiency of companies resulting from outsourcing, are not generally recognised as a potential gain in the national context.

Current patterns and adjustment challenges

The international sourcing of ICT activities is growing rapidly. It seems to be reasonably distributed across countries even though some major suppliers, such as India, have emerged. Exports of other business services and computer and information services, which are used to approximate international service sourcing, are growing rapidly in many countries, with the fastest growth occurring mainly in non-OECD countries.

However, in the absence of official statistics, little of detail is known about the impact and extent of the globalisation phenomenon overall. It is clear that the international sourcing phenomenon is not new in ICT or in other industries. It has existed in manufacturing for many years. What is new is that it is increasingly taking place in the service and R&D activities of both ICT and other industries, and is now starting to affect those white collar jobs previously considered 'untouchable'. There are no official numbers of jobs that have moved abroad, only anecdotal evidence and projections. Published numbers vary widely, but even the largest projections of 'jobs lost to offshoring' are relatively small in comparison to normal job churning in advanced (including EU) economies, as the above EMERGENCE data indicate.

Preliminary results from the analysis of the OECD's (2004a) occupational employment data suggests that some 20% of total employment is likely to be affected by the international sourcing of ICT-intensive service activities. Most of these are clustered in service sectors such as financial and insurance services and computer and information services. The offshoring of service activities has also generated considerable debate, especially since it now also involves some high-quality service jobs, even though relative numbers remain very small.

Anecdotal evidence also suggests the following breakdown (OECD, 2004a):

- of all outsourcing: 2/3 national, 1/3 international
- of all offshoring (international) activities: 2/3 insourcing, 1/3 outsourcing.

Most current data and evidence show that internationalisation occurs in response to:

- increased competition, resulting from trade liberalisation and reinforced pressures to cut costs, combined with rapid technological change, making services as well as manufacturing increasingly tradable
- skills shortages and skills mis-matches – ensuring a skills base is in place increasingly becomes a locational determinant of economic activity.

The overall expected impact of international sourcing is likely to involve initial job losses in the country from which the offshoring originates, and job creation in the host country. Despite this, both will probably experience efficiency gains and cost savings induced and enhanced by greater competitiveness and productivity growth, and this should create new employment and growth opportunities in both locations.

However, the adjustment process in home countries may be costly, especially for those who have lost their jobs. Education and training programmes will need to be adapted to enable

people to take advantage of new employment opportunities and life-long learning and skill-upgrading will become the norm. A change in mentality will be needed as people are increasingly likely to have multiple jobs and even multiple careers. (See also section 4.3). Thus, a measured response to international sourcing would be to take advantage of the benefits while managing the adjustment process and maintaining good labour conditions and social welfare provisions everywhere. EU countries should remain committed to liberalising trade in services and avoid a protectionist response.

Thus, policy recommendations are likely to include those proposed by the OECD (2004a):

- Avoid a protectionist response and remain committed to liberalising trade in manufacturing and services (including through GATS Mode 4: movement of persons).
- Manage the adjustment process and compensate for adjustment costs where necessary.
- Adjust education and lifelong learning systems to train and retrain workers, not just in specific skills but also in order to obtain broader and transferable skills so as to enable them to take advantage of new employment opportunities.
- Ensure good labour standards and welfare provisions in home and host countries.
- Reassessment of the inter-connection between national, EU and supra-national ICT R&D policies, including the balance between basic and applied research, and the role of interdisciplinary research to further product and process innovation.

Measuring the role of ICT in the economy

The productivity paradox and the problem of services

Until very recently, economists have found it signally hard to establish – let alone quantify – a causal relationship between ICT and economic performance, whether the latter is measured in terms of growth, productivity or competitiveness. The OECD Growth Project (2001a) re-drew attention to the 'productivity paradox', originally suggested by Robert Solow. (Solow, 1987) This OECD survey evidence relates to countries, however, the 'paradox' message applied equally to a region or to a firm. Of course, this 'paradox' simply expresses the fact that a clear relationship has been difficult to establish between ICT and productivity improvements or economic growth, but this is true for many so-called inputs to, or drivers of, economic growth and social change. In the case of ICT and productivity, this may be due to the likelihood that the effects take a long time to reveal themselves (as historically was the case with the introduction of steam power and electricity), and because it is simply very difficult to isolate the effects and interactions of so many variables. This is a debate which is on-going.

However, some substantial evidence started to emerge about 5-6 years ago. For example, when comparing two cohorts of companies, one implementing ICT, upgrading skills and changing the management structure, and one doing none of these things, over a period of 6-8 years, the former cohort achieved a significantly higher long-term productivity growth compared to the latter. Interestingly, this was after a short initial period of lower productivity growth due to the need for individuals to learn how to use the technology (data from Eurostat show that acquiring ICT skills can be a costly and time-consuming process) as well as to change the management structure (European Social Fund, 1999).

Further, "Paul David, an economist at the Oxford University, suggests that a technology will start having a significant effect on productivity only if it has reached a 50% penetration rate. American computer use has reached the 50% mark only recently, and other rich economies still lag behind. That puts ICT at roughly the same stage now as electricity reached in 1920. Almost exactly on cue, growth in labour productivity in America's business sector has increased to an annual average of 2.9% since 1996, from an

average of 1.4% in 1975-95. In the year to the second quarter of this year, productivity surged by 5.2%" (Economist 2000, p. 13). Since this *Economist* review, of course, we have had the dot.com crash and a lowering of productivity increase again, but this probably has more to do with business cycles and business confidence than with ICT as such.

In the same article the *Economist* argued: "A breakdown of productivity growth by industry shows that in many of the sectors that use computers most intensely, notably banking and education, productivity actually declined in the 1990s. So is IT a waste of money? Not necessarily: more likely, the figures are flawed. The service sector has always been hardest to measure, and IT and the Internet have exacerbated the problem because much of their benefit comes in the shape not of cost savings, but of increased product quality, convenience and customer service. Such gains rarely show up in GDP figures."

Further, the data presented in this context in the *Economist*, in addition to showing a productivity decline in banking, health and education for the period 1987-97, also showed a productivity increase in all other sectors represented, including manufacturing, wholesaling, public utilities, insurance, transport, communications, retail trade, etc. So the evidence is mixed, apart from the fact that the data are probably inadequate. In an analysis of 600 big American firms between 1987 and 1994, the *Economist* reportedly "found that investment in computers appeared to boost annual Total Factor Productivity by 0.25-0.5%. The productivity gains got bigger over longer periods, confirming that it takes time for firms to reorganise their business before they reap the full benefits of IT. Their research also showed that firms that coupled ICT investment with changes in their organisational structure, such as decentralisation, enjoyed the biggest productivity gains from IT" (Economist 2000, pp. 17-18).

With the expansion of the service economy the search for strategies to strengthen service productivity becomes even more important. This general trend also extends to the public sector. But approaches different from those used in manufacturing are required for performance improvements in the area of services.

While productivity gains in manufacturing were mainly realised by employing an engineering model, i.e. largely based on standardised products and the application of technology, this model is of limited use in services. Herzenberg et al. (1999) argued that the case- and situation-specific nature of most services demand an orientation along an interpretative model instead, and that this goes hand in hand with policies towards a learning economy and a learning region. They identify two complementary pathways to productivity improvements which they call economies of depth and economies of coordination. Although standardised production processes are also possible in service industries to some extent, "the basic assumption of a well-defined product with attributes independent of the production process applies only partially, poorly, or not at all to other service processes."

This parallels the contention that whilst goods are produced and then delivered to customers, services in a real sense are first produced only when they are delivered to customers. Thus, in most services, the 'product' differs depending on the customer: a nurse's patient, a teacher's student, a waitress's meal. For each provider a slightly or largely different process – a different model of production – applies from one customer to the next. Each process is interpretative, depending on a customer's desires and the needs of the situation (Herzenberg et al. 1999, p. 57).

In services also ICT plays an important supporting role to achieve economies of depth (improving skills of case-specific interpretation and situational response in services) and economies of coordination (improving adjustment of efforts in collaborative service processes). Examples of such benefits of ICT include their contribution to facilitate communication through mobile devices or to faster and more comprehensive access to information.

Further basic strategies which are utilised to achieve productivity improvements in more and more service areas are introducing elements of self service with the support of ICT (such as with electronic telling machines, eBanking, eGovernment, call centre support, etc.). With such forms of technological incorporation, often as a combination of hard-, soft-, and 'humanware', ICT seems also now to be opening up new opportunities for performance gains in service production (Häußermann et al. 1995, p. 49. See also Miles, 1993). In addition, as mentioned previously, automation is making increasing inroads into services, as there appears to be evidence that we are on the edge of a major move towards the commoditisation of business processes.

The paradox resolved?

While evidence for a link between ICT developments and economic growth was thin up to a few years ago (the so-called Solow paradox), data is now becoming available to support the hypothesis that ICT adoption has a positive effect on levels of productivity within an economy. (OECD, 2003) In particular, the OECD's major study (OECD, 2004b) concluded that the empirical evidence of the economic impacts of ICT is significantly improved from what it was only a few years ago. Furthermore, in terms of empirical evidence and measurement, many OECD countries now provide estimates of ICT investment that enable calculations of capital services, whilst data on the ICT sector and on the services sector are available for many countries, although important gaps in our knowledge do remain. In addition, many countries now have regular business surveys of ICT use that provide an overview of diffusion patterns.

According to the *Economist Intelligence Unit* (2004), there is now no doubt that the link between ICT and economic growth is strong in developed economies. However, it is also the case that this relationship is not straightforward, for example, it seems only to kick in after a certain threshold is reached, and only after an adjustment period. In addition, there are many other factors which are important and which help to explain the marked differences between countries, as summarised earlier.

Both the OECD (2004b) and the Economist Intelligence Unit (2004) point to three major ways in which ICT positively impacts the economy: through ICT investment, through ICT production, and through ICT use.

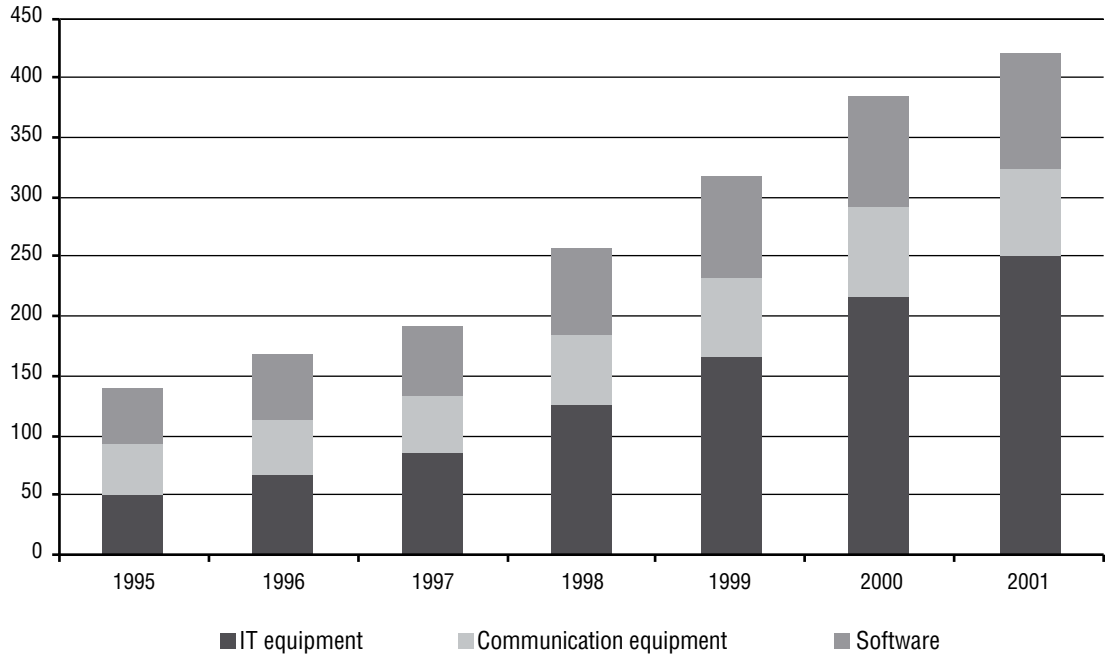
ICT investment boosts capital deepening, which in turn leads to increases in labour productivity. Research has shown that ICT capital investment has made a significant contribution to GDP growth over the past decade, accounting for between 0.3% and 0.8% of GDP per head growth in the OECD in the 1995-2001 period. (OECD, 2003) In many OECD countries the share of ICT investment in total investment has increased, especially in the US, Australia, Canada and the Nordic countries.

Other European countries are also investing large amounts of capital in ICT goods and services, but still tend to lag behind overall, accounting for 2.6% of GDP compared with 4.2% in the US. (Colecchia & Schreyer, 2001, and Bartelsman and Hinloopen, 2002) As seen in the diagram on page 177, ICT gross fixed capital formation in the EU totalled nearly €1.9 trillion in 1995-2001, and expanded at an average rate of 19.5% over the period.

In terms of ICT production, both hardware and software, this itself can make a large contribution to GDP growth, although only a minority of European countries have been able to enter and remain competitive in this market. For EU Member States competition on the world market takes two forms, namely competition with non-EU economies and competition with fellow Member States. (Horlings et al, 2002) Roughly 60 percent of EU trade takes place within the Union.[148] The figure on page 178 shows the

148 OECD data show that in 2000 56% of the value of imports and 60% of the value of exports came from and went to other EU countries. (OECD, 2003)

ICT investment in the EU (1995-2001). Gross fixed capital formation in 14 EU countries (in contrast 1995 prices), billions of Euro.



Source: Timmer et al, 2003, reproduced in the Economist Intelligence Unit, 2004. p. 12.

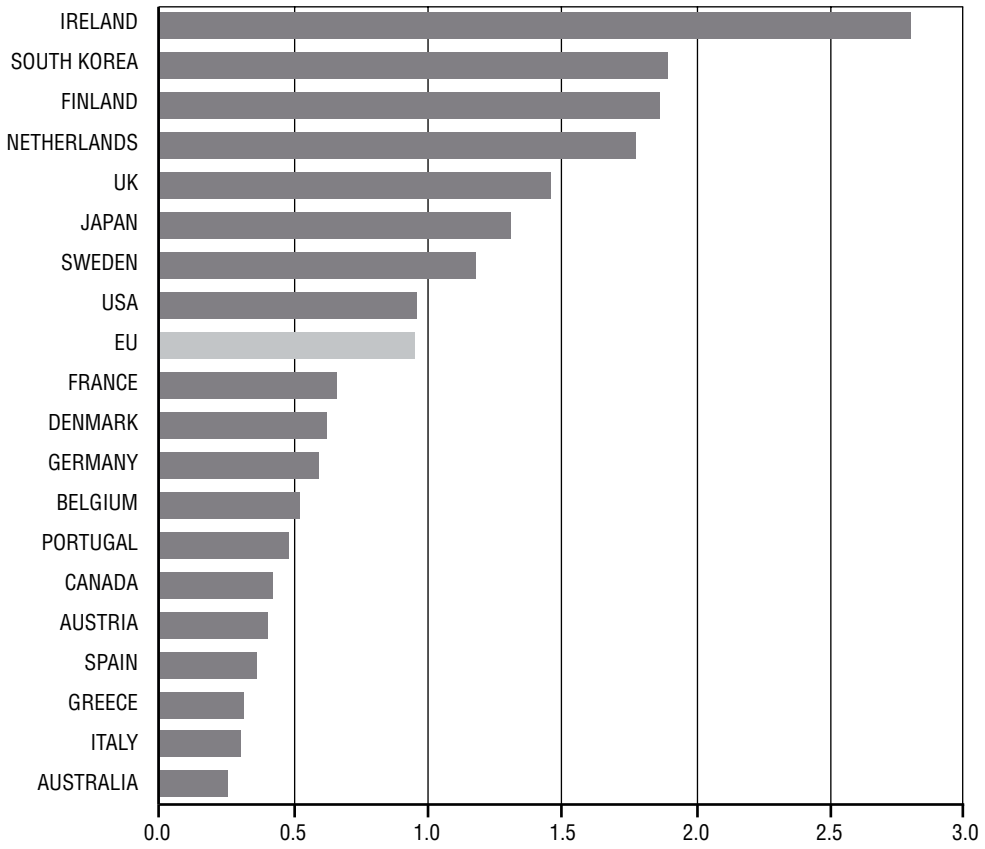
Revealed Comparative Advantage (RCA) of 14 EU Member States and their main competitors in the international market for ICT and consumer electronics.[149] Countries with an RCA of more than 1 have a comparative advantage, while those with a value below 1 have a comparative disadvantage, although this can also be interpreted simply as degree of specialisation. Although the EU has approximately the same score as the USA, only 5 Member States have a comparative advantage in IT and consumer electronics. The other economies have a considerable comparative disadvantage.

One important measure of ICT's impact on productivity (total factor productivity, TFP) growth, has as a result accelerated in those countries with a comparative advantage. (Ark, et al, 2002) However, the strong competition for ICT production means only a few highly specialised countries can succeed, but this is not thought to be a hindrance to reaping the productivity benefits of ICT throughout the rest of the economy. (OECD, 2003)

The largest economic effects of ICT are, however, through its use across the whole economy, and particularly in sectors where such use can most readily be translated into increases in productivity. In the service sectors, these tend to be in such areas as financial and insurance services and computer and information services. However, achieving such benefits requires a variable set of other factors to be in place, dependent on sector and circumstances. Moreover, this is still to some extent contentious ground, as although the US and probably Australia almost certainly demonstrate these effects, Europe as a whole has yet to convince, as illustrated in the diagram on page 179. It is important to make a distinction here, however, both between individual European countries and between levels of analysis. At the micro firm

149 The RCA value is equal to the share of a commodity in a country's exports divided by the share of this commodity in world exports.

Revealed Comparative Advantage (RCA) in IT and consumer electronics, 1997-2001



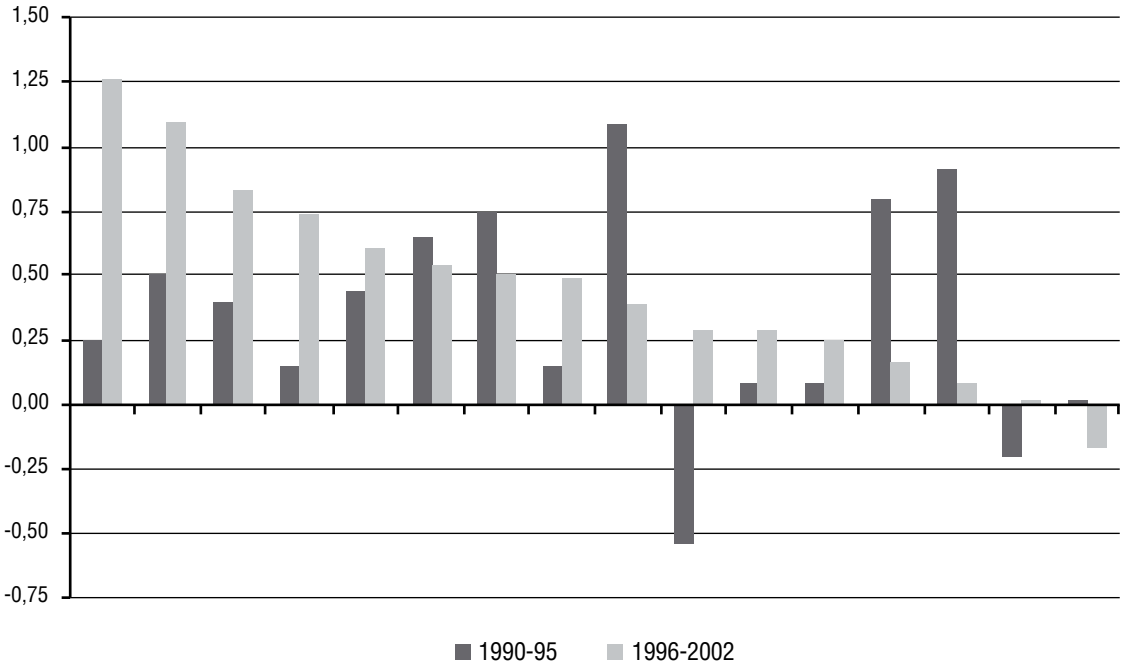
Source: ITC (2003), Note: the value for the EU is an unweighted average of the 14 Member States in the figure.

level, the evidence does suggest that ICT use is beneficial, whilst it is at the aggregate or national level, that the evidence is much less conclusive about the benefits of ICT use. (OECD, 2004b, Economist Intelligence Unit, 2004)

There is also strong evidence to support the above findings from research conducted under the auspices of the European Commissions' Research and Technology Programmes. For example, empirical results from the RISESI project (RISESI, 2004) clearly demonstrate that expenditure on ICT has overall positive effects on the growth of employment in ICT producer and ICT using sectors. Regression analysis was used to show that, when controlling for growth in demand and in labour costs, the job creating effects of new technologies was greater than the job replacing effects. RISESI concludes that although ICT activities are a relatively small part of the economy as a whole, they nevertheless have strong and pervasive effects. In aggregate terms, countries with a strong and dynamic presence in ICT have shown better overall performances. However, they also point out that no regular positive relationship can be found between innovation, growth of production and new jobs across different countries or sectors. The differences between product and process innovations may explain this diversity of outcomes, but also the differential performances of major national firms play a role, as well as the uncertainty and volatility dominating many of these industries. Thus domestic and sector differences are very important.

In terms of more and better jobs arising from ICT, recent work undertaken in support of the European Commission concluded that ICT investment has direct employment effects in the ICT industry, in ICT and RTD departments of companies and in RTD institutions. (RAND, 2005, p. 49) On the other hand ICT may reduce the demand for labour in existing

Contribution of ICT-using services to aggregate labour productivity growth. Contributions to value added per employed person, in percentage points



Source: OECD (2004b), estimates, reproduced in the Economist Intelligence Unit, 2004. p. 13.

companies. Therefore the total contribution of ICT to employment varies over time. The positive effects have a time lag, whereby the increase in competitiveness and the creation of new businesses should lead to new employment in the longer term. What 'better jobs' are is difficult to determine, but the concept implies a reduction of manual labour, increasing efficiency and allowing the same person to fulfil more functions and to execute them better, thus increasing job satisfaction and value added per employee. Also there may be new opportunities for 'better' jobs via distant working, increased mobility and the emergence of independent workers, supported by ICT.

