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The IPTS REPORT

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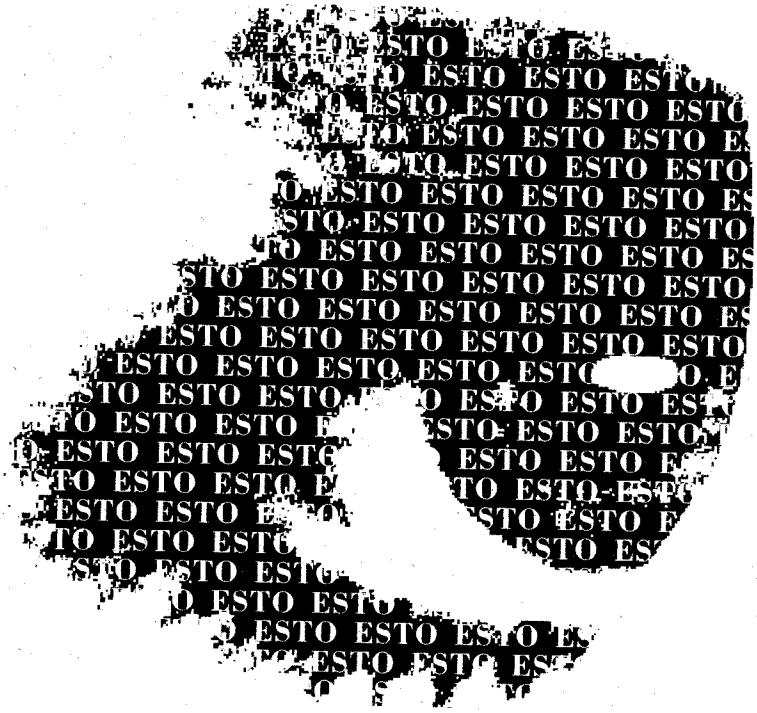

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literacy obfuscates the need for science to review its own ways and how they may perpetuate the gap. Suffice it to mention here the time-honoured practice whereby a key task for all scientific disciplines is to create its own jargon, differentiating/delineating it from related disciplines, and (although perhaps inadvertently) making it largely impenetrable to outsiders, including other scientists.

Moreover the public and by extension the policy-maker craves certainty, answers which are definitive, not conditional on other parameters, especially when the underlying question involves risks/threats to health, security, well-being. It is indicative that scientists are often caricatured/vilified for beginning their responses with the usually entirely appropriate: "It depends...". The language of probabilities, as mentioned above, is neither easily intelligible, nor soothing, and not even really informative for much of the public. Tongue-in-cheek one can say that whereas science has moved and operates comfortably in a quantum universe, the public does not want to let go of the relative certainty of a Newtonian world.

The above come on top of evident differences in scientific and political priorities, such as divergent timetables for providing answers/solutions to questions, which make the interaction of science and policymaking difficult. There are ways to deal with the above but they deserve their own space and will be relegated to a future editorial.

Note

1. Daniel Yankelovich, Issues in Science and Technology online, Summer 2003, **http://www.nap.edu/issues/**

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logy as well as the retooling of factories to produce diesel engines in larger volumes would necessarily have had to start several years earlier. Therefore one can safely assume that the potential of the technology had already been recognized by industry.

The voluntary commitment

On February 5, 1999, the European Automobile Manufactures Association (ACEA) signed a voluntary commitment with the European Commission (EC) on reducing the average CO_2 emissions from new cars. The EC's aim during negotiations had been a target of 120g CO_2/km for all cars sold annually by 2005, and 2010 at the latest, but in the end a target of 140g CO_2/km in 2008 was agreed upon, with an intermediate target of 165-170g CO_2/km for 2003. The improvements should be reached *"mainly by technological developments and market changes linked to these developments"* (OJ 1999), and *"the Commission intends to present a legislative proposal on CO_2 emissions from passenger cars, should ACEA fail to achieve the CO_2 emission objective for 2008"* (OJ 1999). This last sentence is a statement indicating that there will be no need for legislation as long as the objective can be achieved by the measure taken. Equivalent commitments were signed with the Korean and Japanese automakers one year later (OJ 2000)[2].

The commitments include provision for an annual monitoring report on progress. The latest report (EC 2002) summarized progress and concludes: *"In summary, the Commission and ACEA currently have no reason to believe that ACEA would not live up to its Commitment"*[3]. ACEA has reached an average of 164g CO_2/km in 2001, ahead of the 2003 deadline for this level, and the improvements have been reached via technological developments as well as related marked changes. In this context the commitment could be seen as a success story for voluntary approaches to environmental improvements.

Analysing the success of the commitment

There are however, some questions to ask before reaching any conclusions:

- *How would CO_2 emissions have evolved without the pressure of the commitments?*
- *Does the development cause unanticipated side effects that might partly or fully offset the positive effects?*

The OECD has carried out a number of case studies on voluntary environmental commitments (not necessarily specific to CO_2)in different countries (OECD 2003) and concluded that voluntary commitments often meet objectives, but that these objectives would in most cases have been met for other reasons anyhow. The OECD has identified commitments on emission reduction targets, which will be achieved anyhow, as one of the major weaknesses of the voluntary approach. The participants are allowed to capitalize on planned improvements and often use the existence of the commitments as an argument why other regulations should not be put in place. This process may be considered to be a form of the phenomenon termed regulatory capture[4] in economic literature. In some cases voluntary commitments may thus prevent more stringent legislation while giving manufacturers credit for normal renewal of manufacturing plant.