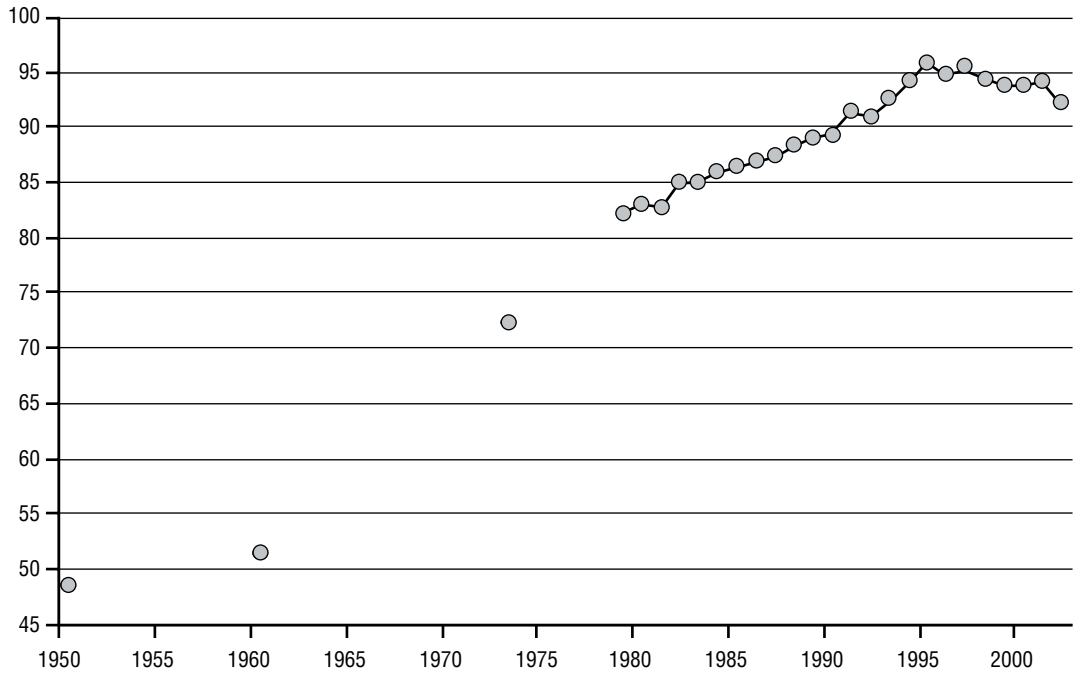
Europe's ICT challenge and productivity slump

There is general and widespread consensus that the relatively heavy investment in ICT in Europe has not delivered the same impressive economic and productivity growth experienced in the US. Although there has been some questioning of whether Europe and the US calculate growth in the same way,[150] there is sufficient evidence that the difference is real and significant. (OECD, 2004b, Economist Intelligence Unit,2004, Department of Trade and Industry, UK, 2005) Thus, in order to adequately rectify the European shortcomings, we need to thoroughly understand the reasons that lie behind the differences.

Since 1945 the overall level of total factor productivity in EU-15 has converged towards that of the United States. However, this convergence was broken in the mid 1990s, and since then the relative productivity performance of the European Union has slowly declined. (Groningen Growth & Development Centre, 2005) Total factor productivity growth has slowed down in the EU,

150 For example, at the "Preliminary analysis of the contributions of the EU Information Society policies and programmes to the Lisbon and Sustainable Development Strategies" Workshop, Brussels, 15 December 2004, Jacques Pelkmans suggested that comparisons could be suspect because the US includes service quality and the EU does not, and that if the same approach was used European 'growth' would be much closer to that of the US.

GDP per hour worked in the EU as a percentage of the USA, 1950-2002



Source: Ark et.al (2003)

whilst it accelerated in the US, and there is as yet no evidence of a new phase of catching up, as shown in the figure above.

The same trend is seen when labour productivity growth and ICT are examined. The data in the table on page 181 show how the US was near the bottom of the 15 country OECD sample in the period 1990-1995 as far as labour productivity growth was concerned, and about half way in terms of the contribution of ICT to this growth. The period 1996-2002 saw, however, a dramatic turnaround with the US rising to fourth position for labour productivity growth and to the top (jointly with Ireland) in terms of ICT's contribution. Ireland's economic miracle is almost unique and is partly based on a determined strategic policy to attract FDI-fuelled ICT production to a very small country in order to compensate for otherwise relatively moderate levels of ICT use.

However, the table also shows big differences across Europe. These data, in fact, nicely illustrate that there are countries in the EU which have kept pace with US productivity growth, as well as in terms of ICT's contribution. These are mainly the small countries, especially Ireland and Austria, but also the Nordic countries, with their own specific socio-economic model which has managed to achieve a high level balance between economic flexibility and labour market security. An examination of the diagram on page 179, which shows the contribution of ICT-using services to labour productivity growth (as opposed to the data in this section which looks at total ICT contribution, i.e. also in terms of ICT investment and ICT production) shows that the UK is Europe's leader. Although the UK is still some way behind the US and Australia, it shares some of their open and flexible market approaches.

This UK and Irish experience, which also follows a typical 'Anglo-Saxon' economic model, together with that of the US, Australia and a number of other non-European countries, lies at the base of the call for a significant shift to so-called economic flexibility and creative destruction. (OECD, 2003, OECD, 2004b,

Labour productivity growth and ICT

	1990-1995			1996-2002	
	Labour productivity growth	ICT contribution		Labour productivity growth	ICT contrib-ution
Norway	3.11	0.85	Ireland	3.76	1.90
Sweden	2.95	0.96	Sweden	2.67	1.33
Italy	2.83	1.09	Finland	2.02	1.40
Finland	2.65	0.43	United States	1.74	1.90
Ireland	2.39	0.68	Austria	1.73	0.75
Austria	2.32	0.76	Norway	1.71	0.68
United Kingdom	2.20	0.74	Denmark	1.45	0.59
Germany	2.11	0.52	Germany	1.38	0.67
Denmark	1.99	0.72	Switzerland	1.10	0.43
Belgium	1.90	0.92	United Kingdom	1.08	1.21
Spain	1.22	0.06	France	1.00	0.18
France	1.13	0.23	Belgium	0.78	0.35
United States	1.12	0.71	Netherlands	0.77	0.48
Netherlands	0.63	0.29	Italy	0.56	0.36
Switzerland	-0.03	-0.42	Spain	0.28	0.14

Source: OECD (2004b), reproduced in the Economist Intelligence Unit, 2004. p. 9.

Economist Intelligence Unit, 2004, Department of Trade and Industry, UK, 2005) Somehow the Nordic experience seems to have been forgotten in this debate.

Despite these important variations, however, the overall diffusion of ICT in Europe appears to proceed at a slower pace than in the USA. This is even more apparent now that the EU has ten new Member States which generally lag even further behind compared to EU-15. On the other hand, it does appear that ICT diffusion in the EU follows the same pattern as in the USA, albeit with a time lag. (Ark et al, 2002) There is a strong dispute about whether ICT diffusion has overshot in the US in which case slower EU diffusion is a good thing. Also, some technologies diffuse faster in the EU. Barring a major economic crisis, the impact of ICT could appear in the EU on a similar scale as in the United States somewhere in the next five to ten years.

Daveri (2002, 2004) generally supports these conclusions, pointing out that ICT has been rolled out and used in Europe, albeit at a slower pace than in the US, and that the slow-down in productivity is both due to this delay as well to the ways in which ICT have been used. The data in the table below have been decomposed to show the growth rate of GDP per hour in terms of the contributions from ICT and non-ICT capital, from total factor productivity (TFP) growth, and from labour quality, comparing the US with four EU countries.

The most marked changes are the major reductions in the non-IT capital growth contribution and the labour quality (human capital) contribution in Europe, which lead to the slowdown in labour productivity growth in EU4 in the second half of the 1990s.

Looking at evidence on the US side, there are substantial productivity gains particularly in ICT-using industries, including wholesale and retail trade, finance and business services (Stiroh, 2002, Nordhaus, 2002). There is also evidence of productivity gains spreading from innovating industries (i.e. computers, semiconductors) into industries able to effectively use ICT. It has also

been shown that most of the US-EU growth gap stems from a handful of ICT-using industries, including wholesale and retail trade as well as the brokers industry. (Ark et al, 2003). In addition, it has been demonstrated that in Europe there was a decrease in the contribution from non-ICT capital in all industries, and a decrease in the contribution from TFP growth in non-durable manufacturing, to labour productivity growth. (Daveri 2002 and 2004, European Commission, 2993, OECD 2003) From these observations, it can be concluded that the slump in productivity in Europe is at least partially due, not to ICT itself, but to the way it is being used.

Possible explanations for the slowdown in European productivity growth and the slower diffusion of ICT have clear implications for policy. For example, in many European sectors opportunities to invest in ICT seem to be limited by regulations and structural impediments in product and labour markets (such as limited shop opening hours, transport regulations, barriers to entry, restrictions on the free flow of capital, etc.). (Ark et al, 2003) It is also that case that many EU countries are slow to address the main critical success factors as summarised in the conclusion.

A sectoral decomposition shows that the USA has a marked advantage in the ICT-producing manufacturing industries (e.g. computers, semiconductors) and ICT-using service industries (e.g. securities trade, retail and wholesale trade). The EU is relatively stronger in the ICT-producing services, especially due to the rapid growth of the telecom market, and in industries with relatively low ICT-intensity (e.g. chemicals, food, social services).

Overall, there are two versions of the 'convergence hypothesis', both within the EU and between the EU and the US:

i) the absolute convergence hypothesis, i.e. that less developed countries grow faster than countries at the frontier, which is generally not found corroborated by the data

ii) the conditional hypothesis, i.e. conditional on initial capital stocks or human capital, which does seem to be confirmed by the data, also in the EU countries.

Convergence depends of course critically on trade, and many of the investments necessary for endogenous growth (especially when structural change is involved) show up as divergence. The very different operational time scales of ICT related policies will also have an important effect but these are difficult to track or predict.

The growth and dynamism data seem to support a form of divergence within the EU, even though the single market policies should have reversed this, but demographic differences and the opposed tensions in different countries created by the Euro account for much of the failure. The data should also be put in the context of world-wide changes in economic growth. The period 1995-2002 covers several very different episodes, and comparisons are frustrated by the different timing of economic cycles in different regions.

Decomposing aggregate labour productivity growth

Business sector	US		EU-4 (UK, F, D, NL)	
	1979-95	1995-00	1979-95	1995-00
Labour productivity growth	1.21	2.46	2.30	2.02
Contributions to labour productivity growth from:				
IT capital	0.46	0.86	0.33	0.53
Non-IT capital	0.35	0.43	0.70	0.25
TFP growth	0.26	1.05	0.94	1.07
Labour quality	0.13	0.13	0.33	0.18

Source: Daveri (2004)

Again, a sectoral view gives a different picture. For example, removing agriculture, looking at services, or looking at high-tech could help get behind the aggregates which mask structural shifts and thus give a better view of whether or not Europe is optimising its investment in ICT. Finally, there is a pricing paradox, as competition becomes healthier, prices (and thus measured GDP) fall, despite the underlying increases in efficiency and even (real) growth.

Conclusions

Factors important for achieving economic benefits of ICT

Various sources and the research for this paper point to a series of factors which, to a greater or lesser extent, are important in achieving beneficial economic impacts through the use of ICT. (OECD 2004b, Economist Intelligence Unit 2004, Department of Trade and Industry UK 2005, Ecotec 2004, RISESI 2004, SEAMATE 2003, Millard 2004, Sapir 2003) These factors are summarised below, some of which are characterised by the *Economist Intelligence Unit* (2004, p. 4) as the critical success factors that policymakers and managers must address to improve the rewards of ICT.

1. A certain threshold of investment and use of ICT is required, so that benefits are only seen after a time lag.
2. Sufficient investment is required in ICT. It has been demonstrated (Ark et al, 2002 and 2004) that between 1980 and 2000 comparatively lower investment partly explains why the contribution of ICT capital investments to growth in labour productivity in the EU lagged well behind the US.
3. Considerable organisational change is needed to accompany the introduction of ICT to realise the full benefits. (Basu et al, 2003) eBusiness applications, for example, require not only investment in technology, but also organisational changes that impact profoundly on the working environment. Organisational change often requires a short-term diversion of resources into re-organisation and training. (Ark et al, 2002 and 2004) This means that there is a time-lag between investment and any manifestation of productivity growth. The success or otherwise of appropriate organisational change is also related to the availability of know-how and qualified personnel, as well as the capability to innovate.
4. Skills (especially ICT-related managerial skills, generic skills, ICT technology skills, skills to reorganise, and skills to innovate) help determine the effectiveness of ICT use. Difficulties in making the necessary organisational and process changes in the workplace because of a lack of appropriate skills are a major impediment to growth in Europe. Weaknesses in managerial skills and technology awareness, and the lack of an innovation culture, often hamstring European enterprises in their attempts to put ICT to productive use. Management and leadership skills are also vital, and need to be entrenched widely through the workforce.
5. Innovation and R&D capacity and capability. Successful ICT use by firms is often linked to the ability of its workforce to innovate, i.e. to make the ICT investments more valuable through experimentation and some measured risk-taking, such as the innovation of new processes, products and organisational arrangements. Thus, an entrepreneurial culture needs to be developed, which is market-driven and embedded in the firm's organisational and skill portfolio. This can be assisted at the macro level by appropriate security, standards and intellectual property rights frameworks, the availability of venture capital, setting up centres of excellence, and ensuring that public and private R&D funds pull together (for example, as successfully done in Sweden and Ireland). Some empirical evidence shows that ICT expenditures are positively correlated with R&D effort, as

well as with some proxies for the level of education, a proxy for the sophistication of financial markets (the share of venture capital on GDP), and the extent of cooperative relations within the labour market. On the other hand no correlation has been found between ICT expenditures and the power of the trade unions. (RISESI, 2004)

6. The competition and regulatory environment experienced by economic units or sectors, especially in relation to competitors. Many of the sources suggest that excessive and/or inappropriate regulation may make it difficult for firms to seize the opportunities offered by ICT. (OECD, 2004b, Economist Intelligence Unit, 2004, Department of Trade and Industry, UK, 2004) This leads the *Economist Intelligence Unit* (2004) to call for open markets and unfettered competition and a redoubling of the assault on the barriers to competition. For example, structural differences in the regulatory environment help explain the comparatively poor performance of EU Member States. (Basu et al, 2003). The argument put forward is that it is labour and product market regulations in the EU that inhibit the re-organisation required. (Ark et al, 2002 and 2004)

   Regulation should also positively promote so-called 'creative destruction'.[151] "This implies economic flexibility, including flexibility in relation to the entry and exit of firms and the hiring and firing of labour. The potential for ICT to change the economy and society has therefore placed a premium on economic flexibility that may have been largely absent prior to 1995 – when Europe performed relatively well. Labour market flexibility, and/or active labour market policies, are also essential to resolve the structural unemployment problem in some European economies." (Department of Trade and Industry, UK, 2005, p. 16)

7. A flexible approach is also needed in relation to sectoral and national differences in terms of their different needs, characteristics and circumstances. For example, Europe's weaknesses are most acute among small and medium-sized enterprises (SMEs). SMEs fare poorly compared with large firms in access to capital, the fruits of R&D, high quality networks, and management skills training, as well as ICT systems. SMEs account for over 95% of firms in most European countries, However, Europe's big firms also have problems, especially in being slow to adapt processes and changing the way people work. Sectoral differences are also very significant, for example whether related to the manufacturing industry or the service sector, such as in financial and insurance services and computer and information services, which present evidence shows have achieved the greatest benefits of ICT use so far. The role of the public sector is also important, and one of the best things that governments can do is promote effective ICT use, including stimulating demand and providing eGovernment services; in other words to "practice what you preach." (Economist Intelligence Unit, 2004, p. 25)

8. The use of ICT to lever greater effectiveness out of other technologies. Firms which combine ICT use with other advanced technologies tend to do better than those that use only one technology. For example, adoption of advanced process control technology, by itself, has little effect on the productivity growth of a firm, but when combined with ICT and advanced packaging technologies, the effect is significant. (OECD, 2004b)

151 A term first coined by economist Joseph Schumpeter; see OECD (2003), OECD (2004b), Economist Intelligence Unit (2004), Department of Trade and Industry, UK (2005).

Wanted: a great balance

This paper has shown the significant and indisputable impacts of ICT on firms, business organisation and performance, work and skills, as well as on economic growth and competitiveness. However, it has also shown that such impacts are not necessarily beneficial for all stakeholders all of the time and that many non-technology conditions must also be in place, thus highlighting the importance of appropriate decisions and policies at all levels. Although the purpose of this article is not to focus on European policy responses, nor on a synthesis of possible future strategies, several main issues do spring directly from the analysis provided above.

The recent input by the UK Presidency to the i2010 initiative came solidly to the conclusion that, as regards productivity growth, and the improved competitiveness, job situation and innovation which goes hand in hand with this, then ICT matters most and is key to closing Europe's productivity gap.[152] ICT does not just represent a manufacturing sector, but its use is diffusing throughout the economy. The analysis above shows that very significant economic returns can be expected from ICT where the policy environment enables successful complementary investments in organisational change and innovation. This is not surprising as it is the same pattern as seen historically with other so- called general purpose technologies, such as steam, rail and electricity. These showed, as does ICT now, wide ranging impacts on the economy and society, even though the sectors themselves did not form a large part of the economy.

Earlier, we summarised the evidence presented in this article that improved productivity comes from more effective use of ICT and not ICT production per se. According to the UK Presidency, ICT production is subject to intense global competition as traded goods and services. Global economies of scale mean that the sector cannot be large in all countries, but the innovations that drive ICT use are available to everyone. The main cause of the relative European productivity slowdown post-1995 therefore has little to do with the international competitiveness of ICT as a traded sector. Differences in the adoption and use of ICT are mainly due to domestic non-technology circumstances. There is no inherent reason why all countries in Europe should not benefit fully from the use of ICT, provided the policy environment is right. (Department of Trade and Industry, UK, 2005, p. 6)

This begs the question, of course, of what is the right policy environment? Clearly, the critical success factors described in earlier play a key role. But missing from these are a host of issues not directly related to economic performance or to ICT as such, but which it can be argued are just as important, also because they provide the wider frameworks for the successful operation of the economy as a whole, as well as for the use of ICT.

Policy overall needs to concentrate on the establishment of a climate for business (in particular in the private sector) that enables (even promotes, but certainly does not constrain) business growth. This generally means measures associated with the environment in which businesses operate, including the regulatory environment, and eliminating or reducing other constraints on business change and growth (European eSkills Forum, 2004b):

- Measures to stimulate innovation, drawing on diversity
- Measures to encourage a risk-taking environment
- Assistance to SMEs
- Investment in education, training and skills (especially eSkills) development
- Investment in transport and communications infrastructure

152 The UK held the EU Presidency between July and December 2005; see Department of Trade and Industry, UK (2005), p. 5.

- Improvements to competitiveness, quality, flexibility, and responsiveness, aided by ICT.

This points to the need for a more comprehensive demand-oriented approach to technological change rather than a narrow supply approach, which has often been the case in the past. Regional and socio-economic distribution issues, labour market factors, the search for quality in the labour supply and in goods and services are the other relevant factors. Networks that bridge what consumers really want to what innovators supply show how supply itself is dependent on the social organisation of demand.

Overall, the main recent sources are all in agreement that economic flexibility, defined as the capacity for creative destruction, based on the ability to rapidly switch resources due to instantaneous transactions and insignificant transaction costs, is the key enabling factor for the effective use of ICT. (OECD, 2004b, Economist Intelligence Unit, 2004, Department of Trade and Industry, UK, 2005, European Commission, 2005c, Crafts, 2003) The UK Presidency proposes that this should provide a unifying theme for future EU policy.

Creative destruction and economic flexibility are of course essential. The fact of the globalised economy and the evidence presented in this article about the impact of ICT on the economy point overwhelmingly to the need for economic actors, at whatever scale and of whatever type, to be agile, flexible and easy to transform. Crucial is also the ability to optimise the use of embedded ICT in particular, but also other appropriate technologies and tools.

However, these economic actors are organisations composed of people as individuals and as groups, and people are undisputedly the most important resource of all as both implementers and innovators, especially in the advanced economies of Europe. People are not simply economic beings. All surveys show that purely economic factors come some way down their list of priorities. They also have needs related to their psychological well being, the quality and non-pecuniary rewards of their work, and the quality of their wider lives. Human and social capital thus lie at the heart of economic growth and competitiveness at both micro- and macro-levels.

There is a sense in which the road towards creative destruction, as described by most of the main sources drawn upon in this analysis, will lead us into a desert and will become ultimately self defeating if followed blindly. After all, the US may be the model as far as the main indices of economic performance are concerned, but if issues to do with social cohesion and inclusion are brought into the equation, the leadership of the US vanishes. The economy is, it can be argued, just a means to the end of well-being and happiness.[153] If this relationship is seriously reversed, so that economic performance becomes its own ends or the ultimate goal of human existence, the consequences could be grave and have not been analysed in this paper.

A middle, or third, way is required: a great balance between flexibility and well-being. Government is one of the key players in this, not just as an economic actor in its own right, or as policy maker, but also as the framer of the systems of stability and continuity which people need to lead meaningful lives. However, it is not only people, but also the flexible economy itself which requires such systems of relative stability and continuity if economic actors are to have some trust that investment and other decisions are made on a level playing field stretching at least into the medium term.

The concept of trust thus needs to be brought into the equation. (See, for example, Fukuyama, 1995) In the analysis of Europe's highly variegated

153 Wilkinson (2005), Social Capital Project (2005), and World Database of Happiness. Also, Glenn Firebaugh, from Pennsylvania State University, and Laura Tach, from Harvard, have shown that people's reported level of happiness depends on how their income compares with others in the same age and peer group, rather than absolute income or wealth, quoted in the Guardian Weekly, 26 August 2005 to 1 September 2005.

response to ICT, the Nordic countries stand out as highly successful users and producers of ICT in economic terms. The Nordic countries have developed their own specific socio-economic model which has managed to achieve a high level balance between economic flexibility and labour market security. This stands between, on the one hand, the Anglo-Saxon model epitomised by the US and Australia (with the UK and Ireland coming closest in Europe to this model, although they also retain distinctive European characteristics) and which largely informs the main sources examined in this analysis, and the Franco-German central European model, on the other. The Nordic countries have, by and large, achieved the great balance. But the extant recent analyses have generally not managed to examine why or how.

The purpose of this present paper is not to fill this gap. However, one clear answer to the 'how' question is the extremely high levels of trust endemic in the Nordic countries, which strongly impact their economic performance, use of ICT and social lives. Trust seems to be a, perhaps the, common factor. In a recent global survey of trust, Denmark comes out top with the other Scandinavian countries close behind. (Social Capital Project, 2005) High levels of trust positively impact economic and social relations of all sorts, and reduce inequality which is itself a barrier to economic performance (Wilkinson, 2005, and Social Capital Project, 2005), as well as minimise suspicion of new technology and change generally. Trust also improves dealings with government and civil society. Reciprocal trust is critical in enabling economic actors to deploy their organisational and human resources in a way which makes them flexible and thus productive. Creative destruction is very necessary, but it can only work if it is economic actors and organisational forms which are destroyed and created rather than people's working and social lives.

The challenge for European policy makers in the economic sphere is thus to achieve this great European balance in the economy as a whole, as well as in relation to the economy's use of ICT. The European socio-economic model needs re-casting,[154] perhaps by looking more closely at the Nordic variant. The sharp new focus on growth, competitiveness and jobs, ushered in by the Kok Report and the relaunched Lisbon strategy is, of course, wholly necessary. However, the rest of the analysis, the socio-economic framework within which economic performance must sit, and to which it must ultimately be subservient, seems to have been forgotten in current analyses, although it is of course subject to intense political debate. If it remains absent from the main analyses, the economic and technological imperative will surely fail.

How ICT is used in human and social contexts is thus crucial. A central theme is whether ICT can be empowering or isolating, both socially and economically, and whether it can be used to 'bridge' between heterogeneous communities and groups or is best at 'bonding' within existing homogeneous groups. (IPTS, 2004) This applies just as much to economic clusters and networks as it does to social communities. Clearly, ICT can be used for both bridging and bonding depending on circumstances and purpose, which means that appropriate decision-making and policy frameworks are crucial for successful ICT application.