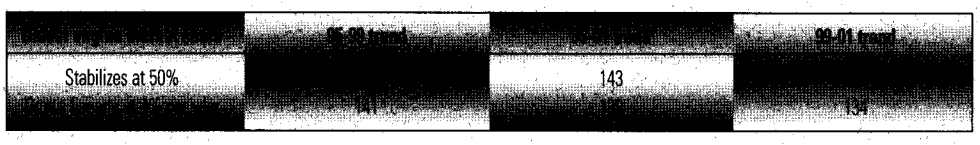
An important safeguard against regulatory capture is to develop an explicit baseline projection before the targets of an commitment are fixed. This will allow both sides of the commitment to better evaluate the level of ambition against the expected cost of accelerated emission reduction. An obvious problem, however, is the uneven access to information. Industry players will know some years in advance which technologies are likely to be used in production, and thus have a relatively solid background against which to estimate future baseline emission profiles. Regulators,

On February 5, 1999, the European Automobile Manufactures Association (ACEA) signed a voluntary commitment with the European Commission (EC) on reducing the average CO_2 emissions from new cars

The OECD has carried out a number of case studies on voluntary environmental commitments in different countries and concluded that although the objectives are often met, these would in most cases have been met for other reasons anyhow

Through a process of regulatory capture, in some cases voluntary commitments may sometimes enable more stringent legislation to be avoided

Table 2. Average CO_2 emissions in 2008 under different assumptions of trend and percentage of diesel vehicles in fleet



Source: Author's own projections based on data from EC, 2002

CO_2/km can thus be reached via a rate of development that does not differ significantly from the period before the commitment was signed if the increased diesel share is also taken into account.

This is not to say that industry is doing nothing, but rather that the voluntary commitment has not added significantly to the pressure already felt by industry. And the fact that it has reduced the probability of other interventions could be seen as a benefit for industry as this creates a more predictable regulatory environment[8].

If the projections are carried forward towards 2012 it will be possible to reach the 120g CO_2/km level desired by the EC g only under the most optimistic assumptions and if diesel account for 84% of all vehicles. Thus an extension beyond 2008 will require an increased effort[9].

Does the development cause unanticipated side effects?

Petrol and diesel are complementary products from the same feedstock (crude oil). Additionally a number of other products such as kerosene, heavy fuel oil, etc. will come out of the process. The natural composition of crude oil allows for a certain distribution of end products, but modern processing technologies allow a chemical conversion of some fractions into others. Conversion is associated with a consumption of energy, leading to a mix of final products with lower total energy content. Thus less processing generally equals more energy available in the end products. In considering the optimum distillate mix from an emissions point of view one has to take into account the efficiency of consumption of different products over the full fuel lifecycle. As diesel engines are more efficient than petrol engines, a higher "production cost" in terms of emissions can be justified by the higher end-use efficiency. The projections presented in Table 2 include a diesel efficiency advantage over petrol in the range of 15-28g CO_2/km thus presenting a significant incentive for automakers to promote diesel vehicles over petrol vehicles in order to meet commitment objectives.

At the "natural crude-oil composition point" diesel is produced at an emissions level of 10-15g CO_2/km while petrol generates roughly twice as much. The increasing demand for diesel forces refiners to apply conversion to a level where marginal diesel today is being produced at a slightly higher emission level than petrol[10]. This means that at present we are starting to see the production emissions of diesel eat into the advantage of the diesel engine over the petrol engine. There is still a slight advantage, but with increasing demand for diesel this could disappear[11].

A refiner optimizes his production based on economic criteria rather than on the emissions. Within the constraints given by the available supply of crude oil, environmental legislation and product standards, available refinery technology and market demand, he aims to produce the combination yielding the highest payoff. Increasing the

The trend would suggest that although manufacturers are clearly making an effort to improve emissions, the voluntary commitment has not added significantly to the pressure on them to do so

Petrol and diesel are complementary products from the refining of crude oil. Although there is a natural composition, to a certain extent modern processing allows more or less of each to be produced from the same feedstock

Increasing the proportion of diesel produced can mean consuming more energy, thus the greater energy efficiency of the vehicle comes at the price of lower energy efficiency at the refinery

ones (at present this is not the case). However, as diesel demand grows world-wide for the same reason as in Europe (i.e. the fact that it is the winning solution), prices will tend to increase and make FT diesel competitive. This leads to an increase in CO_2 emissions if one considers the whole fuel chain.

Thus the commitment is being adhered to but it seems likely that similar reductions would be achieved anyhow even without the commitment. An added benefit for the automakers is a reduced likelihood of other legislation in the field while the commitment is in force. A significant by-product however, is a shift in energy consumption away from the vehicles and onto the refineries. These are not part of the commitment, and so are not taken into account when the commitment is evaluated. The reaction of refiners to the challenge of providing more diesel may, although completely rational, jeopardize the achievements.

Thus we have two actors, one is inside the commitment and one outside. Both act so as to maximize the profits from their business and are doing so effectively. However, the sum of their actions may eventually undermine the value of the voluntary commitment on CO_2 emissions.

A policy solution in this case could be an commitment which covered the whole fuel chain from well to wheel. The administrative procedures needed to oversee such a framework might, however, be prohibitively complicated. It therefore seems likely that other more traditional measures either in form of taxes/incentives or direct regulations may be needed if further CO_2 emission reductions are to be reached in this field[15].