In order to prioritise economic and social empowerment, a way forward seems to be to give support to knowledge generation and exchange in learning communities and organisations, for example through 'communities of practice' as social networks of practitioners (IPTS, 2004). Such approaches rest heavily on the existence of trust between members, which often requires frequent face-to-face contact and the exchange of tacit or 'sticky' knowledge, whilst more codifiable or 'leaky' knowledge can be mediated by ICT.

154 Sapir (2003, p. 97) refers to this as the need for a new social contract.

Policies, therefore, should not focus primarily on ICT, information and knowledge per se, but on social practice, and the communities and networks which form around it. This applies just as much to the economic sphere as it does to the purely social, given the prime role of human resources in economic competitiveness.

Much of the evidence presented in this paper points strongly to the conclusion that ICT, if used in appropriate social, organisational and regulatory contexts, has profound impacts on the way firms operate, on how individuals work and the jobs they do, and on how organisations organise their operations both internally and externally. Extrapolation into the future leads to the prediction that most if not all activities which become 'routine', which manipulate, match and mine data, and which require access to information and systematised intelligence, will become codified and automated by ICT, resulting in the squeezing out of human jobs. Human jobs in the future, on the other hand, will focus even more than at present on activities which humans are innately better equipped to do than machines. Fortunately, this still appears to encompass a large potential area of growth in the numbers and quality of work, revolving around the use and creation of implicit and tacit knowledge. These areas include care, teaching, consulting, counselling, advising, controlling and coordinating, decision- and policy-making, creating, brainstorming, empathising, socialising, etc. In each case, of course, such human-centred work will increasingly be strongly supported by powerful ICT systems.

The uncertainty is, of course, that the boundary between what can be codified and captured by ICT and what cannot is constantly moving. What we think of as 'routine' is part of a dynamic cycle in which new work, knowledge and processes are created and older types are 'routinised'. Thus, the boundary between what machines do best and what people do best is constantly shifting, as both change, also in response to each other. If we are to retain our humanity as ultimately sociable beings in which work and the economy are just means to an end, we must be aware of, and manipulate, these shifting boundaries, and this also requires policy intervention.

This long term evolution in the relationship between people and machines fits quite well with the ageing of societies. As machines increasingly take over the routine and systematised aspects of work, previously performed by low- and unskilled workers, the work that is left requires high skills and high creativity. The boundary shifts so that automated work increases in scope and scale, but work requiring human performance increases in richness and quality, with its scale and scope only dependent on our creativity and ability to innovate. This shift however, is not perfectly synchronous with the actual development of our economies, so in Europe especially we will still require at least a temporary influx of relatively young and unskilled workers in order to bridge the gap, before machines take over such work. In the longer term, however, as the quality of work and living increases for all, we should aim to avoid similar gaps.

References

Acs, Z.J.; FitzRoy, F.; Smith, I. (1999) High technology employment, wages and university R&D spillovers: Evidence from US cities. *Economics of innovation and new technology,* Vol. 8, no.1-2, pp. 57-78

- Aichholzer, G.; Cas, J.; Ducatel, J.; Miles, I.; Jensen-Butler, C.; Millard, J. (1995) "AD-EMPLOY: employment trends related to the use of advanced communications", published by DG XIII, EC, under the Telework '94/'95 Programme, 1995

- Amin, A.; Wilkinson, F. (1999) "Learning, proximity and industrial performance: an introduction", Cambridge Journal of Economics, 23, pp. 121-125.

- Antonelli, C. (1999) "The evolution of the industrial organisation of the production of knowledge", Cambridge Journal of Economics, 23, pp. 243-260.

- Ark, B. van; Inklaar, R.; and McGuckin, R.H. (2002), "'Changing gear'. Productivity, ICT and service industries: Europe and the United States", Paper for ZEW Conference 2002 on Economics of Information and Communication Technologies, June 24-25, Mannheim, and in Groningen Growth and Development Centre, Research Memorandum GD-60, December 2002.

- Ark, B. van; Inklaar, R.; and McGuckin, R.H. (2003) "ICT Investments and Growth Accounts for the European Union 1980-2000", Groningen Growth and Development Centre, Research Memorandum GD-56, September 2002 (revised March 2003).

- Asheim, B. (1996) Industrial districts as 'Learning regions': A condition for prosperity? *European Planning Studies* 4, 379-400

- Bartelsman, E.; and Hinloopen, J. (2002) "Unleashing Animal Spirits: Investment in ICT and Economic Growth", *mimeo*.

- Basu, S.; Fernald, J.; Oulton, N.; and Srinivasan, S. (2003) "The Case of the Missing Productivity Growth: Or, Does Information Technology Explain Why Productivity Accelerated in the US but not the UK?" NBER Working Paper, No. 10010.

- BEEP (2003), Best eEurope Practices, 5th Framework IST Project, European Commission, providing over 320 good practice cases and analyses of Information Society activities: http://www.beepknowledgesystem.org

- Bennet, R.J.; Graham, D.J.; and Bratton, W. (1999) "The location and concentration of businesses in Britain: business clusters, business services, market coverage and local economic development", *Transactions of the Institute of British Geographers*, 24, 4, pp. 393-420.

- BISER (2002), Benchmarking the Information Society in European Regions, 5th Framework IST Project, European Commission: http://www.biser-eu.org.

- Breschi, S.; and Livoni, F. (2001) "Localised knowledge spillovers vs. innovative milieux: knowledge 'tacitness' reconsidered", "Papers in Regional Science", 80, pp. 255-273.

- Cairncross, F. (1997) "The death of distance: how the communications revolution will change our lives", Harvard Business School.

- Casson, M. (1998) *Information and organisation: a new perspective on the theory of the firm*, Oxford University Press, Oxford, pp. 45-46

- Castells, M. (1996) "The information age – economy, society and culture: volume 1, the rise of the network society", Blackwell, Oxford.

- Castells, M. (2000) "The Rise of the Network Society" 2nd ed. 2000, Oxford, Blackwells Publ.

- Castells, M. (2001) "The Internet galaxy – reflections on the Internet, business and society", Oxford University Press, Oxford, New York.

- Castells, M.; and Hall, P. (1994) "Technopoles of the World: The Making of 21st Century Industrial Complexes", 1994, London, Routledge.
- Castro, E.A.; and Jensen-Butler, C.N. (2002) Demand for information and communication technology-based services and regional economic development To be published in *Papers in Regional Science, 2002.*
- Colecchia, A.; and Schreyer, P. (2002) "The Contribution of Information and Communication Technologies to Economic Growth in Nine OECD Countries", OECD Economic Studies, No. 34.
- Crafts, N. (2003) "Fifty years of economic growth in Western Europe: No longer catching up but falling behind?" Stanford Institute of Public Policy Discussion Paper 03-21. November 2003.
- Danish Technological Institute (2004), "Policy debate in the EU on outsourcing of ICT and related services – Options for the Future", Report for EU-US seminar on "Offshoring of services in ICT and related services", December 13-14, 2004, in the framework of co-operation between the European Union and the USA in the field of employment and social affairs, 3 December 2004, under the auspices of the European Commission's DG Employment and Social Affairs.
- Davenport, T.H. (2005) "The coming commoditisation of processes", Harvard Business Review, June 2005, pp. 101-108.
- Daveri, F. (2002) The New Economy in Europe, 1992-2001, *Oxford Review of Economic Policy*, Vol 18/3, pp. 345-362.
- Daveri, F. (2004) "Delayed IT diffusion: really the drag on Europe's productivity?" CESifo Economic Studies, Vol. 50, 3/2004, pp. 397–421.
- Department of Trade and Industry, UK (2005) "i2010 – responding to the challenge", publication issued in September 2005 as part of the UK Presidency of the EU.
- Digital Europe, 2003. 'E-business and sustainable regional development in Europe', Final Report and Summary Report, March 2003, IST Project funded by the European Commission: http://www.digital-eu.org
- Dostal, W. (1999) *Telearbeit in der Informationsgesellschaft. Zur Realisierung offener Arbeitsstrukturen in Betrieb und Gesellschaft*, Göttingen: Verlag für Angewandte Psychologie.
- Ducatel, K.; and Millard, J. (1996) "Employment and innovation in advanced communications technologies: strategies for growth and the growth of employment", *Futures*, Volume 28, No. 2, pp. 121-138, 1996
- Economist (2000) "A survey of the new economy – untangling e-conomics", the "Economist Magazine", 23 September 2000.
- Economist (2005) "The great jobs switch" and Industrial metamorphosis", 1 October 2005, pp. 11-12 and 69-70.
- Economist Intelligence Unit (2004) "Reaping the benefits of ICT: Europe's productivity paradox", a report sponsored by Microsoft, April 2004.
- Ecotec (2004), *Expert Seminar Briefing: Delivering Lisbon through the Information Society: The contribution of DG Information Society and the European Commission,* Ecotec Research and Consulting, 15 December 2004.
- Edquist, C.; Hommen, L; and McKelvey, M. (2001) "Innovation and employment – process versus product innovation." Edward Elgar, Cheltenham, UK.
- EMERGENCE (2003), Estimation and Mapping of Employment Relocation in a Global Economy in the New Communications Environment, 5th Framework IST Project, European Commission: http://www.emergence.nu/
- Engelstoft, S.; Jensen-Butler, C.; and Winther, L. (2002) *Clusters: Are they really there? Another look at Danish industrial clusters* Paper presented at the third meeting of the Regional Studies Association Clusters Seminar Group, January 2002, University of Strathclyde, Glasgow

- European Commission (2000 Presidency Conclusions, Lisbon European Council, 23-24 March 2000, Employment, Economic Reform and Social Cohesion: http://ue.eu.int/Newsroom/LoadDoc.asp?BID=76&DID=66787&from=&LANG=2
- http://europa.eu.int/comm/lisbon_strategy/index_en.html#keydocuments
- European Commission (2001) "The Regions and Research and Development and Innovation Policy: the Challenges and Prospects of Territorialisation", Mitsos, Achilleas, General Director, DG Research, Valencia Conference, 23 February.2001.
- European Commission (2003) "Drivers of Productivity Growth. "An economy-wide and industry-level perspective", ch.2, in "The EU Economy 2003 Review", Directorate-General for Economic and Financial Affairs, *European Economy* 74(6), pp.64–118.
- European Commission (2004a) "Employment in Europe 2004, Recent Trends and Prospects", European Commission, Directorate-General for Employment and Social Affairs, Brussels, August 2004.
- European Commission (2004b) "Working paper on eGovernment beyond 2005 – an overview of policy issues", an input paper for a meeting of the eGovernment subgroup of the eEurope Advisory Group in September 2004.
- European Commission (2005a) Establishing a Competitiveness and Innovation Framework Programme (2007-2013), Brussels, 6.4.2005. {SEC(2005) 433}, COM(2005) 121 final, 2005/0050 (COD)
- European Commission (2005b) "The impact of eGovernment on competitiveness, growth and jobs", IDABC eGovernment Observatory, Background Research Paper, February 2005.
- European Commission (2005c) "The Lisbon Strategy and the EU's structural productivity problem", Directorate-General for Economic and Financial Affairs, Economic Paper 221, by Denis, McMorrow, Röger and Veugelers. February 2005.
- European Commission (2005d) "The EU economy 2005 review", Directorate-General for Economic and Financial Affairs, ECFIN (2005) REP 552229-EN, Brussels, 11 November 2005.
- European Council (2005) Presidency Conclusions, 22-23 March 2005, Brussels, DOC/05/1.
- European eSkills Forum (2004a) "eSkills for Europe: towards 2010 and beyond: synthesis report", European Commission DG Enterprise and Industry, September 2004: http://europa.eu.int/comm/enterprise/ict/policy/doc/e-skills-forum-2004-09-fsr.pdf
- European eSkills Forum (2004b) "European eSkills Conference, 20-21 September 2004, background papers", European Commission DG Enterprise and Industry, September 2004.
- European eSkills Forum (2004c) "European e-Skills 2004 Conference Final Declaration", European Commission DG Enterprise and Industry, September 2004: http://www.eskills2004.org
- European Social Fund (1999) "Info Review", No. 7, February 1999, p. 4, published by the European Commission, and based on original OECD data.
- FAMILIES (2002), Interaction between family trends and new work methods in the Information Society, 5th Framework IST Project, European Commission: http://www.families-project.com/.
- FISTERA (2005) 'Brief synthesis of FISTERA insights 2002-2005', FISTERA Thematic Network on Foresight on Information Society Technologies in the European Research Area, Compañó, R.; Pascu, C.; and Burgelman, J-C. JRC- IPTS, Sevilla, June 2005.
- Flecker, J.; and Kirschenhofer, S. (2002) Jobs on the move: European Case Studies in Relocating eWork, IES Report 386, Brighton

- Fukuyama, F. (1995) "Trust: the social virtues and the creation of prosperity", Simon & Schuster, New York.
- Gibbs, D.C.; Jonas, A.E.G.; Reimer, S.; and Spooner, D.J. (2001) "Governance, institutional capacity and partnerships in local economic development: theoretical issues and empirical evidence from the Humber sub-region", *Transactions of the Institute of British Geographers*, 26,1 pp. 103-119.
- Gillespie, A.; Richardson, R.; and Cornford, J. (2001) "Regional development and the new economy", paper presented to the European Investment Bank Conference, Luxembourg, January.
- Gordon, I.; and McCann, P. (2000) Industrial clusters: complexes, agglomeration and/or social networks? *Urban Studies* Vol 37, no. 3, pp. 513-532
- Graham, S.; and Marvin, S. (1996) "Telecommunications and the city: electronic spaces, urban places", London, Routledge.
- Graham, S.; and Marvin, S. (2001) "Splintering urbanism – networked infrastructures, technological mobilities, and the urban condition", London, Routledge.
- Grannovetter, M. (1973) The strength of weak ties *American Journal of Sociology* 78, pp.1360-1380
- Groningen Growth & Development Centre (2005), ICOP database: www.eco.rug.nl/ggdc/.
- Handy, C. (1995) *Beyond Certainty*, London: Hutchinson.
- Häußermann, H.; and Siebel, W. (1995) "Dienstleistungsgesellschaften", Frankfurt am Main, Suhrkamp Verlag.
- Henderson, V. (1986) Efficiency of resource usage and city size, *Journal of Urban Economics* Vol 19, pp. 47-70
- Hepworth, M. (1989) "Geography of the information economy", Belhaven Press, London.
- Herbig, P. (2002) "Innovation Hot Spots: Raison D'etre: Subcultural Effects" Indiana University , CIBER Research Series, no 16.
- Herzenberg, S. A.; Alic, J. A.; and Wial, H. (1999) "Toward a Learning Economy", in "Issues in Science and Technology", Winter 1998-99, pp. 55-62.
- Høgenhaven, C. (2003) "Sammenligning af danske og udenlandske rammebetingelser og innovationssystemer inden for modebranchen", (Comparison of Danish and Foreign Framework Conditions and Innovation Systems within the Fashion Business), FORA 2003.
- Horlings, E.; Botterman, M.; Cave, J.; Ligtvoet, A.; and De Vries, G.J. (2002) *Accelerated broadband roll-out for the Netherlands: A review of economic benefits* [Report for the Netherlands Ministry of Economic Affairs]
- IPTS (Institute for Prospective Technological Studies) (2004), "ICTs and social capital in the knowledge society", report on a joint DG JRC/ DG Employment workshop, IPTS, Sevilla, 3-4 November 2003, January 2004.
- ITC (International Trade Centre), ITC (2003) database at http://www.intracen.org/menus/countries.htm).
- Jacobs, J. (1969) *The economy of cities* (Vintage, New York)
- JANUS (2004) "The Digital Divide: Opportunities and threats at the verge of EU enlargement", Workshop report January 23 2004, 5th Framework IST Project, European Commission,: http://www.janus-eu.org
- Jensen-Butler, C.N. (1996) "A theoretical framework for analysis of urban economic policy" in: Lever, W.F.; and Bailly, A. (Eds.) "The spatial impacts of economic changes in Europe", Avebury, Aldershot, pp. 251-293.
- Jensen-Butler, C.N.; Shachar, A.; and Van Weesep, J. (Eds.) (1997) "European Cities in Competition" Aldershot, Avebury Books.

- Jensen-Butler, C.N. (2000) "SMEs and e-commerce: Examining the experience of the regions", shared experiences and conclusions from the 2nd meeting of the eris@ SME Work Group's Workshop Programme, Soria, Spain, 20-21 June 2000.
- Kok, W. et al (2004) *Facing the Challenge: The Lisbon strategy for growth and employment*.
- Krugman, P. (1997) "Pop internationalism", Cambridge, Massachusetts/London, The MIT Press.
- Landry, C. (2000) "The Creative City: A Toolkit for Urban Innovators". London, United Kingdom: Earthscan Publications Ltd.
- Leonardi, R. (2004 forthcoming) "Have regions converged?", chapter 4 in "Cohesion Policy in the European Union: the building of the Union."
- Malmberg, A.; and Maskell, P. (1999) Localised learning and industrial competitiveness *Cambridge Journal of Economics* 23, pp. 167-185.
- Martin, P. (2002) "Public policies and economic policy", Université Paris-1 Panthéon Sorbonne, CERAS-ENPC and CEPR, September 2002.
- Martin, R.; and Sunley, P. (2001) *Deconstructing clusters: Chaotic concept or policy panacea?* Paper presented at the Regional Studies Association's Conference on *Regionalising the knowledge economy*, London, 21. November 2001
- Maskell, P.; and Törnquist, G. (1999) *Building a cross-border learning region* (Handelshøjskolens Forlag, Copenhagen)
- McKinsey Global Institute (2003) "Offshoring: Is It a Win-Win Game?" McKinsey Global Institute Perspective, , August 2003, and McKinsey Quarterly (2003), Agraval, V.; and Farrel, D. "Who Wins From Offshoring?" Number 4, 2003.
- Miles, I. (1993) "Services in the new industrial economy", in "Futures", *25(6)*, pp. 653-672.
- Millard, J., (1995) "The Information Society and the Glocal City", paper presented to the International Conference "Urban Utopias, new tools for the renaissance of the city in Europe", Berlin, 16-17 November.
- Millard, J. (2002) *Regional development and cohesion in the European Information Society – a review*, prepared as part of the Best eEurope Practice research project under the IST Fifth Framework Programme: http://www.beepknowledgesystem.org.
- Millard, J. (2004) "Regional development lessons from 100 European case studies": http://www.beepknowledgesystem.org.
- Morgan, K. (1997) The learning region: Institutions, innovation and regional renewal *Regional Studies,* Vol 35, 5, pp. 491-503
- Nonaka, I.; and Takeuchi, H. (1995) The Knowledge-creating Company – How japanese Companies Create the Dynamics of Innovation, New York: Oxford University Press.
- OECD (1997) "Regional Competitiveness and Skills", Paris: http://oecdpublications.gfi-nb.com/cgi-bin/OECDBookShop.storefront/2145776567/Product/View/041997041E1.
- OECD (2001a) "The New Economy beyond the Hype. The OECD Growth Project", Paris, http://www1.oecd.org/publications/e-book/9201091e.pdf.
- OECD (2001b) "Cities and Regions in the New Learning Economy" Education and Skills, Paris: http://www1.oecd.org/publications/e-book/9601021e.pdf.
- OECD (2003) "ICT and economic growth: evidence from OECD countries, industries and firms", Paris.
- OECD (2004a) "Extending the benefits of the social dimension of globalisation to all", Directorate-General for Employment and Social Affairs, COM(2004) 383. Brussels, May 24 2004.

- OECD (2004b) "The economic impact of ICT: measurement, evidence and implications", Paris, September 2004: http://www1.oecd.org/publications/e-book/9204051E.PDF
- Nordhaus, W.D. (2002) "Productivity growth and the new economy", *Brooking Papers on Economic Activity* 33, 1–67.
- Pink, D.H. (1997) 'Free Agent Nation', *Fast Company*, 12: 131-140.
- Polanyi, M. (1966) "The tacit dimension", London, Routledge & Kegan Paul, Ltd.
- Pongratz, H.J, Voß, G. (1998) ‚Der Arbeitskraftunternehmer. Eine neue Grundform der „Ware Arbeitskraft"?', *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 50(1).
- Porter, M. E. (1985) "Competitive advantage".
- Porter, M. E. (1998) Clusters and the new economics of competition. Harvard Business Review (November- December): 77-91.
- RAND Europe (2005), "The Spring Council Review-Implications for Information Society Policy Options: Options for Information Society deployment beyond 2006", Prepared for the European Commission as support to the extended impact assessment of the 2005 Spring Council Review, June, 2005
- Retine project (2001) "RETINE – Regional Typology of Innovation Needs – report to the European Commission", DG Competitive and Sustainable Growth, October 2001.
- RISESI (2004), The Regional Impact of the Information Society on Employment and Social Integration, 5th Framework IST Project, European Commission: http://www.risesi.org/
- Romano, A.; Passiante, G.; and Elia, V. (2001) "New sources of clustering in the digital economy", "Journal of Small Business and Enterprise Development", 8(1), pp. 19-27.
- Rowntree Foundation (1999) *Whose flexibility? The costs and benefits of non-standard' working arrangements and contractual relations* by Kate Purcell, Terence Hogarth and Claire Simm, York, England
- Sabel, C. F. (1994) "Flexible specialisation and the re-emergence of regional economies" in Ash Amin (ed.) "Post Fordism: a reader", Oxford, UK, and Cambridge, USA.
- Sapir, A (2003) "An agenda for a growing Europe: making the EU economic system deliver", report on the Independent High-Level Study Group established on the initiative of the President of the European Commission, chaired by André Sapir, July 2003.
- SEAMATE (2003) Socio-EConomoic Analysis and Macro-modelling of Adapting to Information Technologies in Europe, 2003: http://www.seamate.net/
- Senge, P. (1990) The Fifth Discipline: The Art and Practice of the Learning Organization, New York: Doubleday.
- Social Capital Project (2005), "The Danish Social Capital Project", Aarhus School of Business, 2005: http://www.asb.dk/departments/nat/research/socaphome.aspx.
- Solow, R. (1987) "We'd Better Watch Out", *New York Times Book Review*, No. 36 (July 12).
- STAR (2001) "Electronic freelancing: myth or reality", STAR issue report number 9, May 2001: www.databank.it/star
- Stiroh, K.J. (2002) "Information technology and the US productivity revival", *American Economic Review* (December), pp. 1559–1576.
- Storper, M. (1993) Regional "Worlds" of Production: Learning and Innovation in the Technological Districts of France, Italy and the USA. Regional Studies, Vo1 27, pp. 433-455.
- Storper, M. (1996) "The regional world", Guildford Press, New York and London.
- TIGERS (2000) http://tigers.infonomics.nl.
- Timmer, M.; Gerard, Y.; and van Ark, B. (2003) "IT in the European Union: Driving Productivity Divergence?" Research Memorandum GD-67, Groningen: Groningen Growth and Development Centre.