Biomass diesel is more environmentally friendly because it is carbon neutral. However, it is expensive to produce and can only compete if it is exempted from taxation

Keywords

voluntary commitment, CO_2, transport fuels

Notes

1. Petrol and diesel engines each work on different principles. In a petrol engine the fuel is compressed and then ignited with an electric spark. In a diesel engine it is compression alone that ignites the fuel. The principle used in the diesel engine is thermodynamically more efficient, therefore diesel engines are generally more efficient than their petrol counterparts (typically around 10%).
2. As ACEA accounts for more than 85% of the new vehicles sold in EU-15, the ACEA commitment is by far the most important.
3. The commitment with the Japanese automakers received a similar evaluation, whereas some concern has been expressed about the ability of the Korean automakers to live up to their commitment.
4. The theory of regulatory capture was set out by Richard Posner, an economist and lawyer at the University of Chicago, who argued that "regulation is not about the public interest at all, but is a process, by which interest groups seek to promote their private interest ... Over time, regulatory agencies come to be dominated by the industries regulated."
5. IPPC is the Integrated Pollution Prevention and Control framework, where a publicly funded secretariat develops reference documents on Best Available Techniques in a broad range of sectors. As industry players are participating in the process regulatory capture is possible, but the process is designed to minimize the impact.
6. "The negotiations lasted several years, but the impact of this pressure is difficult to measure. Compared to the US however, European automakers have improved significantly faster."

Improving Access to European Transport

Aristotelis Naniopoulos, *Aristotle University of Thessaloniki*

Issue: The number of people who face some form of mobility handicap at some point along the transport chain is estimated at over 50%. Moreover, as the number of elderly people increase in Europe, equality issues demand a more pro-active approach to the problem. Increased mobility within the EU means the numbers of travellers with language and local familiarity problems is also increasing. These issues suggest a need for appropriate policy and actions on a pan-European level, focusing on the establishment of accessible transport chains reaching throughout Europe in urban and interurban areas.

Relevance: "Planning and Design for all", along the whole transport chain, could become a prevailing issue for Europe in the coming years. To meet these demands effectively, European policy will have to move faster and more decisively in terms of legislation, promoting best practice and research.

Introduction

Transport chains, understood as the combination of all the forms of transport a travellers use to get from their point of origin to their destination (whether public, private, motorized, etc.) are made up of discrete parts involving various transport modes. It is not always easy for people to move smoothly along the chain and to use the different modes seamlessly. Indeed, for large swathes of Europe's population it is not possible at all, despite the efforts and advances achieved on various levels during recent decades.

One striking statistic is that more than 50% of people face some form of mobility handicap at some point along the transport chain. The issue is complex, due to the fact that the problems faced by the different groups of the population vary in type and severity and therefore appropriate support needs to address a heterogeneous range of difficulties. However, the percentage of people affected is too high to be ignored in political, social or marketing terms. Moreover any measures addressed primarily at people with mobility handicaps will make a significant contribution to improving the quality of transport for all.

There is no doubt that providing accessible transport chains in Europe is a challenging issue for policy-makers, scientists, society and industry. Practically speaking though, is it a feasible target or is it a utopia? The main objective of this article is to challenge the predominant but ineffective way of

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

Transport chains are made up of various different modes. For people with mobility difficulties it is not always easy to move seamlessly between them

The percentage of the population with disabilities is usually estimated at around 12-15%. If other groups who may have difficulties with the transport chain are included, the overall figure rises to around 50%

The built environment and open spaces

The built environment, which includes buildings and constructions of all types used by people, including open spaces such as pedestrian areas, plazas, parks, visitable sites (e.g. historic monuments, beaches), presents various types of difficulties in their use by people with disabilities, e.g. stairs, narrow passages, obstacles of various kinds, etc. To help overcome some of these difficulties, many countries have set up regulations and design guidelines concerning the built environment which apply in particular to new buildings. At present there are differences, however, between the various EU countries and there is therefore a need for harmonization. Any such harmonization would need to be based on selecting best practice on purely scientific criteria, backed up with additional research and verification, where required, so as to provide effective guidance without restricting creativity while also providing room for new developments in the future. The setting up of a high level body to define pan-European regulations and design guidelines for the built environment and open spaces for adoption by all EU countries seems to be useful for two main reasons:

- The new accession countries (and any future accession countries) urgently require high quality harmonized guidelines which they can apply so as to avoid mistakes or the expense of starting from scratch.
- EU industry will benefit from significant economies of scale.

In addition to the guidelines on accessibility and mobility in the built environment and public space it would be necessary, especially for countries lacking the appropriate know-how (such as many of the accession countries) to adopt a framework code for the use of public space. This might be seen as something which relates to the local level and therefore the responsibility of local authorities thus, according to the subsidiarity principle, no EU-level action needs to be taken. However, in reality in many cases, citizens' rights (especially those of the disabled) are being violated by the misuse of public space (e.g. parking on pavements, overuse of pedestrian areas by shops, street furniture hindering seamless movement), thus making many city areas inaccessible and hostile for large sections of the population and even hampering those people's mobility across different regulatory systems.

Transport modes and terminals

Significant achievements have been made in Europe in terms of access to transport modes and terminals. However these have tended to only be in parts of the total chain and, moreover, to be limited to specific locations, thus making efforts to disseminate best practice essential.

For private cars extremely significant initiatives have been pursued at the EU level concerning the homologation of car adaptations (QVAVADIS) the issuing of a common driving licence, the impacts of new in-car systems such as Intelligent Transport Systems (ITSs) on driver with disabilities (TELAID). The interest of car manufacturers and the car industry as a whole to promote such issues[2] is an important push factor for the continuation of relevant actions at the EU level.

In the case of heavy rail, the working group (COST 335, 1997), has reported that most European railways are responding to needs of the mobility impaired, but there is still a variety of systems used, not all of them equally effective. Moreover, arrangements in stations are not always adequate, especially in the case of old station buildings.

Similarly in the case of metro systems one can find a mixture of highly efficient arrangements on new lines, together with the highly ineffective and practically inaccessible old ones. One particularly

Analogous to the issue of access to transport, the built environment also presents a series of obstacles to people with reduced mobility

Common guidelines for access and mobility in the built environment and public space would be a valuable way of helping all countries bring themselves up-to-date while avoiding duplicated efforts

Progress in almost all areas of transport has been patchy, with a mixture of the highly efficient arrangements together with inadequate and inaccessible ones

to maintain the momentum of innovations in this area of in-vehicle systems.