- Tuomi, I. (2002) Networks of Innovation, Oxford University Press, Oxford and New York.
- Turner, A. (2001) "Just capital – the liberal economy", London, Macmillan.
- United Nations (2005) "Understanding Knowledge Societies: In twenty questions and answers with the Index of Knowledge Societies", Department of Economic and Social Affairs (DESA), Division for Public Administration and Development Management, United Nations, New York, 2005.
- Varian, Hal R. (2001) "Economics of Information Technology" (University of California, Berkeley)
- VSO, Virtual Smart Organisation (2003) analysis undertaken by RAND Europe and the Danish Technological Institute for DG INFSOC, European Commission.
- Wiel, H.P. van der (2001) "Does ICT boost Dutch productivity growth?", *CPB Document* no. 016
- Wilkinson, R.G. (2005) "The impact of inequality: how to make sick societies healthier", Routledge, 2005.
- Williamson, O. (1986a) "Vertical integration and related variations in a transaction-cost economics themes", in J. Stiglitz and G. Mathewson (eds), "New developments in the analysis of market structure", Cambridge, MA, MIT Press.
- Williamson, O. (1986b) "Hierarchical control and optimum firm size", in "Economic Organisation", Brighton, Wheatsheaf, Chapter 3, pp.32-53.
- World Database of Happiness (2005), quoted in the Social Capital Project (2005).

196 ipts Technical Report Series

8. The New Meaning Processing Paradigm

by Ilkka Tuomi

During the last decades, research and development of information technologies has been guided by what can be described as the *information-processing paradigm*. The information-processing paradigm has influenced theories of computer hardware and database design, organization theory, research on artificial intelligence and knowledge representation, theories of human learning and cognition, as well as economics. This chapter argues that the limitations of the information-processing paradigm are now rapidly becoming visible. The development of important new applications of information society technologies, such as instant messaging, blogging, tagging, social filtering and networking, distributed annotation, and knowledge management systems, implement ideas that cannot easily be described using the traditional information processing concepts.

The old paradigm does not work well anymore because it is built on a conceptual foundation that is not well suited to the present reality. Yet, at the present, we lack well-articulated models and concepts that would effectively move beyond the old paradigm, and guide policy, research, and design. This chapter, therefore, tries to outline the characteristics of an emerging new paradigm—the meaning-processing paradigm.

The chapter combines a brief conceptual introduction to the new paradigm with some practical examples of developments that highlight the relevance of this paradigm. It also discusses some policy approaches that emerge in the new paradigm.

In the new meaning-processing paradigm, information and communication technologies are understood as technical systems that are integrated with and embedded in social, cultural and cognitive processes. These processes consist of the ways people consume and produce goods and services, and the way they interact with other people. Information technologies are now becoming a media for socially, culturally and historically embedded meaning processing. Thus, whereas research and product development within the traditional information-processing paradigm required mainly knowledge about microelectronics, mathematics, logic, and engineering, the new paradigm can only fully be described using cultural, social, and epistemic knowledge. When new applications of information and communication technologies are taken into use, they acquire their functionality and meaning in a historical context of existing technologies and social practices. Technologies do not come into world ready-made; instead, they are interpreted and shaped by active actors who appropriate technological opportunities in serendipitious, unexpected and innovative ways. The emerging paradigm, therefore, is inherently dynamic, social, and evolutionary.

In the traditional information-processing paradigm, semantics was a major challenge and the problem of meaning was explicitly pushed beyond the limits of the paradigm. Information systems were designed based on a strict separation of syntax and semantics. This was a central design requirement for traditional computing architectures. The reason is simple: algorithmic computer programs can process data only when the meaning of data is fully represented in data structures and programs do not have to interpret it.[155] In the emerging paradigm, information and communication systems do not aim at algorithmic processing of data, except in some well-defined

155 The design rationale and limitations of traditional computer architectures in processing knowledge and meaning are discussed in Tuomi (2000), which also showed that the conventional concepts of data and information emerge as a side effect of computer system architectures and the epistemological models that they implement.

special cases. On one hand, information systems are now increasingly used to implement abstract communication and knowledge processes where information-processing concepts become trivial and irrelevant. Bits are now becoming a similar commodity as electrons, and we do not have to talk about bits any more than we need to talk about Maxwell equations when we talk about future information society technologies. On the other hand, real advances in the micro- and nano-level information processing technologies will require that we reconsider the conceptual foundations of the information-processing paradigm. In other words, there is an increasing need to bring meaning back to computing, communication and knowledge society technologies.

At present, the traditional information-processing paradigm is being extended to include semantics. A large number of initiatives aim at developing knowledge and meta-data representation schemes that would enable automated processing of meaning. These initiatives often revisit—and sometimes reinvent—the ideas of knowledge representation that were popular in artificial intelligence research in the 1970s and 1980s. These initiatives, therefore, often rely on epistemological approaches that are known to have difficulties in handling meaning. Although brute-force computing can sometimes solve practical problems related to meaning, a paradigm that lacks conceptual rigor or relevant dimensions in describing the problem of meaning can only with great effort be scaled-up to practical meaning processing tasks. This chapter, therefore, also makes the perhaps controversial claim that initiatives such as the Semantic Web promoted by the W3C will have only limited success in the future. A truly semantic Web already exists. To understand its character and evolution, we need, however, a new epistemological approach and a new research paradigm.

Throughout this chapter, we emphasize the importance of epistemological concepts. One problem with the traditional information-processing paradigm was that it mainly relied on one specific epistemic model, empirical positivism, and often assumed it to be trivially true. Epistemic models have therefore often remained invisible and implicit in technical, economic, and policy discussions related to information society technologies. In the present chapter, we make epistemic discussion explicit. The aim is to provide concepts and language that help in articulating challenges and opportunities in the knowledge society, where knowledge, indeed, is not trivial anymore, and where the proper and theoretically robust characterization of knowledge has become an important practical problem.

The underlying claim in this chapter is that we are approaching a discontinuity that requires reframing many ICT engineering, design and policy problems. The new paradigm does not emerge ex nihilo, and the chapter tries to build bridges to research traditions that have existed for many decades. New paradigms exist in laboratory scale before their society-wide impact is felt. The elements of the new paradigm are not new; instead, the novelty is in the overall restructuring of existing knowledge. Paradigms change when we reinterpret and reconfigure existing pieces of a puzzle so that the present reality forms a coherent picture. In the first phase, we have to recognize that there is an anomaly and that the world does not fit well with our models of it. This is often difficult, as the old models typically work extremely well in many practical situations by construction. As Kuhn noted, social forces drive and constrain paradigm change, and new paradigms often emerge only after old professors die. Today, millions of people have invested heavily in skills and theoretical concepts that are directly related to the information-processing paradigm. When a new paradigm replaces the dominant paradigm, new skills and new disciplines of knowledge become relevant and old ones lose some of their relevance. This happens, however, only when the anomalies of the old paradigm become clearly visible and practically important. Then we have to give up some fundamental assumptions and reconceptualize the world. This is a natural part and a sign of learning. Creation

of new knowledge requires that obsolete truths become obsolete and that we unlearn what we learned earlier.

Competitive advantage in research and business is gained by locating discontinuities early and by linking weak signals that on the surface appear to be disconnected. This chapter, therefore, invites researchers to join the work of discovering the potential new sources of leadership in information society technologies. Instead of elaborating the meaning-processing paradigm in any great detail, the chapter aims at giving a quick glance over the emerging landscape. In particular, I try both to provide references to relevant earlier streams of research and introduce some concrete examples that could provide starting points for further discussions.

Structure of the Chapter

This chapter starts by contrasting the two paradigms of information processing and meaning processing. The aim is to first give the reader a general idea of where the focus of each paradigm lies. We do this by discussing differences between the paradigms in three areas: epistemology, the organizational model, and the socio-economic model. We then summarize some main differences in Table 1.

Then we move to a more detailed discussion that points to related research traditions and provides references that are useful for formulating the new paradigm. This exploration of conceptual foundations is intended to provide a concentrated introduction to some key ideas underlying the new paradigm, as well as links to relevant research disciplines. After this theoretical and conceptual discussion, the chapter describes some example Internet applications that highlight different elements of the new paradigm. Instead of a detailed discussion of these examples, we simply show how these representative applications look and point out some of their most relevant characteristics. The report finishes by discussing out some policy implications and areas for information society policy development.

The two paradigms: an overview

This section summarizes the main differences between the information-processing and the meaning-processing paradigms. Due to the multidisciplinary nature of the new paradigm, we first provide a very high-level overview, and then, in a subsequent section, introduce more detailed discussion and references to existing research.

Epistemology

An important difference between the information-processing and meaning-processing paradigms can be found in their epistemological starting points. The information-processing paradigm is based on empiristic and positivist concepts of information and knowledge. The meaning-processing paradigm, in contrast, is based on a constructivist approach.

The empiristic and positivist epistemologies typically assume that the world consists of perceiver-independent objects and that knowledge is accurate representation of these objects and their relations. Empirism states that only observations of the external world can lead to knowledge. Positivists, in turn, argued that reality consists of things that can be asserted by empirically confirmed facts. Various interpretations on both empirism and positivism exist. The common view that the world is "out there" and that knowledge is about empirically verified facts and laws of nature is called naïve realism. Since the 1950s, epistemologists have generally agreed that this naïve realism has to be modified, for example, because facts depend on theoretical models within which they make sense. The main characteristic of positivist and empiristic epistemologies is the strict separation of subjects and objects of knowing, as well as the assumption that knowledge has to be independent of the social and personal context of knowing. Epistemologists in this tradition often argue that if knowledge becomes subjective, all knowledge claims become equally valid, cumulative science becomes impossible, and anything goes.

The information-processing paradigm has often relied on an epistemic position that closely resembles naïve realism. tried to represent knowledge about existing objects. This led to questions such as how to avoid logical and empirical errors in knowing the reality. An influential early example was the mathematical theory of information, developed by Shannon and Weaver. The fundamental goal of the theory was to find efficient coding schemes that would maximize the probability of correctly receiving a message selected from a predetermined set of messages. This same epistemic starting point was often adopted by researchers on artificial intelligence and human information processing, who tried to represent and process knowledge about existing objects, and model knowledge structures stored in the human brain.

The traditional information theory implicitly assumed a closed world. The constructivist approach that underlies the meaning-processing paradigm takes as its starting point an open world. This world is not simply "out there." Instead, its objects and characteristics are generated and organized by intelligent actors, who use their cognitive capabilities to structure the reality and make sense of it. In this view, humans create information and knowledge by active processing. Many alternative interpretations of the reality are possible, constrained by cultural, social and even biological factors.

The cultural and social foundations that provide the basis for interpretation of meaning also imply that the processes that produce meaning are not purely individualistic. Instead, they are grounded on historically accumulated stocks of meaning and shaped by social interaction. The accumulated stocks of meaning are not arbitrary or detached from the rest of social life. The meaning of things and events depends on social differentiation, institutions, existing conceptual and value systems, and social practices. Scientific knowledge, for example, is deeply rooted to socially shared stocks of accumulated knowledge, specific scientific practices and instruments of observing the world, and conceptual systems that make facts, theories and observations meaningful and relevant for the scientific community in question. Knowledge is constructed in a social and historical process, not as isolated universal facts or bits of information, but as coherent systems that integrate human knowing and action. Knowing, therefore, is understood in the meaning-processing paradigm as an active process and verb, not a static representation of an observer-independent reality.

Organisation model

In organisation theory, the information-processing paradigm has had a major influence during the last decades. Leading authors in organization studies argued that organizations and their structures should be understood as information processors. Often the underlying model was a hierarchy that was assumed to make decisions based on information received from the environment.[156] In organisational information systems research, the information-processing paradigm led to extensive studies on decision-support systems, executive support systems and, for example, attempts to implement comprehensive enterprise information architectures.

The meaning-processing paradigm, in contrast, has been visible in studies on organisational knowledge-creation and strategic sensemaking. Research on organisational learning, organisational narratives, knowledge-based organisation and innovation management also often understood organisations as loci of meaning processing.[157]

156 Influential examples include Tushman & Nadler, 1978; Knight & McDaniel, 1979; Egelhoff, 1988; March & Simon, 1958.
157 For an extended review of organizational information processing research, see Tuomi, 1999.

Organisational information systems research has been conducted within both paradigms. Research that has highlighted elements of the meaning-processing paradigm has often focused on computer-mediated communication, augmentation systems and collaboration systems that support knowledge creation and innovation. Also studies on Internet communities and self-organisation have often focused on the social aspects of communication and interpretation, thus moving beyond the information-processing paradigm. Studies on user-centric design, emotional design, domestication of technologies, and, for example, ethnographies of technology use have also highlighted meaning-related factors in information and communication systems.

Research on organisational knowledge-management systems has been divided along the lines of the two paradigms. In particular, around the mid-1990s some knowledge-management scholars adopted an epistemic position that closely resembled naïve realism. Researchers rooted in computer engineering and programming, and information systems and knowledge-based technologies often understood organizational knowledge management systems to be about representing, storing and processing data. In contract, researchers influenced by studies on business strategy, innovation, organizational sensemaking, collaboration technologies, social learning, change management, and social studies on technology, often adopted a view in which knowledge management systems are facilitating tools in an essentially social process of knowledge generation, diffusion and action. In general, the first approach lead to attempts to automate knowledge processing using computers, whereas the latter tried to make people and organizations more intelligent by supporting human knowledge processes.

Socio-economic model

The information-processing paradigm has close affiliation with the mainstream schools of economic thinking. For example, in the neoclassical theory, prices have often been understood to contain information about the marginal utilities of consumers and the costs of producers. Market, in itself, has commonly been perceived as a computational machine that processes price signals. Leading neoclassical economists have explicitly argued that the distributed information processing mechanism of markets outperforms any rational planning and design. Institutional economists working within the neoclassical framework have also explained the emergence of organisations and institutions using information processing costs. In general, during the last decades information-processing models of economy have been influential and visible. Economic actors have been perceived as economic decision-makers who maximize their utilities and self-interest, perhaps with bounded rationality or with other imperfect computations.

Studies on neoclassical economics have typically adopted an empiristic and positivistic epistemology. In this epistemology, the epistemic challenge is to accurately represent and extract information about the world and its objects. Economic actors, in turn, are typically perceived as calculators who compute economic options and outcomes, and then realize options according to the calculated outcomes. In this theoretical tradition, it rarely makes sense to ask why utilities or preferences are what they are. Questions about values and meaning of products and consumption, therefore, typically remain in an opaque black box, and outside the economics proper. Whereas traditional computer system research pushed meaning beyond its domain by representing it in data structures that provided the static constraints for automated data processing, economics pushes meaning out of its equations by reducing it into a one dimensional number that has no internal structure. This approach, in itself, reflects the epistemic idea that the laws and facts of nature have to be universal and independent of subjective valuations. Modern economic theory typically assumes that values are fully subjective and personal, and therefore cannot and should not be modeled in economic

theory. Somewhat paradoxically, this leads to concepts of value, utility and preference that are fully universal and agnostic concerning personal values and meaning.

Neoclassical models, therefore, are also independent of history and culture. By construction, the market is understood as a universal mechanism, which in its theoretically optimal form operates independent of time, place or social structures. In its pure abstract form, neoclassical economics understands economy as a social system that consists of individual rational decision-makers, who reveal their preferences, expectations and knowledge in their economic transactions. In this approach, economic transactions, in turn, fully represent all relevant information about values, thus consolidating histories and expectations into points in time where values are cleared. Neoclassical economic theory, therefore, typically rejects from its models information that relates to culture, contingent historical events, and social and ethical value systems. Historically accumulated, contingent, structural, and qualitative factors, such as social and organizational networks pose an important challenge to this theoretical approach. Similarly, the epistemic foundations of the neoclassical theory lead to difficulties in handling meaning-related phenomena, such as knowledge, learning, novelty, and innovation.

In contrast, economic sociologists, since Marx, Durkheim, Weber and Schumpeter, have emphasized the importance of the historical and cultural context. For example, Durkheim highlighted the role of symbolic systems that create and embed "social facts," as well as rituals and religion-like systems of belief that underlie social and economic behavior. Weber, in turn, argued that social sciences are different from natural sciences because in the former both the researchers and the objects of study attach meaning to events. Therefore, according to Weber, researchers cannot understand social behavior without taking into account the meanings that mediate social action.

More recent research on social meaning processing has pointed out that consumers are not passive sinks of goods and services. Instead, they consume products and services in contexts where their consumption makes sense. Instead of being active only at the moment of decision-making and maximization of self-interest, consumers use material and symbolic goods to produce meaning. Producers form symbiotic relations with the users of their products, and products, in turn, are used to allow consumers to participate in social meaning processing.

Sociologists have further pointed out that meaning processing is in many ways structured. Modern societies are functionally and culturally diversified. The social infrastructure of economy consists of communities of specialized practice and interpretation, multiple linguistic genres and a rich variety of conceptual and value systems. Practical social and economic activity often requires crossing of the associated interpretation and cultural boundaries.

In this "non-neoclassical" view, economic transactions are accompanied by knowledge that extends beyond the time and place of economic transactions. In practice, economic transactions exist only within a context of historically accumulated stocks of knowledge and other resources, including social capital, trust, structures of social practice, technical designs, as well as social institutions, including laws, bureaucracies, sanctions, and political and organizational power. The interpretation of these elements relies on communication and requires active processing by participants. The economic transaction, in this view, is therefore only a tip of an iceberg, which is complemented and combined with various other symbolic and material exchanges that facilitate production of meaning and participation in social processes. Often the economic transaction can also be bypassed in production activities, as, for example, students of open source software development have pointed out. Most important, new information and communication technologies enable new ways

in which information and knowledge contexts can be built. This can reorganize both economic transactions and markets, for example, by making history, reputation, social capital, value systems, and trustworthiness explicitly visible.

The production of new meaning potentially leads to reinterpretation of meaning. The economy of meaning production is, therefore, inherently unstable. This recursive nature of meaning production implies that the underlying utilities and values are constantly being reinvented. New "needs," "values" and "demand" can therefore also intentionally be created in the economic system. The economy of meaning production is a continuously expanding one, and not structured by the problem of acquiring and distributing scarce resources. In the meaning-processing paradigm, economy is fundamentally about creating new areas for economic exchange, not about optimally dividing existing scarcity, as the classical economists thought.

Summary: Main characteristics of the two paradigms

Table 1 below summarizes the main differences between the two paradigms.

Conceptual starting points

This section describes in a concentrated form key theoretical contributions that underlie the meaning-processing paradigm. This section is deeply multidisciplinary. The goal is to give

Table 1. Main characteristics of the Information and Meaning Processing Paradigms.

Paradigm:		Information Processing	Meaning Processing
Epistemological model		**Positivist, empirist, objectivist**	**Constructivist**
	Knowing subject	Individual cognitive processors of mental knowledge representations	Cultural and historical actors who participate in social processes of knowing, sensemaking and intelligent action
	Concept of information	Structured facts about observer-independent reality	Socially and culturally interpreted and articulated signals and communications
Organizational model		**Organizations as information processing structures**	**Organizations as intelligent actor systems and knowledge-creators**
	Strategy	Hierarchical decision-making; strategic long-term planning	Distributed organizational learning, competence development and utilization, directed and led by shared vision, narrative, and interpretation culture; strategic management of cross-boundary knowledge, innovation and communication networks
	Information systems	Decision-support systems (DSS), Executive Support and Information Systems (EIS/ESS), Data Mining Systems, Enterprise Information Architectures (EIA)	Computer-Mediated Communication Systems (CMC), Collaboration Systems (CSCW), Cognitive Augmentation and Knowledge Construction Systems, Business Intelligence Systems (BIS), Organizational Memory Systems (OMS)
Socio-economic model		**Neoclassical economy with scarce resources**	**Institutional and sociological system of expanding space of meaning and economic interactions**
	Consumer	Individuals expressing their self-interest, needs, and preferences	Consumption as production of socially meaningful interactions and progress
	Sphere of production	Profit-maximizing individual and organizational actors	Symbiotic and co-evolving user-producer ecologies
	Sphere of economic interactions	Universal market	Diversified value and knowledge communities that act as carriers of social practice

the reader a set of pointers to key literature and research traditions that provide material for the new paradigm. Due to space limitations, we will not explore the different research traditions in any detail; instead, the aim is to paint a broad overview of the area.

New theoretical paradigms reorganize and combine existing knowledge in new ways. They also provide novel interpretative frameworks, in which familiar concepts may gain new meaning. Much of the meaning-processing related research has itself been multidisciplinary. In practice, this means that there is no trivial access to some key ideas of the new paradigm, and that the following snapshot of theoretical research lines necessarily remains cursory. A more detailed elaboration would require a more in-depth review of these research lines, as well as an explicitly articulated synthetic summary that would show how the mentioned research traditions complement each other. Due to practical constraints, the present chapter remains only a first step on this longer path.

A brief example may, however, help in understanding and overcoming this challenge. Concepts that look relatively straightforward sometimes need to be interpreted using specific theoretical frameworks, also in the subsequent sections of this chapter.

In sociological theory, Niklas Luhmann (1995; 1990; 1992; 2000) has in great detail developed a model of societies as meaning processing systems. In his systematical studies Luhmann elaborated a rather sophisticated and idiosyncratic theory, which argued that societies are meaning processing systems that exist as systems of communication. Luhmann built his theoretical sociology on general systems theory, phenomenological sociology, and in particular the theory of autopoietic systems. The last one was developed in the 1970s by the biologists Humberto Maturana and Francisco Varela (1980; 1988), as a non-Darwinistic theory of evolution of living systems, perception, cognition and communication. The underlying lines of research combine and synthesize epistemological work of philosophers such as Henri Bergson, Edmund Husserl, and Maurice Merleau-Ponty; the abstract study of Laws of Form by George Spencer Brown; theories of meaningful social action by Émile Durkheim, C. Wright Mills, G. H. Mead, Talcott Parsons and Kenneth Burke; and second-order cybernetics of self-referential and self-organizing systems (cf. Mingers, 1995). These literatures do not belong to basic courses on information system design, computer engineering, or information society policy, for example. In fact, relatively few researchers have used these theoretical starting points to develop information systems or models of information society.[158]

With the understanding that a full elaboration of the various research traditions and explication of their linkages is both impossible and unnecessary in this chapter, the following theoretical sections simply provide brief introductions to some main related lines of research. Furthermore, the discussion below does not try to cover all relevant research traditions. The aim, instead, is to make the reader aware of the types of relevant research that can usefully be brought together to build the foundations for the new paradigm. We focus on three areas: epistemology, society, and political economy.

Epistemology

The ways in which we conceptualize and understand knowledge and information implicitly define the ways in which information and communication systems are analyzed, studied, and designed. Scientists and engineers, therefore, use epistemological models extensively in their everyday work. These models are sometimes

158 An important and well-known exception is the now classic computer-mediated collaboration system, the Coordinator, developed by Terry Winograd and Fernando Flores. In their Understanding Computers and Cognition, Winograd and Flores (1986) integrated some of these theoretical traditions with speech act theory. Their work had major impact also because Winograd—one of the leading pioneers in artificial intelligence research—essentially argued that AI researchers should reconsider their traditional approaches.

implicit, but they have practical implications. We can therefore ask which models provide a good basis for the design of technologies, theories, and policies. In the knowledge society, epistemology, therefore, is not just a peripheral issue; instead, it is one of the core issues, and requires explicit analysis.

As was noted above, positivist and empiristic epistemologies have strongly influenced the information-processing paradigm. When researchers working within the information-processing paradigm quote philosophers, they often refer to philosophers such as Bertrand Russell and Karl Popper. The priority of empirical observation is well present in the quote that starts Popper's (1981) classic work, Objective Knowledge. The quote is from Russell, and it reflects the basic positivist worry that truth and knowledge can be destroyed by making them relative and less than universal:

> *"The growth of unreason throughout the nineteenth century and what has passed of the twentieth is a natural sequel to Hume's destruction of empiricism."*[159]

Empiricism underlies the information-processing paradigm by providing a model of knowledge where knowledge is accumulated by observing facts about the reality. This view assumes that true knowledge is independent of any particular knowing subject and that it represents a universal reality. Facts, therefore, cannot be contradictory; knowledge cannot depend on knower's history or context; world follows a logic of simple truth-values; and knowledge cannot exist without a unique reality. In this model, knowledge is accurate representation of reality, which, perhaps, for the time being remains only partially known.

Researchers working with questions related to meaning processing have, in contrast, adopted philosophical positions that are close to phenomenological, hermeneutic, constructivist, and pragmatic traditions. Whereas empiricism started from the assumption that the reality exists "out there," and that the main epistemological problem was to represent it accurately, phenomenological, constructivist and pragmatic philosophers have asked, how the "reality" becomes what it is, already before we start to explicitly "represent" it. In these philosophical traditions, questions concerning the nature of objects that constitute the world, in other words ontology, provide the foundation for epistemological considerations.

This primacy of ontology has been one of the key characteristics of the phenomenological philosophies of Edmund Husserl (1982), Martin Heidegger (1968; 1977) and Maurice Merleau-Ponty (1962). Their work, in turn, has influenced hermeneutic philosophies. Hermeneutics, the theory of the interpretation of meaning, has been developed by authors such as Hans-Georg Gadamer, Paul Ricoeur and Jürgen Habermas (cf. Bleicher, 1980).

Henri Bergson (1988; 1983) developed around the turn of the last century a radical and original epistemological position that was based on a fundamental critique of the empiristic epistemology. Bergson started by analyzing the emergence of cognition and perception in living beings. Bergson, for example, asked how the possibilities for perception emerge and change in

159 Popper does not give the source of the quote but it comes from Russell's History of Western Philosophy, 1945, p. 672. Russell believed that giving up empiricism would mean that: "The lunatic who believes that he is a poached egg is to be condemned solely on the ground that he is in a minority, or rather—since we must not assume democracy—on the ground that the government does not agree with him." Russell perhaps wrote this while eating English breakfast. In some cultures, normal people, however, categorize themselves, for example, as green parrots. This has puzzled anthropologists, who have tried to figure out whether people actually think they are green parrots, or whether they only symbolically associate themselves with green parrots. Russell, of course, faces the same problem when someone asks whether he thinks he really is a philosopher, or whether he is a philosopher only because other people really think so. From the pragmatic point of view, however, claiming that one is a poached egg is lunatic, for example, if with the claim one risks ending up on Russell's breakfast plate. In general, the lunacy of claiming to be a green parrot, a poached egg, or a philosopher depends on what the speaker and her audience mean by green parrots, poached eggs, and philosophers.

the course of evolution, and how the physiological possibilities of action shape the ways in which reality is perceived and constructed. In particular, Bergson described how reality necessarily becomes structured into objects and located in space and time for intelligent observers. In other words, Bergson also explained why the realist and empiristic views of the world are natural for living and acting beings. At the same time, Bergson showed how the very functioning of intelligence necessarily hides parts of reality and how the natural attitude of intelligence makes some important phenomena, such as the key processes of life and knowing, unintelligible for the human system of cognition. To understand human cognition and knowing, we have to first understand the natural limits of cognition that lead us to the common-sense naïve realism, and then adopt a broader interpretative framework that moves us beyond these limits.

Bergson further argued that the possibilities for human action underlie the human capabilities of making distinctions in the world. The capabilities of cognition are, therefore, deeply connected with the possibilities of action. In contrast to disembodied minds, epistemologists, therefore, should focus on embodied and acting living beings if they want to understand perception, cognition, and knowledge. According to Bergson, reality, as such, can never be known, as the human system of perception and intelligence necessarily constructs the world in a way upon which it can act. As biological living beings, humans, however, may expand the boundaries of their intelligence and knowledge using an alternative form of cognition which Bergson called intuition. By intuition, he meant those cognitive processes that access the reality at a pre-conceptual level.[160]

American pragmatists William James, John Dewey and George Herbert Mead also often appear in studies related to meaning processing. The pragmatic method, according to James (1977:425-43), is based on interpreting the practical consequences of epistemic claims. Truth and facts, in other words, are not abstract; instead, they depend on whether we interpret them in a way that makes sense, given the practical implications of our claims. Pragmatists thus brought the questions about knowledge back to practical and concrete environments, where the knower tries to do something with knowledge. Mead (1967) linked this pragmatic view with theory of symbolic and linguistic systems, arguing that the human mind is fundamentally social and produced by communication. Mead's views have also been characterized as "objective relativism," as according to him knowledge emerges as a relation between the knowing subject and the known world. His view was "relativistic," as knowledge was dependent on the particular position and capabilities of the knower, yet "objective," as it conceptualized knowledge as generalized invariants about reality which different knowers experienced in a similar fashion. Knowledge can become "objective" when it expresses events that are perceived as similar by "generalized others" internalized in the human thought. Both knowledge and the knowing mind, therefore, are social, and knowing can only be understood in the context of social psychology.

In parallel to American pragmatists, Soviet developmental psychologists, led by Lev Vygotsky, created a sophisticated theoretical framework for understanding the linkages between social and cognitive development. This Vygotskian research tradition—also known as cultural-historical or

160 Bergson had a major influence on social, cultural and scientific movements in the beginning of the 20th century, and his thoughts created major political, philosophical and religious controversies (cf. Antliff, 1993). Since then, his contributions have to a large extent been deleted from mainstream works of history of philosophy, especially in the Anglo-American philosophical literature. This is partly because his analysis made the key starting points of the mainstream analytical and empiristic traditions questionable. Russell (1979:765), for example, stated that those "to whom action, if it is to be of any value, must be inspired by some vision, by some imaginative foreshadowing of a world less painful, less unjust…will not find in this philosophy nothing of what they seek, and will not regret that there is no reason to think it true." (cf. Tuomi, 1999: 87-95). I have argued before that many failures in artificial intelligence research resulted from the fact that researchers followed Russell instead of Bergson in their epistemological assumptions (Heinämaa & Tuomi, 1989).

socio-cultural activity theory— has since the 1920's had a profound influence in particular in the domain of education and developmental psychology (cf. Kozulin, 1990; Wertsch, 1985; van der Veer & Valsiner, 1994). Due to the fact that the seminal writings of this school became widely available in English translations only after the 1970s, the full impact of the socio-cultural activity theory has become visible only relatively recently, however. Important early proponents of the Vygotskian ideas in the English speaking countries include Jerome Bruner (1986; 1990), Sylvia Scribner (1997) and Michael Cole (1986).

In his "Thought and Language", originally published in 1934, Vygotsky argued that the development of the mental capabilities of the adult human mind can only be understood as a process that relies on accumulated social and cultural resources. Historically, three different and parallel developmental processes enable this development of human thought processes (Luria & Vygotsky, 1992). The first is the slow and gradual "ontogenic" evolutionary process that creates the biological capabilities of perception and functioning. The second is the historical process of cultural evolution that accumulates cultural, symbolic and technical resources and artifacts, which humans can then use in their cognitive action. Vygotsky, for example, described how material artifacts such as knotted ropes become cognitive tools that are used to augment human memory and cognitive capabilities. Humans, therefore, can "outsource" some of their mental functioning to technical devices and conceptual symbol systems. This idea has become influential in studies on distributed cognition (e.g. Hutchins, 1995; Salomon, 1993; Rogoff, 1990). According to Vygotsky, the theoretic systems of science represent the most advanced form of this evolutionary process.

The third developmental process, which was the main focus of Vygotsky and his followers, was the mental development of the child. Vygotsky asked, in particular, how individuals gain their mental capabilities and become able to participate in social and cultural processes as competent adults and, for example, learn scientific models of the world. Vygotsky's answer was that this development occurs in a close interaction between adult members of the culture and the child. In particular, the child develops advanced mental capabilities in a "zone of proximal development," where he or she can perform advanced mental functions with the help of an adult. After the child learns how to accomplish such feats, the cognitive and practical "scaffolding" becomes unnecessary, and the child starts to be able to perform advanced mental functions on his or her own. In this process, the mind of the child becomes infused with cultural resources and capabilities.

According to Vygotsky, the most advanced forms of thought rest on a linguistic foundation. He distinguished the concepts of meaning and sense, arguing that "meaning" has to do with words and their conceptual relations, whereas "sense" depends on the context of speech. The sense of communication could, therefore, never be inferred from the meaning of the words that constitute a sentence. In the same ways as it is impossible to infer the meaning of a word by studying the letters that form the word, it is impossible to infer the sense of a sentence by adding up meanings of words. Word meanings and communicative sense simply live in different phenomenological universes.

Based on Vygotsky's ideas and their refinement, his colleague and student A. N. Leont'ev (1978) further developed a general theory of symbol-mediated action. Leont'ev's activity theory distinguished three conceptually independent levels in human behavior: activity, action and operation. The level of "activity" was socially and culturally constituted performance that aimed at fulfillment of a motive. For example, people can engage in activity of constructing a building or hunting for game. Activity is accomplished through a sequence of goal-oriented "actions," such as erecting the walls, or making noise that frightens the game so that it becomes visible and can be killed.

Human action, in turn, is performed through "operations," that implement actions in specific concrete contexts. Most importantly, available operations depend on available technical tools. For example, the action of "killing the game," can be implemented in various ways, for instance, by throwing stones or spears, or by using a sling or a gun. The appropriate operations depend on the context where the action is performed, as well as accumulated technologies and skills. For example, it may be easier to hunt fish using spears than with stones, and it may be easier to hunt flying birds with a shotgun than with a spear. The possibilities to implement actions as operations therefore depend on the concrete situation at hand, but also on culturally accumulated resources. In a culture that does not have shotguns, you cannot use shotguns.

The work of socio-cultural activity theorists has highlighted several important points that have been relatively invisible in the information-processing paradigm. First, advanced mental activities are deeply rooted in culturally and historically accumulated stocks of meaning. Knowledge production and interpretation, therefore, depend on context, social learning processes, and memory. When, for example, a scientist observes an electron in a laboratory he or she always sees it through a complex system of socially shared and learned theoretical concepts and technical artifacts that implement these concepts and enable and constrain their meaningful interpretations. Second, the stocks of meaning are socially diversified, continuously evolving, and related to social practices carried by communities formed by social division of labour. Vygotskian ideas, therefore, have also become important in making the "community of practice" one of the key concepts in recent discussions on knowledge creation and learning (Lave & Wenger, 1991; Wenger, 1998; Brown & Duguid, 1991; Brown & Duguid, 2000). Third, humans rapidly integrate new technical and symbolic resources into their meaning-making processes, and use technological artifacts as cognitive tools, effectively extending and augmenting their cognitive capabilities with material and symbolic artifacts. This last idea, of course, has also influenced the development of the Internet and modern user interfaces (cf. Licklider, 1960; Engelbart, 1963; Licklider & Taylor, 1968; Johnson, Roberts, et al., 1989).

In psychological theory, key authors of these constructivist ideas—in addition to Vygotsky—include Jean Piaget. Piaget's ideas have also been widely used within the information-processing paradigm. In his later writings, Piaget, however, comes close to Vygotsky, emphasizing the social and cultural foundations of knowing. Piaget, for example, noted that scientific knowledge and systems of thought evolve in a continuous process. "More specifically," he noted, science "is a process of continual construction and reorganization." (Piaget, 1970:2)

The construction of meaning and knowledge was a major theme also for Michael Polanyi (1998; 1967). Polanyi specifically pointed out that knowing always requires a context that necessarily has to remain unarticulated and subsidiary for the knower. Human perception can only operate by focusing on something particular in a field of factors of which it has to remain unaware. Such "from-to" knowledge Polanyi called tacit knowledge, and described how tacit knowledge also provides the foundation for scientific knowledge. Polanyi, therefore, argued, for example, that the positivist dream of knowing the future by computing the trajectories of all the atoms in the universe was futile. To get to the level of meaning of things and events, tacit knowledge is needed as much as explicit knowledge. All the relevant knowledge cannot be made explicit at the same time, however. As Polanyi (1975: 36) put it: "you cannot use your spectacles to scrutinize your spectacles." Even if the Laplacian dream of knowing the future by calculating the positions of all particles in the universe would one day be fulfilled, the results of the computation would be unable to tell us anything of interest, as the meaning would have been left out of the computation from the beginning.

The meaning of human acts also needs to be interpreted as acts that are reflexively performed for others who try to make sense of them. The context of meaning is a narrative context, which tells where things come from, where they are, and where they are heading. As Bruner pointed out, human action become meaningful through communication that integrates acts into meaningful stories:

> *"Indeed, the meaning placed on most acts by the participants in any everyday encounter depends upon what they say to one another in advance, concurrently, or after they have acted." (Bruner, 1990:18)*

Whereas phenomenological and constructivist epistemologies are now quite frequently referenced in information system research, a relatively little-know source of epistemological ideas is the Kyoto School of phenomenological existentialism (Nishida, 1987; Nishitani, 1991; Carter, 1997). This school has since the beginning of the last century combined in a unique way European continental phenomenology, American pragmatism, and Buddhist philosophical thinking. Recently, it has had an important impact on theoretical models on knowledge-creation and innovation. Contributions of this school have remained somewhat underutilized, however. Partly this is because the Asian approach to philosophy tends to discuss philosophical questions in the context of religion, which is an unfamiliar context for most Western epistemologists. When ontological questions are understood to be the basis for epistemology, the linkages between Buddhist thinking and Western philosophy become clearer, however.[161]

The Kyoto School is interesting for a number of reasons. Its early starting point was a critique on the basic tenet of most Western philosophical thinking: the idea that philosophy and knowing rests on the fundamental separation of the subject and object. In contrast to this apparently obvious starting point, the founder of Kyoto School, Kitaro Nishida, argued that we need to understand cognition as a process where objects and subjects mutually construct themselves in the act of cognition. The separation of subjects and objects is therefore a wrong starting point for epistemology. The rejection of this starting point, however, also implies that we need to develop "a logic of paradoxes," where we can describe phenomena that are at the same time inside and outside of the active perceiver. The reality, according to Nishida, "is" and "is not" at the same time, and we need a logic that matches with the reality if we want to describe it well.

As the Kyoto School starts from a well-informed critique on the fundamental assumptions of the conventional Western philosophy, it has the potential to introduce new elements to sophisticated epistemological thinking. In practice, it has influenced Japanese technology policy makers and provided starting points to one of the most influential models of organizational knowledge management (Nonaka, 1994; Nonaka & Konno, 1998). It has also been used to derive an architecture for a "semantic" computer (Shimizu & Yamaguchi, 1987). Although the semantic computer project was abandoned for various reasons, it still represents an interesting example of how a computer system can be built on an epistemology which is different from the one used to design conventional algorithmic computers. In particular, it seems to be the only existing attempt to design a self-organizing system that could automatically process meaning.[162]

The above-discussed theoretical traditions share the idea that "reality" is actively "constructed" by humans. The experienced and

161 The Kyoto School, in fact, has been called the only philosophical school in Japan. This is because, even when the members of the Kyoto school were discussing traditional conceptual issues that in Japan have normally been categorized as religious issues, the thinkers in the Kyoto School explicitly related their work to Western philosophical traditions, including Bergson, James, Husserl, and, for example, Heidegger.

162 The associative memories and self-organizing maps of Kohonen (1980; 1984) could perhaps also be described as "meaning processing systems." To my knowledge, Kohonen has not made this link.

known "world" is not simply "out there" to be more or less correctly perceived, as empiricists thought. Instead, it is the result of active cognitive work of the perceiver. This basic insight was the core of the Kantian revolution, but it was put into a dynamic context when it was combined with evolutionary considerations and individual cognitive development. The categories through which humans perceive and know the world, became then the present end-points of evolutionary and developmental processes, and deeply integrated with technologies at hand. Furthermore, technologies, themselves, become part of the human process of knowing. Information is not innocent or objective; it does not wait us behind the veil of reality and it cannot be extracted from the world. Instead, information is produced in the act of bringing together the constraints and possibilities of the human mind, technologies of observation and action, and the world where the "outside" and the "inside" are inseparably connected.

Social meaning processing

Polanyi emphasized the importance of personal history and experience in the process of generating scientific knowledge. Others have focused on the social infrastructure of knowing and knowledge. An early pioneer in this area was Ludwik Fleck (1979), who used the history of medical sciences to show that systems of scientific knowledge are produced and maintained by specialized communities. Fleck called these "thought communities." According to Fleck, the meaning of scientific observations and data was rooted in specific diagnostic practices and technologies, and propagated in the society when young researchers adopted existing views of the world. Fleck, though, remained little known until Thomas Kuhn popularized the idea that scientific knowledge exists in the context of scientific "paradigms," which are maintained and guarded by scientific communities. The ideas of Fleck and Kuhn have become particularly productive when they have been combined with empirical and historical studies on human categorization and learning. For example, starting from Fleck's ideas, Mary Douglas (1987; 1996) described the ways in which human thinking, individual preferences and collective memories depend on social institutions. The role of social and institutional power structures in shaping categorization was a central theme to Michel Foucault (1970) and his followers. George Lakoff (1987), in turn, emphasized the cultural and linguistic aspects in the way realities are constructed, whereas Karin Knorr Cetina (1999) focused on practical epistemic settings in scientific laboratories. The earlier theoretical work of Mikhail Bakhtin (cf. Morson & Emerson, 1990) on linguistic genres and the communal foundations of meaning has also become increasingly visible in information sciences in the recent years. These lines of thought appear in several recent studies on information systems, including Nardi (1997), and Bowker and Star's (1999) study on the consequences of classification for the society and for information infrastructures. All these authors have essentially argued that knowledge is a communicative process that occurs within communities or cultures, where social forces shape the structures of knowledge.

Bowker and Star were also influenced by actor-network theory (cf. Law & Hassard, 1999). The highlights of the actor-network theory include the idea that human activity is performed in material contexts where material objects gain meaning and become integrated in networks of communication and knowledge. Actor-network theory, thus, moves beyond traditional semiotics that focuses on linguistic meanings, and links to studies on technical and cultural artifacts. In particular, actor-network theory dilutes the boundaries between human and nonhuman actors. Human relations and power structures, for example, can potentially be translated into material structures and technical functioning. In Bruno Latour's (1993; 1999) terminology, a speed-bump, for example, can be described as a "sleeping policeman." This is because the nonhuman actor —speed-bump— plays roughly the same social role as the human actor, a

policeman in controlling the speed of cars. In a similar fashion, complex social resources and institutions, such as "the British government" can become represented through public servants, paper forms, or computer systems (cf. Law, 1992; Tuomi, 2001). Latour also proposed a tactic for discovering the complementary meaning of social structures and material structures:

> *"This explicit principle is: look for nonhumans when the emergence of a social feature is inexplicable; look to the state of social relations when a new and inexplicable type of object enters the collective." (Latour, 1999:209)*

In the last two decades, Peter Berger's and Thomas Luckmann's The Social Construction of Reality has also been a seminal contribution to social theory. Berger and Luckmann argued that the traditional focus on "history of ideas" in the sociology of knowledge was misplaced. Systematic knowledge, be it scientific, philosophical or even mythological, forms only a part of the human stocks of knowledge used in the everyday life. Social theory, therefore, should take also pre-theoretic and practical knowledge into account when it describes how societies become possible. Common-sense knowledge, according to Berger and Luckmann (1966:27) "constitutes the fabric of meanings without which no society could exist."

The idea that societies are collectively constructed through communication and made real by fixing and representing socially shared meanings through social institutions, symbols and material artifacts has become extremely popular in social and cultural studies in the last two decades. Researchers have studied the social construction of a broad set of things and ideas, such as gender, facts, identity, the child viewer of television, quarks, and statistics (Hacking, 1999). The idea that social stocks of meaning also provide the foundation for the emergence of new knowledge and innovations has also become important in social studies of technology. One point of departure in the social constructivist studies on technology was the observation that technological artifacts are open to sociological analysis, not just in the usage but also with respect to their design and technical functionality (Bijker, Hughes, & Pinch, 1987). Technical systems—for example, a computer program for managing financial accounts—can only be understood in a context where historical processes and power struggles have led to specific practices and rules of representing human and economic activity in numbers and signs. Such "subjective" and "imagined" social orders become then embedded and materialized in technical systems, making them "objective," "path dependent" and sometimes difficult to change.

Social studies on how technological worlds are constructed have also lead to a renewed interest in the role physical artifacts and space has in meaning processing. Both material artifacts and the structures of physical space constrain and enable human activity, and embed and sediment social meaning. For example, Lefebre (1991) has explored the linkages between physical and mental spaces. Castoriadis (1998) tried to elucidate how the society and its institutions are created by its members and the society itself in a socio-historical process. Pacey (1999), in turn, has studied the individual, social and political meanings of technology.

Societies are structured at many different levels. Cultural-historical activity theory allows us to describe societies as systems of specialized activity. Fleck's thought communities, in turn, emerge around specialized groups of practitioners. Actor-network theorists, in contrast describe the world as heterogeneous systems of humans and technologies. On a more abstract level, Luhmann and Castoriadis introduce the level of cultures. In the modern world, all these different levels of diversity and analysis are real and important.

The information-processing paradigm, however, has only limited capacity to describe such historically and socially grounded and structural phenomena. As Bruner noted fifteen years ago:

> *"Insofar as information in this dispensation can deal with meaning it is in the dictionary sense only: accessing stored lexical information according to coded address. There are other 'meaning-like' operations such as permuting a set of entries in order to test the resultants against a criterion, as in anagrams or Scribble. But information processing cannot deal with anything beyond well-defined and arbitrary entries that can enter into specific relationships that are strictly governed by a program of elementary operations. Such a system cannot cope with vagueness, with polysemy, with metaphoric or connotative connections…Information processing needs advance planning and precise rules. It precludes such ill-formed questions as 'How is the world organized in the mind of a Muslim fundamentalist?' or 'How does the concept of Self differ in Homeric Greece and in the postindustrial world?'" (Bruner, 1990:5)*

One can, of course, argue that information processing, electrons, and bits are the foundation for all modern communication and meaning processing systems. At the same time, one needs to remember that the information-processing paradigm brings with it not only bits but also a broad set of theoretical assumptions. These include the assumptions that the world is a closed world, that different interpretations of the world do not matter in practice, and that precise rules can be described to operate technical systems. One might then ask, however, whether the world really is closed, whether different interpretations do actually matter, and whether, indeed, we need bits for meaning processing. Perhaps bits, after all, were only artifacts created by the mathematical theory of signal compression and the era of either-or semiconductor switches?

The political economy of meaning production

One way of understanding meaning in information systems is to study information society technologies in the context of production, consumption, and exchange. Such an economic context, however, need to be extended beyond purely economic and monetary transactions. In particular, some of the fastest growing Internet applications can be found in the area of identity production, as the following sections illustrate. One may ask, for example, how we appropriate resources, things, symbols and communications in our environment to produce a meaningful life. Research on anthropology of fashion, for instance, has shown that people use clothes to make social distinctions and signal memberships in particular social groups. Fashion, in this sense, is a communication and meaning processing technology. People also customize and personalize products they buy. The economic importance of this phenomenon has led, for example, to flexible manufacturing systems that support customized mass-production and product varieties. Manufacturers have also started to design products that allow personalization and user-created modifications and, as the examples in the next section show, much of the production on the Internet now occurs outside conventional systems of production.