Infrastructure-based information systems (e.g. Variable Message Signs (VMS), Variable Directional Signs (VDS)) also require appropriate interfaces and settings to be easily understood by people with mobility handicaps, especially in the case of foreign travellers unfamiliar with the local language.

The TROPIC and TRAVEL-GUIDE projects have made a contribution to the provision of appropriate guidelines in this area. It would be particularly useful to agree on a commonly accepted and recognized set of pictograms and extend their use as widely as possible.

On-going EU actions are important to ensuring that issues of safety, usability, information content, related to people with mobility handicaps, are taken into account when new technologies emerge and new systems are developed or implemented.

The organization of transport services

Providing transport services to people with mobility handicaps can be addressed by focusing either on ensuring that services intended for all users offer appropriate accessibility arrangements or on arranging special services for specific population groups. However, it is extremely important to promote the first approach wherever possible as enabling people with the various types of mobility handicaps to mix with other people rather than be isolated enhances their well-being and allows them to feel equal, accepted by society, and to enjoy the benefits of socialization. Moreover, other people get used to the presence of people with mobility handicaps and improve their acceptance attitude. At the same time, the cost of providing the service tends to be lower. The provision of services for all requires special arrangements in the vehicles used, in the relevant infrastructure, as well as some form of training of the service personnel. Although adequate technical solutions and service arrangements exist their adoption and expansion in Europe is still very much behind with some exceptions in certain areas and countries. Steadfast political determination is required to adopt such a policy Europe-wide.

Examples of a variety of schemes providing special services can be found, some of them quite innovative. The choice of the scheme depends on local conditions but here also providing know-how and promoting best practice is extremely important. One interesting example is the development of "dial a bus systems" which utilize modern information and telecommunication technology as well routing algorithms, and is the outcome of EU projects such as SAMPO and SAMPLUS[4].

Conclusions

Planning and Design for all could become a prevailing issue for Europe in the coming years. Travel for all could also take the form of a priority policy including bold measures and actions which could include:

- The adoption, on a Pan-European level of a legal framework similar to the Americans with Disabilities Act (ADA) applied in U.S. and which has also recent imitators in other countries, such as the U.K. The European Union could utilize existing experiences from member countries as well as from ADA and produce something which will be suitable for the European application environment and traditions.
- R&D efforts are needed so as to continue work on issues related to the systematic definition of the needs of people with mobility handicaps along the whole transport chain, as well as to review existing solutions and systems and identify current gaps and next development of new solutions/systems, utilizing the latest technology.

To aid foreign travellers unfamiliar with the local language it would be useful to agree on a set of pictograms and extend their use as widely as possible

Efforts to improve access for passengers with reduced mobility should aim to adapt to normal services to accommodate them as far as possible, rather than run special services for them

Keywords

transport chains, people with disabilities, mobility, reduced mobility

Notes

1. Obviously, this estimate is only intended to be very approximate as these categories are not necessarily mutually exclusive.
2. Such as the AUTONOMIA programme being applied worldwide by the car manufacturer Fiat.
3. This is for instance the case in Thessaloniki, Greece.
4. The SAMPO (System for Advanced Management of Public Transport Operations) project ended in 1997. SAMPLUS is based on its results.

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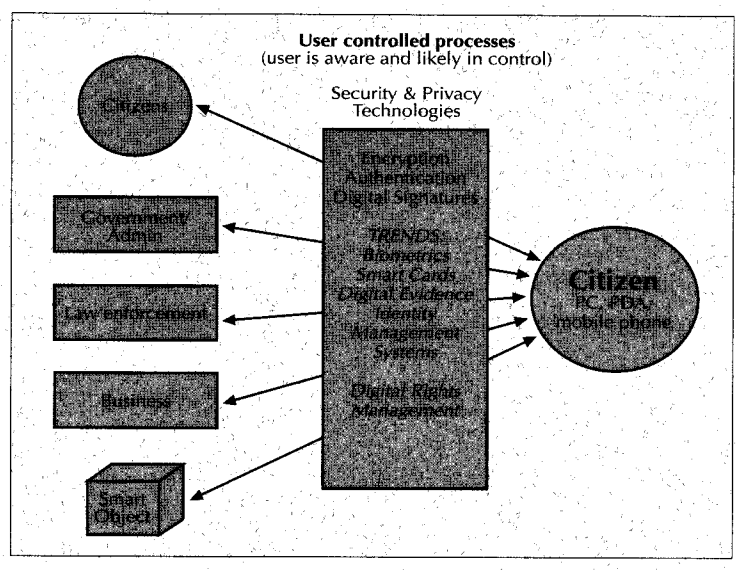
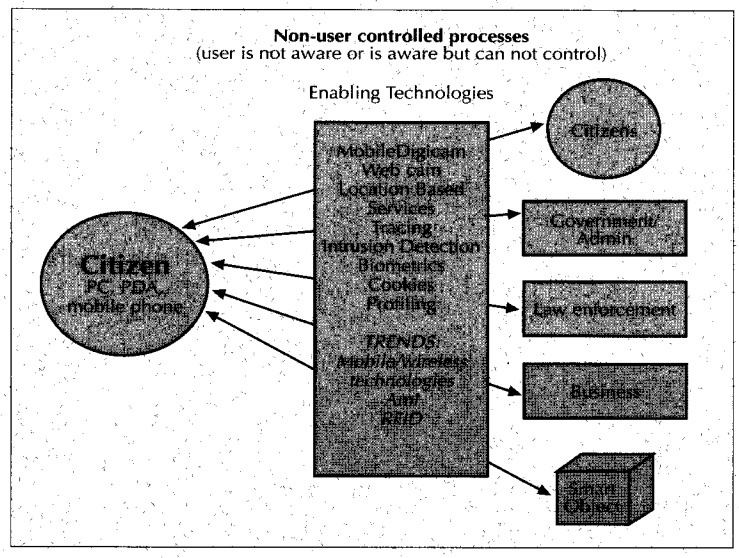
Figure 1. Interactions controlled by citizens in the Information Society



example, when law enforcement bodies collect personal data. New technologies such as mobile digital cameras, positioning systems, tracing, biometrics and cookies, although not necessarily conceived for such purposes, provide powerful tools which may potentially be used to invade people's privacy. Consumers and users are currently concerned about both the lack of security and privacy (Ipsos Reid Group 2001), and it is generally accepted that these concerns are hindering the potential development of the Information Society. However, while ICTs are making privacy abuse and some forms of crime easier, they also provide the enabling infrastructure both for new types of

Personal data is increasingly being used in interactions over which the user has no direct control or which he or she is unable to prevent

Figure 2. Interactions not controlled by citizens in the Information Society



vironment to ensure the confidentiality and integrity of the data exchanged, authentication of actors (particularly as concerns their privacy) and non-repudiation.

Examples of technologies used to provide the basic security functions include: data encryption for information confidentiality and integrity, e-mail encryption, passwords, smart cards or tokens, Public Key Infrastructure based certificates and digital signatures, Biometrics and national identity systems. The expected evolution of security technologies is towards stronger and more efficient cryptographic technologies, smart cards, biometric technologies and Public Key Infrastructures (Infocomm, Nov 2002). Furthermore, the different forms of crime and abuse have led to the development of technologies to fight against crime, including crime prevention technologies (firewalls and filters, antivirus software), crime identification and monitoring tools (intrusion and crime detection systems) together with crime prosecution tools (computer forensic tools, i.e., specific tools and methods for the collection of digital evidence).

However, in spite of the availability of such security technologies, concern about security continues due to worrying facts such as the lack of user awareness and education regarding both the risks and the tools available to give protection. Users also need to be made aware of the rapidly increasing sophistication of crime, the need for adequate up-to-date protection tools, and the persistent system vulnerabilities.

Privacy enhancing technology challenges

Privacy Enhancing Technologies (or PETs) have been developed as a means of countering the erosion of privacy. These could include enabling commerce and communication while limiting the collection of personally identifiable information and not facilitating the collection of personal information, not forcing Internet users to trade privacy for convenience and not treating privacy as a business commodity (US FTC, May 2003).

Anonymity and pseudonymity are techniques that help protect privacy, facilitating free speech and access to public records or sensitive sites, for example. Although they cannot be used in all cases, as some situations require strong identification to combat crime, anonymity and pseudonymity play an important role in the Information Society as in many situations full identification is not really necessary, as it may be sufficient to disclose just one or more attributes. Other examples of PETs are effective database management and identity management systems.

Evolution of PETs is expected in the area of data minimization (of the amount of personal information an individual releases to organizations), ranging from anonymiser technologies to policy information (privacy seals) and privacy preference mechanisms, multi-purpose and multi-lateral Identity Management Systems (that will allow the user to decide which type of identity data he/she will provide to which actor in order to interact, with the inclusion of anonymity and management of several pseudonyms), and distributed identities.

The high cost of developing privacy-compliant and privacy-enhancing products, the lack of consumer awareness and the complexity of installation and use, are the main factors limiting user market demand for PET products, which in itself questions the business case for future development in PETs (IPTSb, July 2003).

Pan-European and cross-sectorial initiatives in the area of identification and authentication

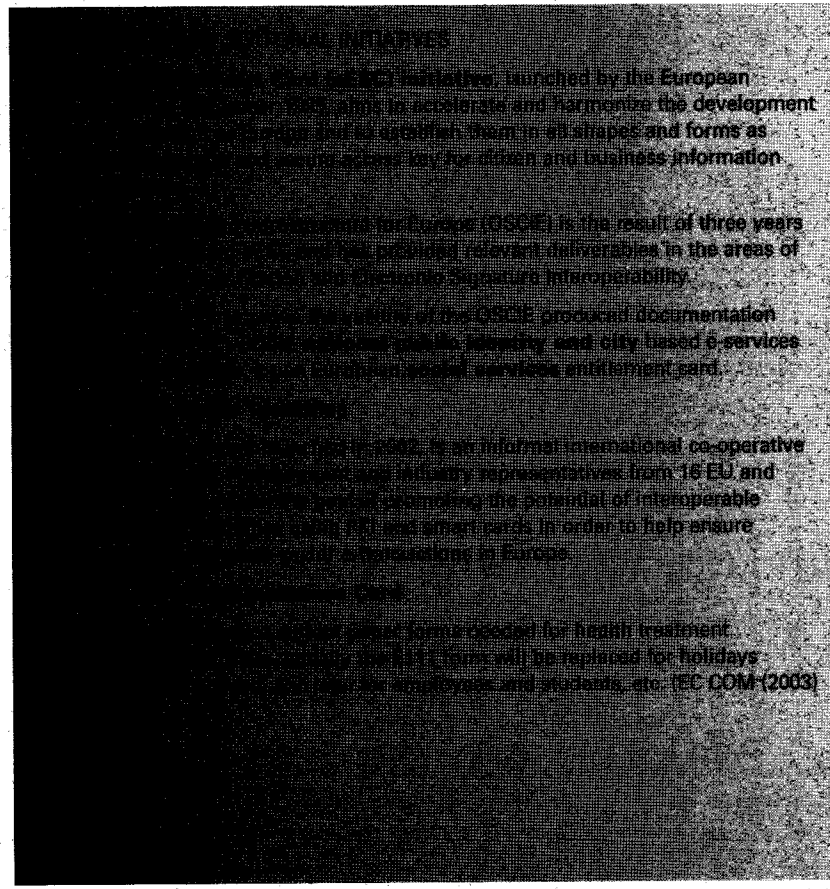
It is anticipated that trends towards the convergence of e-identification/e-authentication instru-