In this section, I briefly discuss research on the production and exchange of meaning, and provide links to research that could be used to describe distributional issues in the economy of meaning. I start with meaning embedded in material objects, consumption, and fashion, and quickly highlight some important contributions between ethical theory, communication, narrative studies, socially-grounded value systems, and political theory. This section then finishes with a short discussion on Amarya Sen's capability-based theory of economic development. Due to space limitations, I will, again, leave many unconnected threads, and provide only a rapid glimpse on the relevant research lines.

Csikszentmihalyi and Rochberg-Halton (1981) were among the first to empirically study how people use material objects in defining who they are, who they have been, and who they wish to become. They argued that people use man-made things to organize their attention and cultivate personal and social goals. Material objects, thus, become invested with psychical energy. This psychical energy is critical for the

survival of social systems, as without structured awareness social order would not be possible. Csikszentmihalyi and Rochberg-Halton, in particular, studied how people invest household objects with meaning.

McCracken (1988), in turn, described the ways in which meaning is manufactured in modern economic systems. He argued that the cultural systems of categorization provide the basis for constructing the self, and that the modern consumption economy to an important extent exists as a system that transfers cultural meaning from the world of communication to the world of things, and vice versa. Consumer goods, according to McCracken, are key locations of meaning:

> *"Clothing, transportation, food, housing exteriors and interiors, adornment, all serve as media for the expression of the cultural meaning according to which our world has been constituted." (McCracken, 1988:83)*

Simmel's (1990; 1971) classic studies on economic exchange, value and fashion also linked material goods and their social meaning. Social circulation of goods as a source of meaning, trade and taste has also been studied by social and cultural anthropologists (e.g., Appadurai, 1986). In the context of business strategy and product marketing, several authors have recently emphasized the importance of meaning as a driver of consumption and source of value (e.g., Friedman, 1986; Fournier, 1991; Richins, 1994; Helfenstein, 2005). Pine and Gilmore (1999) presented an influential variation of this theme by arguing that we should forget the idea that information is the foundation of the New Economy. Instead we should focus on informationalized services and experiences. They further argued that mass customization transforms goods into services and services into experiences. The future growth area in the economy was, according to Pine and Gilmore, in creating meaningful experiences. Thus, they recommended that business strategists consider themselves as "dramaturges" who stage narratives and transform commodities into valuable experiences.

If specific ways of perceiving the world depend on historically accumulated stocks of meaning and on diversified systems of social practice and activity, it is natural to assume that different views of the world also imply different systems of value. When we analyze "value systems" as systems that provide the basic distinctions that make meaning and value judgments possible, different communities can be expected to have different and perhaps incompatible ways of valuing things. Values, therefore, are not just individual preferences. Instead, they are culturally learned, as complex interdependent systems of meaning. More fundamentally, the systems that enable basic distinctions also guide the ways in which the reality is perceived and interpreted. This creates a model of a society in which a plurality of value systems co-exists and where communities with different value systems negotiate their interests. As a result, questions about political decision-making, social distribution, and theory of justice become linked with questions about knowledge and social meaning processing.

Hannah Arendt put the implications of this pluralistic model into the context of the historical development of the modern economy. Arendt also highlighted the point that humans become "real" through action. As biological beings they can stay silent and disengaged from action, but they reveal their identity and who they are only when they engage in action. As the consequences of action are fundamentally unpredictable in a social world where the effects of action propagate in the web of social interactions, all action is risky for the actor. Thus every free human action becomes a statement and a claim for the need for intervention. Human acts, therefore, also create an ongoing narrative of "who" the actor is. Although pure instrumental action is also possible, the specifically human way of being is to participate in the web of social interaction:

> *"The disclosure of the 'who' through speech, and the setting of a new beginning through action, always fall into an already existing web where their immediate consequences can be felt. Together they start a new process which*

eventually emerges as the unique life story of the newcomer, affecting uniquely the life stories of all those with whom he comes into contact. It is because of this already existing web of human relationships, with its innumerable, conflicting wills and intentions, that action almost never achieves its purpose; but it is also because of this medium, in which action alone is real, that it 'produces' stories with or without intention as naturally as fabrication produces tangible things. These stories may then be recorded in documents and monuments, they may be visible in use objects or art works, they may be told and retold and worked into all kinds of material." (Arendt, 1998:184)

This importance of interwoven narratives as the basis for making sense of the world and in making distinctions in it was a key theme also in Alasdair MacIntyre's (1981) analysis of the development of ethical theories and the concept of modern identity. MacIntyre noted that value systems are rooted in communities of practice. He argued that man is, "in his actions and practice, as well as in his fictions, essentially a story-telling animal."

"Deprive children of stories and you leave them unscripted, anxious stutterers in their actions as in their words. Hence there is no way to give us an understanding of any society, including our own, except through the stock of stories which constitute its initial dramatic resources." (MacIntyre, 1981:216)

To understand the meaning of a thing or an action, we have to know where it came from, and where it is going. Meaning, thus, cannot be represented in a dictionary definition. It emerges only as a part of a story.

The pluralistic model of society underlies also Charles Taylor's (e.g., 1989) studies on the historical roots of modern ideas about identity, ethics and the self. Taylor, in particular, has emphasized the point that although different communities in the society have different value systems and ways of interpreting the world, this does not imply that we should give up the idea that we can make rational choices in ethical problems. In given practical contexts, values can be compared, even when there are no absolute and universal values.

In his communicative "discourse ethics," Jürgen Habermas (1993) attempted to define the universal principles according to which incompatible worldviews can be "reasonably" negotiated. John Rawls (1999) has further tried to outline a theoretical system of justice that would be perceived as a legitimate basis for regulating relations between societies and states where people do not share the same moral, philosophical, religious assumptions. Rawls' earlier theory of justice has had a broad influence in the discussion on political theory and democracy. In this more recent "The Law of Peoples," he, in effect, sketches a philosophically grounded constitution for a multicultural global world.

These contributions highlight the point that human action is fundamentally communicative and social. Information society technologies, therefore, enter the core processes of social life. As different communities perceive their worlds using different stocks of accumulated narratives and meanings that emerge from their specific social practices, the modern world is a pluralistic world of communications. People do not live in a global village, where shared values would provide the foundation for making distinctions and producing well-aligned interpretations of the reality. Instead, the global world is a loosely coupled federation of overlaid, overlapping and also incompatible interpretative communities.

Russell's dream of finding a unique and objective reality that would make politics redundant was, therefore, at its core a totalitarian dream. Contrary to what Russell expected it would not lead to "a world less painful, less unjust, less full of strife."[163] Instead, as Arendt argued, humans

163 See footnote 160.

become humans when they face the dilemma of being individual actors in a community, without which they or "free acts" could not exist. This makes humanity, society and culture essentially "political" phenomena. Individuals create meaningful lives and identities by living in a fundamental tension between being creative, innovative and original actors and at the same time being members of society. In the Arendtian terms, people become humans when they organize themselves in the polis. In the modern world, the agora, of course, is implemented using information and communication technologies. In this sense, information society technologies are more than just tools for making democracy possible or effective; instead, they are the platform which makes politics possible in the first place.

Information and communication technologies radically change the visibilities of communities in the society at large, and also increase their interdependencies in the global space of communications. The political challenge, therefore, is not only to negotiate interests; instead, it is also to translate the various discourses in the society so that interests can be processed by the society. Furthermore, if the social order is to be perceived legitimate by the members of the society it has to be legitimized in ways that are independent of specific cultural practices. Thus, the theoretical questions about meaning processing inherently link with questions of political models and ethics.

This political and ethical dimension remains outside the traditional information-processing paradigm, as the epistemological starting point of this paradigm was that information can be processed without knowing the cultural or historical context, or the factors that create specific ways of understanding the world and making distinctions in it. From the point of information society foresight, the implication is that "politics" in the future does not only mean lobbying existing interests as they relate to technical architectures and standards, for example. Instead, information society technologies are deeply political themselves. The society exists as ongoing communication and meaning processing, and politics, in the Arendtian sense, is about rules of participation in this public sphere. Information society technologies are not just used to implement politics; instead, information society technologies are the infrastructure of politics. Decisions about technical architectures, therefore, are fundamentally political, and require sophisticate understanding about the political models that different technical architectures make possible and impossible. Although this political dimension remained relatively invisible in the early phases of the computer revolution, it is becoming now clearly visible as computers are networked and people start to use them in their everyday life.

An economic model of development that fits this pluralistic world has been elaborated by Amartya Sen (1992; 2000). Sen argued that the expansion of human capabilities and freedoms should be understood as the basis of development. The relevant freedoms, however, depend on cultural and individual factors. Sen therefore positioned the theory of economic development into a context of theory of justice and democracy. Sen's capability-based model has had broad influence and it underlies, for example, the Human Development Index published by the UNDP. The capability-based model can be linked in a relatively straightforward way to questions about the capabilities of new technologies to expand human possibilities for meaningful action. The capability-based model, therefore, could also provide the missing link between economic theory, political theory, ethics and the theory of social diversification. It could also be used as a basis for evaluating new technologies. In other words, using the capability-based model, we could better answer the core policy question why and when some technical advances can be associated with social and economic development.

Meaning processing in the Internet: Some example applications

Semantic Web

A well-known attempt to add semantics to the web is the W3C activity on Semantic Web (http://www.w3.org/2001/sw/). The W3C Semantic Web represents "the meaning" of concepts by links to metadata and associated thesaurus definitions. The basic motivation for the semantic web is to add descriptive metadata to web content so that it can be automatically processed. The W3C initiative tries to move from "words" to "concepts," with the assumption that the metadata descriptions add the level of semantics to the net.

There is considerable effort underlying this "next-generation web" project. With some exceptions, the various initiatives still implicitly rely on the traditional information-processing paradigm. For example, in the Scientific American article that popularized the W3C Semantic Web activity, Berners-Lee, Hendler and Lassila explain the goal of the activity in the following terms:

> *"The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation." (Berners-Lee, Hendler, & Lassila, 2001)*

This description, of course, is problematic in constructivist epistemologies, which start from the observation that meaning cannot be well-defined. From a constructivist point of view, the idea that well-defined meanings would enable computers and people to work together looks similar to Laplace's claim that by knowing the positions of all the particles in the universe we can determine all its futures. As was pointed out above, even if that would be the case, the futures so discovered would be of little interest of humans. To put it simply, as the original conceptualization of the Laplace's problem essentially leaves meaning out of the picture, it would have great difficulties in determining whether a specific location in the universe consists of a chicken or a bowl of chicken soup.

Similarly, from the meaning-processing perspective, the description of the goals of the Semantic Web simply leaves out those aspects of the problem that relate to meaning. The description is particularly confusing, as the concept of "meaning" is used instead of the technical term "semantics," and because even the latter term would only make sense in the context of computer science. This specific technical sense of the word "semantics" actually has very little to do with semantics, as it is understood outside computer science. Also the idea that people would somehow require well-defined meanings before they can cooperate, or course, represents a simplified picture of social and cooperative behavior.[164] One could therefore argue that the Semantic Web activity promises to solve the problem of meaning by first getting rid of it.

More accurately, the W3C Semantic Web activity can be described as a set of projects that aim at making web content more accessible using machine-readable meta-data. Specifically, it defines standards for representing particular application domains using the Resource Definition Framework (RDF) and the ontology definition language OWL. The challenges for adding "semantics" to the Web have generated a large number of proposals how, actually, this should and could be done. For example, some authors (e.g. Bouquet, Giunchiglia, et al., 2004) have argued that domain-specific ontologies need to be combined with user-specific contexts. Epistemologically, this approach implements Mead's "objective relativism," discussed above. Other approaches are closer to the meaning-processing paradigm. For example, the bottom-up computer supported peer-to-peer negotiation of user-specific ontologies proposed by Aberer,

164 In fact, ambiguity and equivocal concepts have been argued to be highly important for innovation, learning, and social change (e.g., Schon, 1963; Weick, 1995; Bougon, 1992; Tuomi, 2002).

Cudré-Mauroux and Hauswirth (2004), generates translations between different user ontologies by a mechanism that resembles the spreading of rumors.

The problems associated with using knowledge and ontology representation systems have been widely discussed during the last two decades in the artificial intelligence literature (e.g., Pylyshyn, 1987). One major problem is the fact that context and history makes a difference in getting the meaning right (Suchman, 1987). Indeed, the discussion above on the epistemological basis of meaning processing actually implies that the basic assumptions of the W3C semantic web project has fundamental weaknesses. The project is mentioned here because the visibility of the W3C may give the impression that the problem of semantics actually has been addressed by the consortium.

The Semantic Web project will perhaps succeed in adding some semantic processing in controlled micro-worlds, in a similar way as the traditional artificial intelligence applications did. The epistemological problems of the semantic web project will, however, become visible when micro-worlds need to be combined, when the conceptual system evolves, or when the same content is used in alternative interpretative and practical contexts. The W3C goal of creating ontologies that, for example, enable automated processing of purchase data and supply-chain management, of course, is a relatively simple problem of micro-world semantics.[165] It is, therefore, important to note that, although the W3C initiative talks about "semantics" as the major missing element of the present World-Wide Web, its approach is still deeply grounded in the information processing-paradigm of computing.

Yet, the World-Wide Web has been extremely successful. To a large extent this was because it allowed computers to be used for meaning processing. This was possible as the World-Wide Web basically provided a repository for human language, images and sound, without any assumptions about how meaning should be represented. The web, thus, remained perfectly agnostic about the meaning of the content and activities it was used for, enabling an efficient distribution of labour between human cognitive capabilities and technology. This is one of the main factors explaining the extremely fast propagation and proliferation of web applications.

In the next sections, some example applications are briefly described, where the social and cultural aspects of meaning are explicit. From an engineering point of view, they may look trivial. From a socio-economic point of view, they represent some of the fastest growing uses of the net.

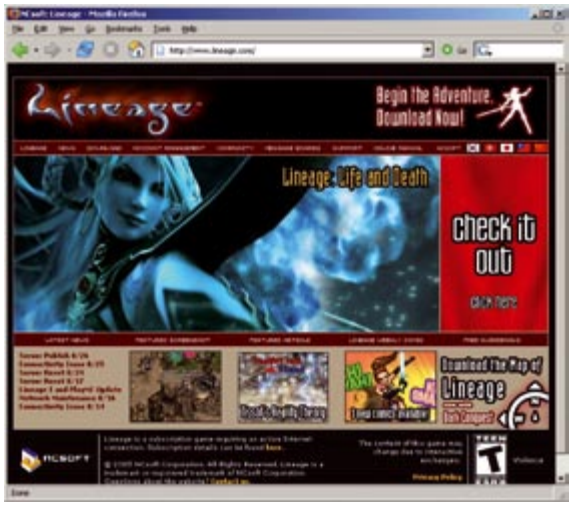
MMOGs and virtual worlds

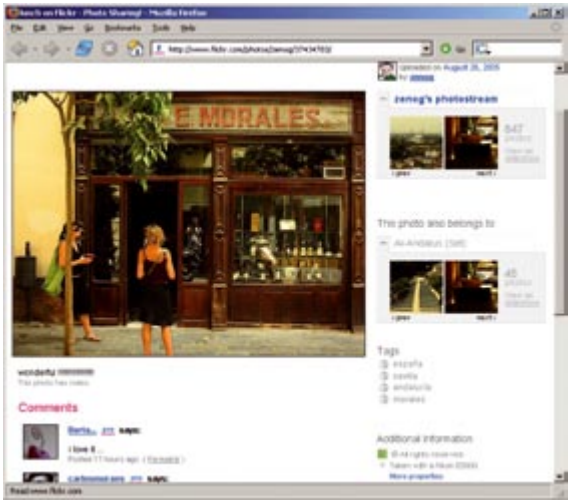
Massively multiplayer online games (MMOGs) are interesting examples of the way people now use the Internet to construct identities, communities, and stories. Whereas they are often perceived simply as "entertainment," modern multiplayer games are large and continuous expanding universes, where also users participate in the construction of the game.

Currently, NCsoft, headquartered in Seoul, South Korea, is the world's largest independent online game company. Established in 1997 as a systems integration company, NCsoft became the leading online game software company with its Lineage game (http://www.lineage.com), introduced in 1998. Lineage was one of the key drivers of broadband diffusion in Korea. Currently there are more than four million active subscribers worldwide playing Lineage.

A somewhat different approach is adopted in the EVE Online (http://www.eve-online.com). It is set in an unknown part of the universe, and includes several thousands of solar systems,

165 Indeed there exist many successful initiatives in creating semantic structures for business transactions and information exchange in controlled micro-worlds. The World-Wide Web itself was based on the SGML standard, a main early application of which was in the U.S. Department of Defense's Computer-aided Acquisition and Logistic Support (CALS) initiative.





many of which are settled by the players. The players can inhabit worlds, create organizations and alliances, accumulate wealth and build economies, much as they would operate in a simulated real world. The system provides a persistent and continuously evolving world that runs on servers in London. In August 21, the system recorded 13.993 simultaneous players. In August, a team of players also successfully constructed the first user-created outpost in the system, including a strip club, where they offered cold drinks and hamburgers to celebrate the event.

Neopets (http://www.neopets.com), in turn, is a community of over 70 million virtual pet owners across the world who feed and play with their pets and adventure around Neopia with them. The system has a free membership and it includes over 160 games, trading, auctions, greetings, and messaging.

Habbo Hotel (http://www.sulake.com) is a virtual "hang-out" where people can walk, dance, eat, drink and chat in cafes, restaurants, swimming pools and games rooms. The users can also decorate rooms, chat with other users, host parties, etc. In July 2005, the system had over 4 million users. The participants can use credit cards and SMS to buy "habbo coins" that they can then use to buy decorations for their rooms, gifts to their friends, and to play games. The participants, represented as user-tailored "habbo characters" (avatars), therefore, construct personalized virtual spaces for themselves and structure their interactions around the virtual architecture of the five-star Habbo Hotel.

Flickr

Flickr (http://www.flickr.com) has been called "massively multiplayer online photo sharing" and a media for "visual conversations." It allows people to post their photographs on the web using Internet-connected PCs and mobile devices. The photographs can be tagged and commented by the people to whom the poster gives access rights. Often access rights are given to anyone using the Internet. People can also embed pop-up comments directly on the images, highlighting specific details, providing information on the image content and, for example, telling their personal stories associated with the picture.

Flickr, therefore, creates an image-sharing platform where members of a social network can access images, collaborate in organizing and categorizing them, and tell stories about them. It also allows photographs to be made visible to everyone connected to the net, thus providing visibility to people who publish their images. The images stored in Flickr can also be used in personal blogs. They are also used in location-based applications that link pictures with addresses and GPS points. In the beginning of year 2005, about 80 percent of the over 5 million images stored in the system were accessible to

all web users. Professional photographers who use the open Creative Commons licensing also distribute photographs using the system. Flickr has now over 1 million members, and over 4000 images are uploaded to the service each second. Flickr, which is still in beta, was recently acquired by Yahoo!

Social software and journals

Today, several free blog services combine digital representation of their users with social networking and aggregation of diary and discussion entries. For example, LiveJournal (http://www.livejournal.com), an early blogging system, based on open source software and launched in 1999, allows registered users to keep diaries, post photographs and join public and restricted groups. Users can also read aggregated journals of their friends and the people belonging to specific groups. LiveJournal has now some 2.5 million active users, and about 250.000 users updating their pages during the last 24 hours. The number of blogs registered in the Technorati service doubles now every 5.5 months and the system registered about one new blog every second.[166] In mid-November 2005, the total number of blogs was estimated to be over 100 million, and Technorati tracked 21.3 million blogs.

Some newer social software systems are rapidly gaining popularity. For example, MySpace (http://www.myspace.com) has now some 27 million members. The system allows the members to maintain profiles and links to the profiles of friends, join forums and participate in groups, rate and listen music, keep blogs, and contact people with email or instant messaging. The users can also send text messages through the system, as well as "bulletins" to all friends to inform them about what is happening in your life or, for example, invite them to a party. The system is free to use, and uses banner advertisement for funding. There are now, for example, about 9.600 music-related groups, ranging from High School Goths and electric bass players to Linkin Park, the last one with some 40.000 members. Users can also sign up as artists and post up to four MP3 songs of their music free. At present, artists can also upload videos for editorial review. The best videos are featured in the system.

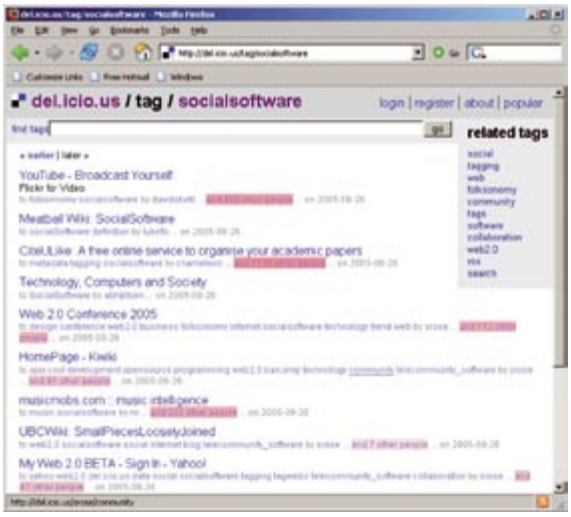
Yahoo 360° (http://360.yahoo.com), now in beta, has similar functionality. It also allows you to publish a "radio station," which your friends can listen to. Yahoo 360° also links to the user's mailbox and Flickr, allowing the users to manage large annotated picture collections and slide shows.

Del.icio.us

del.icio.us (http://del.icio.us) is a social bookmarks manager. It is a free service that allows the users to add web pages to their personal collection of links, to categorize those sites with keywords, and to share collections among browsers, machines, and with other users.

The users add a simple bookmarklet to their browsers. When they find an interesting web page they simply select the del.icio.us bookmarklet, and the application asks for information about the page. The user can add descriptive terms to group similar links together and add notes. The list of links can be accessed from any web browser. The users can view their links by date, or by specific keywords, which are dynamically defined, as needed. Del.icio.us has become widely popular as it also allows the other users to see the links that others have collected, as well as show who else has bookmarked a specific site. People can also view the links collected by others, and subscribe to the links of people whose lists they find interesting. Del.icio.us shows how many people have bookmarked a specific page on the web, and allows people to search and browse bookmarks based on categories that the users themselves have defined. The system shows also

166 http://www.technorati.com/weblog/2005/08/34.html



a dynamic list of most popular tags and, when the user browses a specific tag, related tags, a list of which is automatically generated by analyzing the associations between tags. In practice, by using del.icio.us, the dynamic tags and their relationships self-organize and categorize the content on the web. The system, for example, gives a good indication of emerging new hot topics on the web.