A wide range of technologies may be used to provide basic security functions, including encryption, biometrics, and national identity systems

Anonymity and pseudonymity are techniques that help protect privacy, facilitating free speech and access to public records or sensitive sites, for example

The high cost of developing privacy-compliant and privacy-enhancing products and their complexity for users makes the business case for them questionable

Box 1. Examples of emerging convergence initiatives in the area of identification/authentication



B) CROSS-SECTORIAL INITIATIVES

1) Banking identification systems

Banking identification systems are used for a multitude of purposes, including both commercial and public sector applications. For example, the Finnish Ministry of Finance in its recommendation from 2002, suggests that the state online services that require strong identification should be based on the identification method used by Finnish banks. Nordea's[4] current approach is to promote a single sign-on to facilitate the development of e-services, to leverage the existing trust in banks, customers' online habits, and mass adoption of Internet banking services (Payments & Confidence Conference, September 2003). Also, Estonian Internet banking portals are used for accessing e-government and other commercial services (Hansabank, Nov 2002).

2) National identity cards

National Identity cards are used in some countries (e.g. Spain) for identification in the physical and virtual world for public and private sector applications. It is expected that future national e-ID systems will also be used for more applications than accessing e-administration and e-government services, such as applications in the private sector, as already announced by the Spanish issuing public institution (Fábrica Nacional de Moneda y Timbre – FNMT, June 2003). Similar predictions have been made for the UK Entitlement Card (FIPR, Feb 2003), to the effect that *"if an Entitlement card system was to be rolled out, experience shows that it would quickly become used for a variety of unforeseen purposes ... the private sector would also be likely to quickly make use of an Entitlement card — particularly as they would not have to bear any of the cost of doing so."*

3) Public-sector systems

Another example of cross-sectorial use is the Finnish Government proposal (Nov. 2002) to combine the electronic identity card and social security cards into one electronic identity card.

Keywords
e-identification, e-authentication, e-ID, public sector, banks, identity theft, security, privacy

Notes

1. Monitoring and analysing network traffic. This may be done legitimately in order to optimize network usage, or not so legitimately to intercept third-party data.
2. Website spoofing is a technique used to gain unauthorized access to information in which an attacker communicates with a legitimate user under a false pretence (e.g. using a "spoof" copy of a bank's website that collects passwords and user names with which to perpetrate fraud).
3. In the US, electronic payment solution provider, Star Systems (2002), found that 5.5 percent of the respondents in a November 2002 survey of 2,000 US adults had been victims of identity theft. Of the victims identified in the survey, 29% reported having credit cards in their name issued to another person; 23% had bank accounts in their name opened by another person; 21% had loans in their name by another person and 18% had their currently existing bank account taken over. The US Federal Trade Commission (FTC)'s Consumer Sentinel database reports that 43% of consumer fraud complaints in 2002 were about Identity theft, with more than 161,000 cases reported, an increase of 88% compared to 2001. From these, 50% are related to credit card fraud (24% to new accounts and 12% to existing accounts), 25% to phone or utility bills, 16% to bank fraud, and 9% to loan fraud. In the UK, banks, building societies and financial institutions reported more than 40,000 cases of identity fraud in 2002 compared with fewer than 13,000 cases in 2000 (Sunday Times, UK, *Ministers to act on huge rise in stolen identities*, January 5th, 2003).
4. A financial institution operating in the Nordic and Baltic region.
5. As published on Sunday Times, *Ministers to Act on Rise in Identity Theft*, 5 January 2003.

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ment in R&D and growth (Bassanini 2000, DTI2002), it remains difficult to demonstrate a similar correlation on a regional or national basis (COM2002a). One may argue whether it is growth that is the dependent variable (Solow 2000). Such thinking may be overly reliant on a linear model of innovation in which knowledge is created and diffused independently from its application in marketable products further down stream (Rostrup-Nielsen 2003). More recent thinking looks upon the innovation process as a complex interaction between a number of players and considers the innovations to be shaped by many parameters. Nevertheless, from either viewpoint universities play a key role, firstly by providing the trained scientists and engineers for the process of innovation in industry and secondly by participating directly in that innovation process (Nelson 1996). Universities can also patent their inventions and create businesses in the form of spin-off companies or by direct licensing to other firms. Universities may also promote innovation by collaborating with research departments from existing firms which outsource research tasks to university groups ("spin-in").

Attempts to compare different countries' abilities to innovate using a so-called innovation scoreboard (COM 2002b) may be misleading as they rely on aggregate numbers. Trends in these indicators may be of use, but one has to go one level deeper to understand the differences. These differences may concern the individual mechanisms which may drive the innovation process. It is here that we may learn something from the experience in the US. The US has been a front runner in this and has also been the first to deal with issues emerging in industry/university relations.

Aspects of US Innovation Policy

The development of innovation policy in the US has been characterized by powerful interactions between government-funded research and innovative entrepreneurs, not least through small firms which create jobs and contribute to growth by focusing on new technologies (Wessner 2002). Moreover, public investment in basic research has been reflected by the large number of published papers from academic research cited in US-patents (Pavitt 2000).

The US research and innovation systems (Feldman 2002a) were not the outcome of a conscious attempt to define such a system in advance, but rather a reflection of the US approach to problems. Government funds are mostly mission oriented, and thus directed towards goals clearly accepted by academia and industry.

This has become important as economic growth is often driven by regulations in important fields such as health, energy, environment, transportation, communication, and defence. This process is driven by a number of mechanisms working in parallel. Typically the emphasis is on early stage, high-risk, high-reward projects (such as the Advanced Technology Programme) (Wessner 2003a). It is interesting to note that a significantly higher fraction of industrial R&D is funded by the government in the US (14%) than in EU (8%).