Plazes

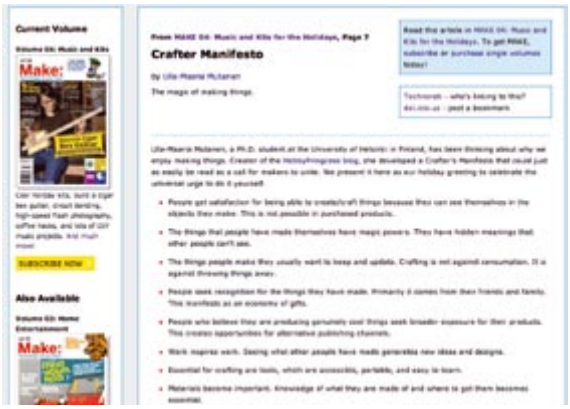
Plazes (http://www.plazes.com) is a grassroot approach to location-aware interaction. It aims at global collaborative effort to annotate physical locations, so that they can be linked to web content and used to link the "virtual" world with the physical world. The system creates a location "fingerprint" using the signature of the router that is linked to a specific local Internet access point. The user can then register this fingerprint as a specific "plaze." The users can then add notes to the plaze. A plaze contains information about the actual location like pictures from Flickr, comments and mapping information, as well as the people currently online at that plaze. Plazes also allows you to share your location with the people you know and to discover people and services around you. For example, the user can link herself and her blog entries with specific physical locations. Similarly, the users can add physical location to their instant messages. Users can also track their friends in physical space. The service is free and in beta.

At present, the system has over 8000 registered plazes in 91 countries. These include universities, private and public WiFi access points, hotels, airports, homes of people, market squares, museums, etc. The places can also be combined with satellite images and maps that are accessed through the open Google Maps interface. Users can smoothly zoom in from a global satellite image to a close up of the location, show it on a map, and see information about people and comments associated with the place, as well as look for other nearby places.

Annotation of objects and the Crafter's Manifesto

New services, for example Microsoft's Aura,[167] enable people to annotate physical objects with information on the web. Objects such as clothes, accessories, furniture, and computers can be linked to specific Internet-addresses that are associated with the object. For example, hobbyprincess.com has used RFID tags to annotate objects and places.[168] The tags can be read and written by RFID-enabled mobile

167 http://aura.research.microsoft.com/
168 http://ullamaaria.typepad.com/hobbyprincess



phones, which then link the user to the desired address on the web. Using this approach, objects such as hand-made fashion items can "tell their story" and become "extended objects." In this way, they can also become part of the emerging recommendation-based online markets.

Ulla-Maaria Mutanen, the author of hobbyprincess.com, argues that there is currently a very large latent market of locally produced, non-mass manufactured products.[169] This includes most of art, design, and craft. Also, an increasing number of people are interested in creating fashion, music, movies, and text products, modifying the products they buy, and sharing or trading their creations online, for example, using eBay or etsy.[170] The realization of the economic potential of this activity, however, will require the development of information systems that can use unique identification and metadata of products (e.g. musicbrainz.com).

Voice over IP

One obvious, theoretically interesting and yet rarely noticed meaning-processing application on the Internet is voice telephony. The underlying technology application simply moves bits so that people can talk to each other. The application does not interpret the processed meaning in any way. As the speakers typically generate all the content in real-time, the Internet can simply provide a "pipe" for moving bits. Economically, VoIP is also interesting as the users create the content. This "free content" has also been the basis for the development of the traditional telephony networks. Skype, the leading VoIP provider, has accumulated some 51 million registered users since its launch and on average about 3 million users log on it at any given time. PC-to-PC telephony is typically available free, and connections to and from traditional telephony networks at low cost. OECD now estimates that the revenues from VoIP double in the next two years, to 6.5 billion euros. An important reason for this rapid growth is the fact that most of content does not generate revenues or require agreements on intellectual property rights. Spoken language on traditional telephony networks has been one of the socially and economically most important applications of information technology, and it will most probably remain so also in the foreseeable future. VoIP, however, will also highlight major social and cultural issues, such as questions related to the ownership and reuse of traditionally non-persistent speech.

Policy implications

A new paradigm implies a different view of the world. It requires reframing the problems we are tackling, new priorities, and new strategies and tactics for problem solving. It also leads to new technical architectures that implement solutions to the perceived new challenges and opportunities.

It is impossible to fully draw out the implications of the emerging new paradigm in the present report. In some areas the practical impact may be low. It does not really matter whether the sun rotates the earth or the earth rotates the

169 www.makezine.com/04/manifesto/

170 www.etsy.com/. Etsy is an online marketplace for buying and selling all things handmade. It supports searches by color, place, time and material.

sun when we enjoy the sunset. It does matter, however, when we study greenhouse warming or launch satellites. The conventional information-processing paradigm already has adapted itself to some practical demands that fundamentally have their origins in the challenge of deploying computer systems in meaningful cultural and social settings. For example, telephony services are already implemented using current computer and Internet architectures. To understand how such applications will evolve and could be improved, we, however, need new concepts.

For research policy, the new paradigm points to the importance of linking cultural and social dimensions to information technology development. Information technologies often implement social, cultural and cognitive models that are based on common-sense theories. These theories are not universal and in the global information society they need to be made explicit.

For example, social stocks of knowledge are typically organized around social practices and communities that reproduce those practices. Different communities use different models to perceive the world, they make different distinctions, and they prioritize and value things differently. They have value systems that are tightly linked with the demands of the practice in question, as well as to historically routinized and socially institutionalized interactions between the community and its social environment. In the modern world, people belong to many different communities and these communities often extend beyond organizational and national boundaries. This diversified social structure underlies meaning-making processes in the society, and it provides the foundation for economic exchanges, political interaction and, for example, the construction of identities. Technological architectures that can support communication and interaction within and across such social structures will be important in the extremely diversified global world. "Technologies of translation" that specifically address interoperability at a cultural and social level are becoming important. The traditional question of technical interoperability need to be perceived as a special case of a much broader question related to socio-technical interoperability. Standardization, for example, is not a technical question, or a question of lobbying economic interests. It is a deeply cultural issue that requires explicit models of social change and distribution of power and risk.

Robust implementations of information society technologies in such diversified socio-cultural environments also need to be socially and culturally acceptable. This means that the underlying political models need to be made explicit. Current technical architectures hardwire social processes and beliefs in ways that are sometimes culturally simplistic. Overly simplistic architectures make innovation and change difficult, and limit the potential of global diffusion of new technologies and applications.

The social, cultural and historical emphasis of the meaning-processing paradigm also points to the fact that the present conceptualization of intellectual property is not well-aligned with the new paradigm. Meaning processing is inherently a social and communicative process, where individuals participate by incremental contributions. The locus and origin of innovation cannot easily be located in such socially distributed processes. The ownership rights to user-constructed spaces, such as those found in MySpace and Habbo Hotel, will also be a theoretically demanding area of research. Fundamentally, the current intellectual property right regimes assume a world of scarce resources, whereas the economy of meaning is continuously expanding. To support economic growth and socio-economic development, intellectual property rights need to be redesigned.

In very concrete terms, one implication of the new paradigm is that a criterion in evaluating technical research proposals could be that the proposal shows awareness of the cultural and social dimensions of technology development. If these dimensions are becoming increasingly important, policy-makers could require that attention is paid to them and they could sponsor

research that puts Europe at the leading edge of the new paradigm. When project proposals explicitly have to address the social and cultural dimension of technical designs and development roadmaps, the projects can more easily realize the opportunities of implementing project results in a global world and in the socially and culturally diversified Europe. Such a competence of integrating social and cultural dimensions to technology development could eventually become a core competence in the European Research Area.

At a more fundamental level, the emerging paradigm requires that we reconsider some current justifications for developing information society technologies. For example, at the present there are no conceptually robust approaches in measuring the socio-economic impact of information technology applications. Although it is clear that ICTs have a fundamental impact on society and economy, for example, the current national statistics or measures of economic productivity do not capture these impacts well. As a part of the new meaning-processing paradigm we, therefore, also need a new productivity paradigm (cf. Tuomi, 2004).

Europe exists on a unique foundation of social diversity, where a rich mosaic of languages, thought styles and historically rooted cultures provide a model of the emerging globally connected world. This social diversity reflects a historical process that has generated diversified systems of meaning. Information and communication technologies are now reorganizing these systems of meaning, and making theoretical and practical understanding of meaning processing increasingly important for policymakers, product developers, and researchers in the European Research Area. Europe can build its future by turning this historical inheritance into a competitive advantage. It can do this by explicitly integrating social, cultural and cognitive dimensions into information and communication technology development and research, at the same time moving these technologies into their next evolutionary generation. Through such integration, it can also better develop technologies that lead to true socio-economic development. This, however, requires that we reconsider some of the very basic epistemological and conceptual starting points of the information-processing paradigm, and enrich the research on information society technologies with new sources of theoretical ideas and knowledge.

References

- Aberer, K.; Cudré-Mauroux, P.; & Hauswirth, M. (2004). Start making sense: the Chatty Web approach for global semantic agreements. *Journal of Web Semantics,* 1 *(1)* http://www.websemanticsjournal.org
- Antliff, M. (1993). *Inventing Bergson: Cultural Politics and the Parisian Avant-Garde*. Princeton, NJ: Princeton University Press.
- Appadurai, A. (1986). Introduction: commodities and the politics of value. In Appadurai, A. (Ed.), *The Social Life of Things: Commodities in Cultural Perspective*. (pp. 3-63). Cambridge: Cambridge University Press.
- Arendt, H. (1998). *The Human Condition*. Chicago, Il.: The University of Chicago Press.
- Berger, P.L., & Luckmann, T. (1966). *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. New York: Penguin Books.
- Bergson, H. (1983). *Creative Evolution (first edition 1907)*. Lanham, MD: University Press of America.
- Bergson, H. (1988). *Matter and Memory (first edition 1896)*. New York: Zone Books.
- Berners-Lee, T.; Hendler, J.; & Lassila, O. (2001). The Semantic Web. *Scientific American, (May 17)*
- Bijker, W.E.; Hughes T.P.; & Pinch, T. (1987). *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: The MIT Press.
- Bleicher, J. (1980). *Contemporary Hermeneutics*. London: Routledge & Kegan Paul.
- Bougon, M.G. (1992). Congregate cognitive maps: a unified dynamic theory of organization and strategy. *Journal of Management Studies,* 29, pp.369-89.
- Bouquet, P.; Giunchiglia, F.; van Harmelen, F.; Serafini, L.; & Stuckenschmidt, H. (2004). Contextualizing ontologies. *Journal of Web Semantics,* 1 *(4)* http://www.websemanticsjournal.org/
- Bowker, G.C.; & Star, S.L. (1999). *Sorting Things Out: Classification and its Consequences*. Cambridge, MA: The MIT Press.
- Brown, J.S., & Duguid, P. (1991). Organizational learning and communities of practice: toward a unified view of working, learning, and innovation. *Organization Science* 2, pp.40-57.
- Brown, J.S.; & Duguid, P. (2000). *The Social Life of Information*. Boston, MA: Harvard Business School Press.
- Bruner, J. (1986). *Actual Minds, Possible Worlds*. Cambridge, MA: Harvard University Press.
- Bruner, J. (1990). *Acts of Meaning*. Cambridge, MA: Harvard University Press.
- Carter, R.E. (1997). *The Nothingness Beyond God: An Introduction to the Philosophy of Nishida Kitaro*. St. Paul, MN: Paragon House.
- Castoriadis, C. (1998). *The Imaginary Institution of Society*. Cambridge, MA: The MIT Press.
- Cole, M. (1986). *Culture in Mind*. Cambridge, MA: Harvard University Press.
- Csikszentmihalyi, M.; & Rochberg-Halton, E. (1981). *The Meaning of Things: Domestic Symbols and the Self*. Cambridge: Cambridge University Press.
- Douglas, M. (1987). *How Institutions Think*. London: Routledge & Kegan Paul.
- Douglas, M. (1996). *Thought Styles: Critical Essays on Good Taste*. London: SAGE Publications.
- Egelhoff, W.G. (1988). *Organizing the Multinational Enterprise: An Information-Processing Perspective*. Cambridge, MA: Ballinger.
- Engelbart, D.C. (1963). A conceptual framework for the augmentation of man's intellect. In Howerton & Weeks (Eds.), *Vistas in Information Handling*. (pp. 1-29). Washington D.C.: Spartan Books.
- Fleck, L. (1979). *Genesis and Development of a Scientific Fact*. Chicago, IL: The University of Chicago Press.

- Foucault, M. (1970). *The Order of Things: An Archaeology of the Human Sciences*. London: Tavistock Publishers.
- Fournier, S. (1991). Meaning-based framework for the study of consumer-object relations. *Advances in Consumer Research,* 18, pp.736-42.
- Friedman, R. (1986). Psychological meaning of products: identification and marketing applications. *Psychology & Marketing,* 3, pp.1-15.
- Habermas, J. (1993). *Moral Consciousness and Communicative Action*. Cambridge, MA: The MIT Press.
- Hacking, I. (1999). *Social Construction of What?* Cambridge, MA: Harvard University Press.
- Heidegger, M. (1968). *What is Called Thinking?* New York: Harper & Row, Publishers.
- Heidegger, M. (1977). The Question Concerning Technology. In D.F. Krell (Ed.), *Basic Writings*. (pp. 283-317). New York: Harper & Row, Publishers.
- Heinämaa, S.; & Tuomi, I. (1989). *Ajatuksia synnyttävät koneet: tekoälyn unia ja painajaisia (Thought Provoking Machines: Dreams and Nightmares of Artificial Intelligence; in Finnish)*. Porvoo: Werner Söderström Osakeyhtiö.
- Helfenstein, S. (2005). Product meaning, affective use evaluation, and transfer: a preliminary study. *Human Technology,* 1 *(1),* pp.75-100. http://www.humantechnology.jyu.fi
- Husserl, E. (1982). *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy, First Book (first edition 1913)*. The Hague: Martinus Nijhoff Publishers.
- Hutchins, E. (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press.
- James, W. (1977). Pragmatism's conception of truth. In J.J. McDermott (Ed.), *The Writings of William James: A Comprehensive Edition*. (pp. 429-443). Chicago: The University of Chicago Press.
- Johnson, J.; Roberts, T.L.; Verplank, W.; Smith, D.C.; Irby, C.H.; Beard, M.; & Mackey, K. (1989). The Xerox Star: a retrospective. *IEEE Computer,* 22 *(9),* pp.11-29.
- Knight, K.; & McDaniel, R.R. (1979). *Organizations: An Information Systems Perspective*. Belmont, CA: Wadsworth Publishing.
- Knorr Cetina, K. (1999). *Epistemic Cultures: How the Sciences Make Knowledge*. Cambridge, MA: Harvard University Press.
- Kohonen, T. (1980). *Content-Addressable Memories*. New York: Springer-Verlag.
- Kohonen, T. (1984). *Self-Organization and Associative Memory*. New York: Springer Verlag.
- Kozulin, A. (1990). *Vygotsky's Psychology: A Biography of Ideas*. Cambridge, MA: Harvard University Press.
- Lakoff, G. (1987). *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind*. Chicago: University of Chicago Press.
- Latour, B. (1993). *We Have Never Been Modern*. Cambridge, MA: Harvard University Press.
- Latour, B. (1999). *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard University Press.
- Lave, J.; & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.
- Law, J. (1992). Note on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity. *Systems Practice,* 5 *(4),* pp.379-93.
- Law, J.; & Hassard, J. (1999). *Actor Network Theory and After*. Oxford: Blackwell Publishers.
- Lefebre, H. (1991). *The Production of Space*. Oxford: Blackwell Publishers Ltd.
- Leont'ev, A.N. (1978). *Activity, Consciousness, and Personality*. Englewood Cliffs, NJ: Prentice-Hall.

- Licklider, J.C.R. (1960). Man-Computer Symbiosis. *IRE Transactions on Human Factors in Electronics,* HFE-1 , pp.4-11. Reprinted: In Memoriam: J.C.R. Licklider (1915-1990), Digital Systems Research Center, August 7, 1990. ftp://ftp.digital.com/pub/DEC/SRC/research-reports/
- Licklider, J.C.R.; & Taylor, R.W. (1968). The computer as a communication device. *Science and Technology, (April)* Reprinted: In Memoriam: J.C.R. Licklider (1915-1990), Digital Systems Research Center, August 7, 1990. ftp://ftp.digital.com/pub/DEC/SRC/research-reports/
- Luhmann, N. (1990). *Essays on Self-Reference*. New York: Columbia University Press.
- Luhmann, N. (1992). *Ecological Communication*. Cambridge: Polity Press.
- Luhmann, N. (1995). *Social Systems*. Stanford, CA: Stanford University Press.
- Luhmann, N. (2000). *Art as a Social System*. Stanford, CA: Stanford University Press.
- Luria, A.R.; & Vygotsky, L. (1992). *Ape, Primitive Man, and Child: Essays in the History of Behavior*. Hemel Hempstead: Harvester Wheatsheaf.
- MacIntyre, A. (1981). *After Virtue: A Study in Moral Theory*. London: Duckworth.
- March, J.G.; & Simon, H.A. (1958). *Organizations*. New York: John Wiley.
- Maturana, H.R.; & Varela, F.J. (1980). *Autopoiesis and Cognition: The Realization of the Living*. London: Reidl.
- Maturana, H.R.; & Varela, F.J. (1988). *The Tree of Knowledge: The Biological Roots of Human Understanding*. Boston: New Science Library.
- McCracken, G. (1988). *Culture and Consumption: New Approaches to the Symbolic Character of Consumer Goods and Activities*. Bloomington: Indiana University Press.
- Mead, G.H. (1967). *Mind, Self, & Society (first edition 1934)*. Chicago: The University of Chicago Press.
- Merleau-Ponty, M. (1962). *Phenomenology of Perception (first edition 1945)*. London: Routledge & Kegan Paul.
- Mingers, J. (1995). *Self-Producing Systems: Implications and Applications of Autopoiesis*. New York: Plenum Press.
- Morson, G.S.; & Emerson, C. (1990). *Mikhail Bakhtin: Creation of Prosaics*. Stanford, CA: Stanford University Press.
- Nardi, B.A. (1997). Activity theory and human-computer interaction. In B.A. Nardi (Ed.), *Context and Consciousness*. (pp. 7-16). Cambridge, MA: MIT Press.
- Nishida, K. (1987). *Last Writings: Nothingness and the Religious Worldview*. Honolulu: University of Hawaii Press.
- Nishitani, K. (1991). *Nishida Kitaro*. Berkeley, CA: University of California Press.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science,* 5, pp.14-37.
- Nonaka, I.; & Konno, N. (1998). The concept of "ba": building a foundation for knowledge creation. *California Management Review,* 40 *(3),* pp.40-54.
- Pacey, A. (1999). *Meaning in Technology*. Cambridge, MA: The MIT Press.
- Piaget, J. (1970). *Genetic Epistemology*. New York: Columbia University Press.
- Pine, B.J.; & Gilmore, J.H. (1999). *The Experience Economy: Work is Theatre & Every Business a Stage*. Boston, MA: Harvard Business School Press.
- Polanyi, M. (1967). *The Tacit Dimension*. New York: Anchor.
- Polanyi, M. (1998). *Personal Knowledge: Towards a Post-Critical Philosophy*. London: Routledge.
- Polanyi, M.; & Prosch, H. (1975). *Meaning*. Chicago: The University of Chicago Press.

- Popper, K.R. (1981). *Objective Knowledge: An Evolutionary Approach*. Oxford: Oxford University Press.
- Pylyshyn, Z.W. (1987). *The Robot's Dilemma: The Frame Problem in Artificial Intelligence*. Norwood, N.J.: Ablex Publishing Corporation.
- Rawls, J. (1999). *The Law of Peoples: with "The Idea of Public Reason Revisited"*. Cambridge, MA: Harvard University Press.
- Richins, M. (1994). Valuing things: the public and private meanings of possessions. *Journal of Consumer Research,* 21, pp.504-21.
- Rogoff, B. (1990). *Apprenticeship in thinking: cognitive development in social contexts*. New York: Oxford University Press.
- Russell, B. (1979). *History of Western Philosophy*. London: Unwin Paperbacks.
- Salomon, G. (1993). *Distributed Cognitions: Psychological and Educational Considerations*. Cambridge: Cambridge University Press.
- Schon, D.A. (1963). *Invention and the Evolution of Ideas*. London: Social Science Paperbacks.
- Scribner, S. (1997). *Mind and Social Practice: Selected Writings of Sylvia Scribner*. Cambridge: Cambridge University Press.
- Sen, A. (1992). *Inequality Reexamined*. Cambridge, MA: Harvard University Press.
- Sen, A. (2000). *Development as Freedom*. New York: Anchor Books.
- Shimizu, H.; & Yamaguchi, Y. (1987). Synergetic computer and holonics: information dynamics of a semantic computer. *Physica Scripta,* 36 *(6),* pp.970-985.
- Simmel, G. (1971). *On Individuality and Social Forms: Selected Writings*. Chicago: The University of Chicago Press.
- Simmel, G. (1990). *The Philosophy of Money. Second Enlarged Edition (first edition 1900)*. London: Routledge.
- Suchman, L. (1987). *Plans and Situated Actions: The Problem of Human-Machine Communication*. New York: Cambridge University Press.
- Taylor, C. (1989). *Sources of the Self: The Making of the Modern Identity*. Cambridge: Cambridge University Press.
- Tuomi, I. (1999). *Corporate Knowledge: Theory and Practice of Intelligent Organizations*. Helsinki: Metaxis.
- Tuomi, I. (2000). Data is more than knowledge: implications of the reversed knowledge hierarchy to knowledge management and organizational memory. *Journal of Management Information Systems,* 6 *(3),* pp.103-17.
- Tuomi, I. (2001). Internet, innovation, and open source: actors in the network. *First Monday,* 6 *(1)* http://firstmonday.org/issues/issue6_1/tuomi/index.html
- Tuomi, I. (2002). *Networks of Innovation: Change and Meaning in the Age of the Internet*. Oxford: Oxford University Press.
- Tuomi, I. (2004). Economic productivity in the Knowledge Society: a critical review of productivity theory and the impact of ICTs. *First Monday,* 9 *(7 (July)* http://firstmonday.org/issues/issue9_7/tuomi/index.html
- Tushman, M.L.; & Nadler, D.A. (1978). Information processing as an integrating concept in organizational design. *Academy of Management Review,* 3, pp.613-24.
- van der Veer, R.; & Valsiner, J. (1994). *Understanding Vygotsky: A Quest for Synthesis*. Cambridge, MA: Blackwell Publishers.
- Weick, K.E. (1995). *Sensemaking in Organizations*. Thousand Oaks: Sage Publications.
- Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.
- Wertsch, J.V. (1985). *Vygotsky and the Social Formation of Mind*. Cambridge, MA: Harvard University Press.
- Winograd, T.; & Flores, F. (1986). *Understanding Computers and Cognition: A New Foundation for Design*. Norwood, NJ: Ablex Publishing Corporation.

9. Conclusions

The role ICT plays in the economy is part of a wider debate on future "knowledge" economy options. In this transition phase towards the knowledge economy, analytical models to explore these options are scarce and not widely accepted, and many important concepts are still under discussion. For instance, there is a heated debate in the scientific literature on productivity. Most economists agree that traditional measures of economic growth do not capture adequately the reality of the knowledge economy. Unfortunately, no such agreement exists on an appropriate set of indicators for the measurement of knowledge economy dynamics.

Within this ongoing scientific discussion, a choice was made to highlight and explore those issues, considered decisive for the design of the knowledge society in Europe, that have received less attention from decision makers up until now. The first is the importance of knowledge for our future economy as it will shape the way we design economic and other policies – such as, for example, the thorny problem of how to achieve sustainable financing for existing national social security systems. Second, a number of existing policies will need to be adapted to boost the economy in general and the digital economy in particular. The foresight community, brought together and animated by FISTERA, could contribute to achieving these objectives. Finally, Europe's population is ageing and this poses a number of formidable challenges, where ICTs can contribute to the solutions. This requires an integrated approach for better use of technologies leading to true socio-economic development for Europe.

One of the underlying objectives of this part of the FISTERA project was to understand those policies that might drive the change from the information society to the knowledge society. To conclude, issues that came across in all contributions are discussed in the following:

The need to rethink the Intellectual Property Rights regime

Although intangible, knowledge shares the properties of other capital goods: it can be generated, accumulated and transferred. What is important from a strategic point of view is that knowledge will increasingly gain importance with respect to other capital goods. This has implications for economic, R&D and innovation policies, as well as IST strategies.

The role and the importance of knowledge for the new economy explain why innovation patterns have changed. For instance, many ICT-based innovations are the result of a social and communicative process,[171] whereby individuals often make only incremental contributions to the process. In these circumstances, traditional concepts of intellectual property (IPR) of innovation become difficult to apply. For instance, in such socially-distributed innovation processes based on many decisive, but incremental contributions, the traditional figure of an "inventor" is inappropriate, and the place of innovation – as requested in patent filings – cannot be easily defined. Intellectual property rights therefore need to be redesigned to fit new social and cultural patterns, if economic growth and socio-economic development are to be fully supported.

171 Examples include applications arising from social computing, open source software or shareware.

"Knowledge workers" demand a different social security and social stability contract

Knowledge as capital is tightly related to human talent as capital ("human capital"). The more jobs are knowledge-based, the more this will change the nature of work. "Knowledge workers" –as opposed to those dealing with physical labour- will be predominant and drive the economy. Such occupations will provide a higher level of personal satisfaction and will largely depend on the creativity of the worker. More people will be able to balance their remunerated activities with leisure to suit themselves. However, this attractive perspective will not be realised automatically. Options have frequently been discussed, but necessary changes are not yet in place to enable the emergence of new types of jobs. This will require policies which create flexible working environments and realistic life-long learning schemes.

Changes in type of work, blurring of borders between work and leisure, the ageing society and the increasing range of jobs (from hard physical labour to intellectual activities) should be taken into account when redesigning the foundations of national social security systems. Current social security systems are largely based on a traditional industrial economy model and need to be adapted to the knowledge economy. For instance, the current retirement age and pension conditions originate from the times when the majority of workers were involved in physical labour. Now this is no longer the case, new social security systems should be adapted to knowledge-based workers. To do this properly, the notion of social "security" must be separated from social "stability". In many European countries the meaning of security is understood as "tomorrow will be the same as today". In the future, and even today in the Nordic countries, "security" will mean "tomorrow will be as good as today", whether similar or completely different. Indeed, flexibility is the key to a successful information society, since physical investment is less important; even established structures will be prone to change. This view introduces the need for a degree of flexibility in the design of any upcoming social security system and also ensures that technical and societal innovation should become an intrinsic part of the European value system and policies.

Is this possible in a traditional Europe? In fact it is, as there is no unique social model in Europe, but rather a range of different models in the Members States, the most prominent of which are the Scandinavian, Anglo-Saxon and German models. Europe offers a test-bed for different approaches and the opportunity to learn from a variety of valuable experiences, in order to derive the best balance of deregulation and liberalization. This should promote productivity and efficiency, allowing European systems to eventually converge into one that is sustainable. It appears that reforming, rather than scrapping, will be the best way to prepare for and support the knowledge economy.

Policies needed to to boost the digital economy

Recognizing the fact that ICT accounts for 40% of Europe's productivity growth and for 25% of EU GDP growth,[172] the European Commission set up specific measures focusing on this industrial sector. It has also responded to the recognition of the pivotal role of knowledge and innovation in ICT in the renewed Lisbon Agenda.[173] In June 2005, the Commission adopted a five-year strategy, called 'i2010', to foster growth and jobs

172 Communication by the European Commission, "i2010 - A Euopean Information Society for Growth and Employment", COM (2005) 229, Bruxelles 1.6.2006. p. 3

173 In the revision of the Lisbon Strategy, the report from the High Level Group chaired by W. Kok makes a strong recommendation for Europe to reap the full benefits of ICT: "In order to ensure future economic growth, the EU needs a comprehensive and holistic strategy to spur on the growth of the ICT sector and the diffusion of ICT in all parts of the economy" see "Facing the Challenge - The Lisbon strategy for growth and employment" Report from the High Level Group chaired by Wim Kok, November 2004, p. 22.

in the ICT and media industries. It comprises a set of activities that modernise and deploy EU policy instruments to encourage the development of the digital economy, including regulatory instruments, research and partnerships with industry. The i2010 Initiative has three aims; to create an open and competitive single market for information society and media services within the EU, to increase EU investment in ICT research, and to promote an inclusive European information society. This last will culminate in a European initiative on e-Inclusion, which includes actions favouring citizen-centred services, increasing quality of life (e.g. technologies for an ageing society), and overcoming the geographic and social "digital divide".

As part of the second priority of the i2010 Initiative, the European Commission launched the "Vienna Process". This has two objectives: to identify where Europe should focus and coordinate its research efforts by coordinating the policies and visions of ICT research across Europe, and to coordinate national and European ICT research programmes across Europe. The foresight community can contribute to the first objective by forging a European Vision for ICT.

Capturing the next innovation wave

FISTERA's foresight experience and results can contribute to the visions of Europe's key players and help to define their strategies. FISTERA compared national ICT foresight exercises and designed new visions for the EU in several scenario building exercises. The scenarios were built on findings from "technology trajectories", which depict the possible evolution of clusters of ICT technologies and their applications. Interestingly, it was found that some ICTs will have a far more predominant role than others. These ICTs will attract other technologies and act as catalysts on their progress. Similarly, some applications will have an enormous socio-economic impact and a "disruptive" effect on the way we do business (e.g. Internet and the mobile telephone). Other disruptive applications are likely to have a positive effect on our socio-economic environment in the future. Further candidates for ICT-enabled disruptive applications are currently being identified. Although the timing and nature of disruptions are difficult to forecast, a number of basic conditions can be highlighted.

There are at least three conditions for disruptive innovation, namely performance push, customer pull and organizational competencies. In other words, for a technology to cause disruption, its performance must be superior to that of other technologies or processes, customers must care about different measures of performance, and, with regard to organizational competencies, the incumbents must take a proactive and dynamic view of innovation. To detect which disruptions are about to explode, a deep understanding of the potential market trends, the evolution of technologies and business models is required. Both the supply and demand sectors need to be monitored and scenarios which deal with emerging IS technology impacts and opportunities have to be developed. The starting point for such an investigation is to observe IST trends and business evolutions carefully and explore specific implications for policies, in particular R&D policy in IST.

Many of the innovations currently revolutionising the Internet – amongst them Web 2.0- are having impact because they respond to the consumers' desire to be more active. As Web 2.0 will provide them with content, goods, storage, server capacity and even connectivity, they will be more than simple consumers. The baseline is that users voluntarily offer valuable content, where the value may reside not so much in the individual's contribution itself as in the social process. As a result, the emphasis of the knowledge economy is shifting from a model of "consumer paying producer" to one based on a communicative process, where individuals participate as producers and consumers simultaneously, often by incremental contributions. Foresight practitioners and ICT experts have to analyse both the technological trends and the real socio-economic impact, in

order to feed decision makers with valuable information and to avoid a situation where Web 2.0 could become the "Bubble 2.0".

Adressing the fragmentation of R&D research and internationalization of ICT

The second priority of the Vienna process refers to the coordination of national and European ICT research programmes. This priority responds to the need to reduce the existing fragmentation of R&D research and to make best use of public budgets. Both public and private funding support existing centres of excellence in ICT research across Europe. New centres of ICT research are being created in Europe and around the world, particularly in Asia, which are competing against each other. The prime criterion for successful research is scientific excellence and this has a high cost. The cost of cutting-edge ICT research is spiraling upwards as technologies become increasingly complex and research-intensive. It appears that not even the bigger EU countries can, in the long run, afford to maintain state-of-the-art infrastructure and train highly qualified personnel in all ICT domains. Therefore, a sharing of costs and risk seems a suitable option. In Europe, almost 90% of all public ICT research funding is spent through national and regional research programmes. Consequently, the EU's Framework Programmes for research represent only a small fraction of all research funding – public and private– across Europe. In spite of this modest funding, the European Commission plays a pivotal role in Europe's efforts to coordinate its ICT research and become a global leader.

Better coordination of research capacity may also contribute to putting Europe in the driving seat again, at least as regards a set of critical technologies. ICT-related R&D and production can enable, or even drive, the current wave of internationalisation. There is growing concern among policy makers and the R&D community, that Europe may lose its position in leading-edge technologies such as ICT. Therefore, there is a need to make use of existing R&D capacity-building processes in ICT sectors, and understand their competitive advantages for the location of these capacities at the regional, national and European level. There is an R&D investment gap in ICT[174] which can –to a significant extent- be explained by the lower degree of specialisation of the EU with respect to Japan and the USA.

Take up the challenge of an ageing Europe

Europe is ageing rapidly. When today's baby-boom generation reach retirement age, the dependency ratio will increase drastically and current social security systems are in danger of becoming unaffordable. Immigration may mitigate this trend but it cannot stop it. To ensure future economic development and well-being, Europe will need to increase its productivity levels substantially. Therefore, it would be advisable to put adequate economic policies in place before the baby-boomer generation reaches retirement age. ICTs can make a contribution to maintaining social welfare in an ageing society by increasing productivity and keeping older citizens socially and economically active. However, ICTs can perform this role only if the overall institutional framework of European societies is changed from one fit for industrial manufacturing to one suitable for the knowledge society. For this to happen, ICT adoption needs to be grounded in fertile soil: structural reforms are needed in Europe in order to make innovation (both product and process innovation) and the use of innovative technologies more profitable. Because Europe needs to adapt quickly to a period of rapid technological change (e.g. deployment phase), markets also need to be more flexible, in order to boost investment and ICT adoption. Business creation and innovation

174 IPTS is currently studying private investment in R&D in ICT in the 25 EU Member States and in Europe as a whole. Preliminary results indicate that European ICT business spending in R&D has grown by 6% from 2002 to 2004. In absolute terms, this amounts to 35 billion € which is less than that of Japan and about half the US amount.

need to be freed from rigidities in factor markets, favouring labour mobility and skill upgrading and access to capital, especially risk-capital. All in all, "creative destruction" must be facilitated in order to favour the emergence of innovative forms of economic activities embodied in new businesses, new product and services, new production organization processes, new markets, etc. In addition, by favouring greater competition and greater integration of EU markets, the EU may favour faster adoption of new technologies. This is particularly true in the service sector, where ICT-related productivity gains have been especially low in the EU, as compared, for instance, with the US. Europe is still lagging behind in this domain and there are great potentialities in relation to ICT adoption which can be fostered through greater integration of EU service markets. ICT-led technological changes thus call for deep structural changes, including changes in the organization of businesses, management practices and human capital investment. As regards human capital, Europe must place skills and education at the heart of its growth and employment strategy. These changes are at least as important as investment in ICT and strongly determine the effectiveness of these investments.

Policy makers therefore need to make every effort to put the right framework conditions in place. However, the urgency of the situation has not yet been sufficiently acknowledged. The PhD students of 2020 are entering school now. Therefore, if Europe wants to have a world-class ICT industry in 2030 despite a shrinking workforce, it must adapt its policies much more rapidly than it has up until now. And not just in education and research. If product markets are not pushed into innovation by competitive pressures, young professionals will orient their career plans elsewhere. Risk taking must be rewarded. Reforms are much more urgently needed and will be much more far-reaching than most policy makers think.

The need for an integrated European policy approach

Europe has a unique foundation of social diversity, where a rich mosaic of languages, thought styles and historically-rooted cultures provide a model of the emerging globally-connected world. This social diversity reflects a historical process that has generated varied systems of meaning. How can Europe turn this historical inheritance into a competitive advantage? The way forward could be to explicitly integrate social, cultural and cognitive dimensions into information and communication technology development and research, and, at the same time move these technologies into their next evolutionary generation. This integration would also contribute to the better use of technologies that lead to true socio-economic development.

Europe has recognised the importance of the emergence of the ICT paradigm for the economy and society. It has focused its policy actions on research and innovation. However, it *still lacks an integrated policy approach* that would employ all economic and social levers for stimulating innovation and maximising the benefits of the IS. These benefits will not come by themselves. First, ICTs imply profound changes in processes, organizations and the ways in which all actors operate in our society, whether private businesses or public institutions. More specifically, the advent of ICT is accompanied by a rise of networking activities which questions pyramidal structures and hierarchy. Secondly, policy makers are under pressure for time, due to the fact that the growing importance of ICTs has coincided with globalisation. Both are, in fact, interdependent and require a clear and coherent strategy at both national and EU levels.

Up until now, much of the public debate has been about the implications of globalisation and technological change in terms of the location of economic activities and a potential loss of employment arising from the re-location

of economic activities to low wage countries. In this respect, it is worth emphasising that ICT-led globalisation does not necessarily imply re-location of complete economic activities. In particular, recent trends show an increasingly finer dis-aggregation of the value chains into specialised segments, which are then candidates for relocation to places that offer the most advantages. These new trends cannot be ignored and they cannot be faced with old policy recipes. Policy-makers and the public sector in general have a crucial role to play in helping to make the necessary changes as smooth as possible.

About the authors

Emilio FONTELA

University Antonio Nebrija Madrid, Spain

Dean of the Faculty of Law, Economics and Business Administration of the Universidad Antonio de Nebrija of Madrid, honorary professor of applied economics of the University of Geneva, Switzerland and of the Universidad Autonoma de Madrid, Professor Fontela has also taught in the USA, Japan and several European countries. Besides his scientific contributions in economic areas such as the econometrics of productivity and demand analysis, Prof. Fontela has been active in the development of futures research methodologies (mainly cross-impact analysis, interpretive structural modelling, input-output exploratory modelling and scenario writing) and has acted as consultant to several projects of international organizations (UN, OCDE, EC) dealing with world economic issues. A member of the Editorial Boards of Futuribles, Foresight and Economic Systems Research, Prof. Fontela is President of the AEA (The Applied Econometrics Association, Paris)

efontela@nebrija.es

Jeremy MILLARD

Danish Technological Institute, Denmark

Jeremy Millard has 34 years experience working with new technology, education and training and in consultancy for technology suppliers, public authorities, governments, users, the European Commission, the World Bank, and a number of aid agencies. He has worked on all aspects of the Information Society as practitioner, researcher and policy maker, often taking the leading and management role. He was employed by the UK Open University and by local government from 1971 to 1984, and then moved to Denmark to work with Tele Danmark Consult until March 1999. From April 1999 he is employed by the Danish Technological Institute as a Senior Consultant. As geographer and social scientist, Jeremy has focused heavily on regional development and governance issues, especially in relation to new forms of eWork, eCommerce, eServices and eGovernment, and new business and organisational change projects in the context of the knowledge and networked society. He has worked extensively with local and national government and regional development agencies in all types of areas across Europe, as well as in other parts of the world, particularly in Africa and Asia. He has been involved in developing, evaluating and analysing the impacts of change at the local and regional scale, both from a theoretical perspective and in terms of practical implementation, for example by advising regional development agencies on policy formulation and practice.

Some of Jeremy's recent work includes a survey of European eGovernment research in a global context, an analysis of the impact of the European Union's Structure Funds Programme on its Lisbon 2010 Strategy, and supporting the European Commission with ex-ante impact assessments of major new policy proposals for Information Society development.

Jeremy.Millard@teknologisk.dk

Carlota PÉREZ

Cambridge and Sussex Universities, UK

Venezuelan, researcher, and international lecturer and consultant, specialized in the socio-economic implications of major waves of technical change. Presently, she is Visiting Senior Research Fellow at CERF, Cambridge University, UK, and Honorary Research Fellow at SPRU (Science and Technology Policy Research), University of Sussex, UK. Her articles, from the early 1980s, have contributed to the present

understanding of the relationship between basic innovations, technical and institutional change and economic development. She is consultant to governments in several countries, to private sector associations, to major corporations and various international organizations. She is often invited as lecturer and keynote speaker to major business and government conferences in Europe and Latin America. Her book *Technological Revolutions and Financial Capital: the Dynamics of Bubbles and Golden Ages* (Elgar 2002) has become increasingly influential in the academic, business and policy communities.

carperezperez@yahoo.com

Erik S. REINERT

Tallinn University of Technology, Estonia and Norwegian Institute of Strategic Studies, Oslo, Norway

Erik S. Reinert is Professor of Technology Governance and Development Strategies at Tallinn University of Technology. His research area is the theory of uneven growth, i.e. the factors which – contrary to the predictions of standard economic theory – cause world economic development to be such an uneven process. The outlines of the particular framework of evolutionary economic theory to which Reinert subscribes can be found at www.othercanon.org. Reinert holds a BA from Hochschule St. Gallen, Switzerland, an MBA from Harvard University, and a Ph.D. in economics from Cornell University with the thesis 'International Trade and the Economic Mechanisms of Underdevelopment'. He has worked as managing director of a multinational manufacturing firm with production plants in four European countries. The last fifteen years Reinert has dedicated to teaching and researching in the theory and history of uneven development, with particular attention to the History of Economic Policy as an under-researched area, i.e. what kind of economic policy nations have actually carried out historically as opposed to what reigning theories told them to do. His book How Rich Nations got Rich and why Poor Countries Stay Poor (London, Constable & Robinson) will be published in 2006, his edited books include Globalization, Economic Development and Inequality: An Alternative Perspective (Cheltenham, Elgar 2004) and (with Jomo K.S.) The Origins of Economic Development, How Schools of Economic Thought have Addressed Development (London, Zed 2005).

ESR@info.no

Tobias Schulze-CLEVEN

Berkeley Roundtable on the International Economy

Tobias Schulze-Cleven is a Research Associate of the Berkeley Roundtable on the International Economy (BRIE) and a PhD student in Political Science at the University of California, Berkeley. During the academic year 2005/06, he is a guest scholar at the Max Planck Institute for the Study of Societies in Cologne, Germany. With a general research focuses on Comparative Political Economy and European Politics, he is writing his dissertation on the comparative politics of increasing labor market flexibility in Great Britain, Denmark and Germany. He has contributed to the forthcoming 'How Revolutionary was the Revolution? National Responses, Market Transitions and Global Technology in the Digital Era' (Zysman and Newman, eds.).

tobysc@berkeley.edu

Luc SOETE

Universiteit Maastricht and UNU-MERIT

The Maatsricht Economic and social Research and training centre on Innovation and Technology of the United Nations University

Luc Soete (1950) is Professor of International Economics at the Faculty of Economics and Business Administration, Universiteit Maastricht and director of UNU-MERIT, the Maatsricht Economic and social Research and training centre on Innovation and Technology of the United Nations University. He is also a member

of the AWT, the Advisory Council for Science and Technology Policy in The Netherlands.

He completed his first degrees in economics and development economics at the University of Ghent, Belgium, before obtaining his DPhil in economics at the University of Sussex, England. Before coming to Maastricht in 1986, Luc Soete worked at the Department of Economics of the University of Antwerp, the Institute of Development Studies and the Science Policy Research Unit at the University of Sussex, and the Department of Economics at Stanford University. In 1988 he set up MERIT, of which he has since been the director and which became integrated with the UNU on January 1st, 2006.

His research interests include the theoretical and empirical study of technological change and innovation, with a particular emphasis on new information and communication technologies, on growth, employment and international trade and investment, as well as the related policy and measurement issues.

soete@intech.unu.edu

Ilkka TUOMI

Oy Meaning Processing Finland

Mr Tuomi is currently Chief Scientist at Meaning Processing Ltd. Before his current assignment, he was with the European Commission's Joint Research Centre, Institute for Prospective Technological Studies, Seville, Spain. Before joining IPTS in 2002 as Visiting Scientist, he developed research strategy for the Finnish Technology Agency and the Finland Berkeley Information Technology and Society Program. During 1999-2001, Mr Tuomi was visiting scholar at the University of California, Berkeley, where he conducted research on the new dynamics of innovation networks, working with Professor Manuel Castells. From 1987 to 2001 he worked at Nokia Research Center, Finland, most recently as Principal Scientist, Information Society and Knowledge Management.

Mr. Tuomi has been involved in several European and international research projects since the 1980s. Most recently, he led the socio-economic work package of the interdisciplinary Sixth Framework "Broadband for All" coordination action BREAD. He has written five books, chapters in 21 books, over 40 scientific articles, numerous scientific reports, and he is author of two international patents. His texts have been used as background material for the development of national, regional, and European research strategies, the World Summit on Information Society, Commission communications, and the revision of the eEurope strategy.

He is currently member of editorial boards of Tiedepolitiikka (Science Policy), Lifelong Learning in Europe, and First Monday, a peer-reviewed online journal focusing on the Internet; and member of the advisory board for the Centre for Activity Theory and Developmental Work Research at the Helsinki University.

ilkka.tuomi@meaningprocessing.com

John ZYSMAN

Berkeley Roundtable on the International Economy

John is professor of political science at the University of California, Berkeley, and codirector of the Berkeley Roundtable on the International Economy. He has written extensively on the politics Territories, Globalization, European corporate strategy, Japanese corporate strategy, comparative politics, Western European politics, political economy and policy of European and Japanese business and economic development. His most recent works include "How Revolutionary was the Digital Revolution? National Responses, Market Transitions, and Global Technology", a BRIE-ETLA-Helsinki Project (Eds.) (Stanford: Stanford University Press, 2006), „The Politics of Greed: Privitization, Neo-Liberalism, and Plutocratic Capitalism in Central and Eastern Europe" (Rowman & Littlefield Publishers, INC., forthcoming), "The State in The

Digital Economy," with Abraham Newman. The State after Statism: New State Activites among the Affluent Democracies, Jonah D. Levy (ed.), (Harvard University Press, forthcoming 2006), "Transforming Politics in a Digital Era". BRIE Working Paper # 166 (Berkeley: BRIE, 2005), "Creating Value in a Digital Era: How do Wealthy Nations Stay Wealthy?" BRIE Working Paper # 165 (Berkeley: BRIE, 2005). John has served as a consultant to a number of governments, firms, and international organizations.

zysman@berkeley.edu

European Commission

EUR 22353 EN – DG Joint Research Centre, Institute for Prospective Technological Studies
Luxembourg: Office for Official Publications of the European Communities
2006 – 238 pp.
Scientific and Technical Research series
ISBN: 92-79-02984-3
ISSN: 1018-5593
Catalogue Number: LF-NA-22353-EN-C

Abstract

IPTS hosted a thematic workshop on the "Socio-Economic Aspects of the Knowledge-based Europe: The role of Information Society Technologies (ISTs)", which set out to diagnose major problems for Europe in achieving the Lisbon 2010 objectives. It also aimed to elaborate on possible new initiatives which would go beyond conventional wisdom and which would contribute to defining Europe's future role in a globalised society, taking into account the socio-economic drivers for better quality of life. After the Workshop, a number of well known economists were commissioned by FISTERA to write papers suggesting possible lines of analysis that were not included in the core FISTERA design, but which can be seen as crucial elements for a holistic view of the future of ISTs. This report summarizes and analyses the workshop findings and the views of the economists.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

technical report series

EUR 22353 EN

INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES SEVILLE

ipts

EN LF-NA-22353-EN-C

Publications Office
Publications.eu.int

ISBN 92-79-02984-3

9 789279 029844