In addition, two mechanisms have been particularly helpful in facilitating innovation: The Bayh-Dole Act and the small business innovation research (SBIR) programme. These mechanisms have greatly facilitated the spinning off of new companies from universities.

The Bayh-Dole Act (B-D Act) gives the universities ownership of patents based on results developed with support from public funds. At the same time it is an important element of the law that smaller companies should be favoured in utilizing the patents. It is also possible for professors and other university employees –for a limited period–

Universities play a key role in innovation, both through their direct participation in the innovation process and by training scientists and engineers

Attempts to compare different countries' abilities to innovate may at times be misleading as they tend to rely on aggregate numbers

The development of innovation policy in the US has been characterized by powerful interactions between government-funded research and innovative entrepreneurs

Two mechanisms (the SBIR programme and the Bayh-Doyle Act) have played a particularly strong role promoting innovation in the US

ments, beyond the need to increase the R&D effort to 3%. Innovation policy requires an integrated effort in many fields, including instruments to improve the interaction between all players in the process of transforming scientific results into commercial products/services. One element is to improve the university/industry collaboration.

The target of creating a European Research Area is a step in the right direction, and the EU Framework Programmes have been efficient at creating networks across Europe and breaking down traditional barriers for collaboration. This is not planned to be a panacea but will certainly open up the space for collaboration between universities and industry.

Most instruments for improving innovation work primarily at regional level (COM 1997). This may appear to be somewhat paradoxical in view of the strong international engagement of scientists and industry (Rostrup-Nielsen 2000). One may then ask whether there are any problems which could be solved at the European level or whether there is a role for the Commission in active innovation policy. A working group under *EURAB* analysed this question and came up with a number of recommendations (EURAB 2002) relating to university/industry relations in particular.

One of the recommendations made was to establish the community patent and to set up pragmatic models for intellectual property rights for industry and university relations, so as to avoid some of the problems seen elsewhere (e.g. in the US).

At a national level, Denmark introduced a law on inventions at Danish universities in 1999 which was a Danish version of the B-D Act. After three years, an analysis for Jan. 2000/Aug. 2003 (Techtrans 2003) showed that 273 patents had been filed out of which 99 had been either sold or licensed. Although B-D type legislation creates a well defined legal space, it may not be absolutely necessary. Examples of the spin-off process without the aid of such a mechanism include those from the chemistry department of Oxford University (England) (Richards 2003) and Karolinska in Upsala (Sweden).

Although big companies contribute significantly to innovation (de Wit 2003), technological renewal is to a large extent generated by the high tech SMEs which are highly dependent on the local conditions though often operate on a global level. One important element is to facilitate the spinning off of companies from knowledge centres in universities or larger companies.

The EURAB Working Group suggested that an SBIR like mechanism, as employed in the US, could be very beneficially added to the Integrated Projects of the Framework Programme, FP6, allowing the coordinator to apply a certain percentage of the project for individual SMEs. This would provide a considerable boost for spin-offs from university and established industry. Although an SBIR-like mechanism to be applied in national programmes may not face problems under the Community's Rules on State Aid (COM2003b, Rostrup-Nielsen 2003), in the context of the European Framework Programme an SBIR-like mechanism raises other considerations which cannot be discussed here for reasons of space.

The basic philosophy appears to be that the more partners who collaborate, the better the result. In contrast, one might get more innovation having three groups working in parallel than having all groups sitting together while often following hidden agendas. It could be argued that it is more beneficial to require a "European dimension" at the programme level beyond focusing on the individual projects (ATV 1996).

It is also difficult for high-tech SMEs to find a space in projects dominated by big companies.

Creating a European Research Area is a positive step towards enhancing Europe's innovation potential

The EURAB Working Group has suggested that an SBIR like mechanism would be a valuable contribution to enhancing innovation in Europe

ways of establishing this presence, which is needed to achieve a more balanced collaboration between universities and industry.

The university-industry interaction at Cambridge (England) is one example of how large scale "spin-in" can be carried out successfully in Europe. However, significant results can also be achieved on a smaller scale (Besenbacher, 1998; Rostrup-Nielsen, 2002).

Conclusions

It is useful to compare the experience in the US with that of Europe but Europe should not necessarily copy the US.

It appears that the US has been better at linking the R&D effort to the innovation process by giving its strategic research a stronger mission orientation and making the concomitant effort to ensure the money goes directly to those involved in the research process. The SBIR mechanism is one example of this.

However, it is a challenge to create optimal conditions for relations between universities and the established industry with joint research in "Pasteur's Quadrant" (i.e. fundamental research with potential applications). There is the potential for conflicts of interest for universities when they create new spin-out companies and there is a need to formulate general guidelines for governing IPRs in research in the so-called Pasteur's Quadrant. It is also important that university/industry relations are dictated by the real interests of the partners and not by thematic headlines of public programmes. It is important to improve the general framework for innovation, but it is not sufficient. The lesson from the US experience is to create selective mechanisms allowing individuals to take the initiative. It can be misleading to evaluate innovation potential by means of aggregate figures such as research intensity. Therefore, the Barcelona criteria, should not be viewed in isolation.

In economics, one uses the normal distribution to describe aggregated values with a variance around the mean. In reaction kinetics, we use a similar distribution of the energy of molecules (Maxwell distribution). However, it is not the average molecular energy which is decisive for the chemical reaction to occur, but how many of the molecules having an energy above a certain threshold value - and the presence of the right catalyst. This may be true for innovation policy as well.

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The first *eforesee*[1] pilot exercise has highlighted three possible paths for accession countries in the agricultural sector during the post-accession period.

Current challenges facing agriculture in the CEECs

In order to estimate the possible shape of rural areas by the year 2006 in new members it is necessary to examine trends and developments that form the future of candidate country agriculture (including fisheries) as well as other activities that coexist or will develop in the agricultural sector (e.g. tourism, industry, construction, second homes, etc). Factors that may affect agriculture are:

- The need to comply with the *Acquis Communautaire* and the Common Agricultural Policy (EU proposals for reduced subsidies during a transitional period).
- The Common Agricultural Policy through foreseen reforms towards re-nationalization of income support mechanisms, extensification[2] of production, etc.
- The international context of trade liberalization under the auspices of the WTO.
- The agricultural production technology and mainly the prospect of biotechnology through its effect on the volume of production and on average production cost.
- The demand for agricultural products on a global level and specifically the differentiation of demand towards organic or/and genetically modified products.
- The number of farmers, their level of education, average age, the number and the size of farm units and the way they are managed, as well as the development of extension services (dissemination of research results, information concerning the disposal of products, etc.), through a possible reorientation towards high quality and smaller quantities.
- The new orientation of countries towards participation in the global knowledge economy through the use of information and communication technologies (ICTs).

Other factors that may affect other economic activities in the agricultural sector outside agriculture and fisheries are: a) Income growth patterns globally and locally, driven by demand for tourism-sector services, as well as the possibilities in countries such as Cyprus, for instance, to organize quality tourist services in rural areas, and, b) economic development in the country though the extension of construction (holiday homes, etc.) in rural areas and the related development of industrial and commercial activities.

Finally, we need to determine the relationship between agriculture and other economic activities in rural areas, the possible diminishing importance of agriculture in relation to other economic activities and the forms of correlation between them, given that these connections will affect the level of rural development in each region.

Developments at the level of European, national and local administrations concerning their capability to plan and promote the development process will be important for rural development. The ability of governments, the private sector and local authorities to participate successfully in development plans will make a decisive contribution to the shape of rural areas in the post-accession period.

Forecast trends in the Common Agricultural Policy locally and worldwide

The EU is currently the world's largest importer and exporter of agricultural produce. Nevertheless, competition makes it impossible for farmers to set their own prices, and consumers are able to choose products from a range of origins. Increasingly, farmers are also coming under pressure to act as custodians of the environment, thereby providing a service to society which market mechanisms do

In order to forecast how rural economies will look in the new Member States by 2006, it is first necessary to examine the past trends and current developments

The rural economy will also be affected by overall trends in income and the growth of other industries, such as tourism, construction, etc.

- Food quality
- New products and production processes
- The working environment
- Animal welfare.

Innovation in agriculture

The agricultural sector is in some ways unique among sectors of the economy, particularly in terms of its susceptibility to the weather. Serious droughts and bad weather can affect agricultural output drastically. The application of biotechnology could increase the resistance of crops to biotic and abiotic stresses, including pests and diseases; improve the quality and nutritional value of products and supply the market with novel agricultural products. New techniques could help scientists to create new forms of agricultural inputs, which may be cheaper, more productive and environmentally friendly. The use of information technology could contribute to the overcoming of distances, to the dissemination of information and to the direct advice of rural population in remote areas on matters of interest to them.

Because of the particularities in agriculture, the innovation process should be developed in a legal framework that: a) ensures the free circulation of knowledge, b) strengthens investments in Information and Communication Technology (ICT) applications, and c) encourages entrepreneurship among farmers and agribusiness. There is also a need for a well-educated and skilled rural population, highly educated managers and staff in the agribusiness and agricultural services, as well as a solid infrastructure serving rural areas.

An enhanced innovation effort in Europe's farming sector

The European food sector is of considerable public interest –given that European citizens are all consumers of its products– and it is crucial to the economy in some countries and regions. Added to this is the farmer's role as a manager of the countryside and of nature, as well as the significance for rural development and its contribution to energy/non-food production.

The challenges for Europe's farming and food industries in terms of innovation centre on ensuring competitive, multifunctional and sustainable agriculture, in both economic and environmental terms, and improving food safety, health and nutrition.

The agricultural policy of the EU is oriented towards a new CAP with an economy less distorted by subsidies on the production and marketing of agricultural products, while at the same time ensuring development through special rural development measures.

The main aim for development policy should be the restructuring and the improvement of the wider agricultural sector, in order to face successfully both the European challenge and wider international competition, and to take advantage of WTO trade agreements and accession to the EU. Some may argue that, in order to apply the preferred shared vision emerging from pilot exercises, a lot of money needs to be spent, which is currently not available. However, this is perhaps only a matter of priorities, as millions are spent yearly on measures supporting agriculture, part of which could be devoted towards the restructuring of agriculture through measures compatible with the *Acquis* while respecting the commitments under the WTO.

The need for foresight and its capabilities

Over the last decade foresight has become a highly visible and widespread way of informing the decision-making process relating to technology po-

Giving higher priority to agricultural development implies placing greater emphasis on food safety and quality, protecting the environment, etc. and thus creates a wider role for innovation

Because of the particularities of agriculture, the innovation process needs to be developed in a legal framework that ensures the free circulation of knowledge, strengthens investment in new technologies, and encourages entrepreneurship among farmers

Keywords

agriculture, foresight, common agricultural policy, enlargement

Notes

1. Eforesee is a two-year project that will address challenges faced by policy-makers implementing foresight activities for **smaller economies** and **regions**. In particular it examines the potential role of foresight in dealing with the structural changes to the economy that accompany the **Accession** process, as well as the integration of accession states into a **European Research Area**. More information is available at: **http://www.eforesee.info/**

2. i.e. making less intensive.

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ABOUT THE IPTS

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

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

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

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

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

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

- Technologies for Sustainable Development
- Life Sciences / Information and Communication Technologies
- Technology, Employment, Competitiveness and Society

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