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The IPTS REPORT

EDITED BY THE INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES (IPTS)
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ABOUT THE IPTS REPORT

The IPTS Report is produced on a monthly basis - ten issues a year to be precise, since there are no issues in January and August - by the Institute for Prospective Technological Studies (IPTS) of the Joint Research Centre (JRC) of the European Commission. The IPTS formally collaborates in the production of the IPTS Report with a group of prestigious European institutions, forming with IPTS the European Science and Technology Observatory (ESTO). It also benefits from contributions from other colleagues in the JRC.

The Report is produced simultaneously in four languages (English, French, German and Spanish) by the IPTS. The fact that it is not only available in several languages, but also largely prepared and produced on the Internet's World Wide Web, makes it quite an uncommon undertaking.

The Report publishes articles in numerous areas, maintaining a rough balance between them, and exploiting interdisciplinarity as far as possible. Articles are deemed prospectively relevant if they attempt to explore issues not yet on the policymaker's agenda (but projected to be there sooner or later), or underappreciated aspects of issues already on the policymaker's agenda. The multi-stage drafting and redrafting process, based on a series of interactive consultations with outside experts guarantees quality control.

The first, and possibly most significant indicator, of success is that the Report is being read. The issue 00 (December 1995) had a print run of 2000 copies, in what seemed an optimistic projection at the time. Since then, readership of the paper and electronic versions has far exceeded the 10,000 mark. Feedback, requests for subscriptions, as well as contributions, have come from policymaking (but also academic and private sector) circles not only from various parts of Europe but also from the US, Japan, Australia, Latin America, N. Africa, etc.

We shall continue to endeavour to find the best way of fulfilling the expectations of our quite diverse readership, avoiding oversimplification, as well as encyclopaedic reviews and the inaccessibility of academic journals. The key is to remind ourselves, as well as the readers, that we cannot be all things to all people, that it is important to carve our niche and continue optimally exploring and exploiting it, hoping to illuminate topics under a new, revealing light for the benefit of the readers, in order to prepare them for managing the challenges ahead.

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EDITORIAL

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EU Enlargement and welfare systems competitionDimitris Kyriakou, *IPTS*

As the entry of Eastern European countries into the EU approaches, concerns are being expressed, founded or not, about the impact their accession may have on the economies of the current members of the EU. A key such concern is that migration patterns from newcomers to wealthier members of the EU may seriously strain EU welfare systems. A recent (Spring 2000) paper by Hans-Werner Sinn of the Institute for Economic Research (IFO) in Germany provides a useful analytical point of departure. The first thing one notes is that newcomers will place a burden on existing EU assistance programmes, such as agricultural programmes. A linear extrapolation of current EU subsidies would add 0.8% of EU (current membership) GDP to expenditures on such agricultural programmes when all Eastern European accession candidates are accepted.

Much more important, however, are the impacts potential migration flows may have on incentives and on welfare systems. On the one hand, even before enlargement is taken into account, intensifying competition among countries for favourable investment and locational decisions on the part of firms is already placing tight constraints on the use of taxes as means to sustain/finance welfare expenditures.

On the other hand however, and this is the new element, states will fear that a generous social welfare system will attract migrants more than its fellow EU-member's less generous system. One could envisage a 'race-to-the-bottom' competition among welfare systems, leading to the erosion of the welfare state. Since wage differentials (and more broadly standard-of-living differentials) remain very large (the aforementioned study suggests a difference of a factor of ten between Munich and East Poland) worker flows can be expected.

How do welfare systems enter migrants' calculations, since they may make a less obvious impression compared to wage differentials? Although in general large wage differentials are required to induce migration out of one's country, once this decision has been made, small differences (such as in social benefits) can tip the balance in favour of one or the other migration destination. Since prior or present employment is required in order to be eligible for social benefits, the concern here is not unemployable migrants in search of benefits which they will not get anyway, unless they get a job. The strain, if any, on welfare systems rather will be due to those who do find low-pay jobs, and will pay little or no taxes, receive supplementary benefits either in the form of income support payments, or access to public housing, education, etc.

The implications mentioned above apply not only to our imperfect welfare systems, which need reform, before and beyond the challenges of migration; they also would apply to well-constructed welfare systems. Let us look at the mechanism for this: in a system in which income is redistributed from rich to poor (including the working poor) the arrival of more benefits recipients may induce the rich (and/or their activities) to move abroad (where the fiscal burden may be smaller). This will reduce the return to the factors of production (typically capital) owned by the rich in the destination countries and increase the wages of the poor. Moreover the inflow of net tax-payers abroad will help that government's budget and make it easier to sustain welfare policies.

Exactly the reverse will happen in the country that has attracted a large net inflow of net benefits-recipients, and has suffered the outflow of net tax payers. There will be both tighter budgets and more net recipients to deal with. Paradoxically, a state's generous welfare policy not only may make

it harder for it to provide for its poor, it indirectly makes things easier for its 'stingier' neighbours to which net payers (either individuals or, more often, activities) may migrate. It is this externality that can make the 'race-to-the-bottom' among welfare systems particularly precipitous.

Note that the pessimistic analysis given above does not apply immediately to standards in the workplace. The latter can be seen as compensations in kind, to be added to the monetary wage in order to reach to the overall compensation (in money and in kind) received by the worker. Competition among systems then will lead to different mixes of money-wages and in-kind-wages, and correspondingly different types of mobile workers will be attracted to different systems, depending on their preferred optimal mix of money-wages and in-kind wages.

Space being limited, we will postpone examining possible ways to both deal with these problems, and still enjoy the benefits of labour mobility within the EU, for a future editorial.

European Policy for Technology Innovation in Transport: Finding the Right Role and the Right Options

K. Matthias Weber, *IPTS*, & Henk van Zuylen, *AVV*

Issue: Transport is a complex multi-level system which is slow to change but suffers from growing efficiency and congestion problems and has serious environmental side-effects. Several new and promising technological options are emerging which could help address these problems but they confront barriers to their uptake.

Relevance: European transport policy has set challenging objectives for the coming years. New technologies are expected to play an important role in achieving these objectives. While it is necessary to avoid "picking winners" in a technology-push fashion, European transport technology policy can nevertheless play an important role in enabling and facilitating the uptake of more sustainable technologies, and in complementing efforts made in the Member States as well as by industry. Identifying the technology areas and innovation phases where European action can have added value is particularly important in order to develop consistent "packages" of policy measures.

A lot of progress has been made over recent years in reducing emissions from motorized transport, reducing accident rates and offering faster and more comfortable means of transport

Introduction: Benefits of and barriers to innovation in transport

A lot of progress has been made over recent years with respect to reducing emissions from motorized transport, reducing accident rates and offering faster and more comfortable means of transport. However, the continuing increase in transport demand seems to be offsetting much of the progress made. Congestion and CO₂-emissions raise particular worries about the sustainability of our present way of delivering and using transport services, and, as already analysed in more detail in the Special Issue 47 of the IPTS Report, urban air quality continues to be a concern.

Awareness of the urgency of these problems has grown at European policy level, as evidenced, for example, by the Commission's current Transport Policy Action Plan (CEC 1998). As well as emphasizing the need to improve the operation of market forces in the provision of transport services, enhancing the efficiency and quality of transport services and reducing their environmental impact are also explicitly mentioned.

New technology is expected to make a major contribution to improving the current situation. For instance, Van Wee et al. (1996) demonstrated in a scenario study the feasibility of achieving the following emission reductions

between 1990 and 2030 using technological innovations:

- CO₂: -80%
- NO_x: -90%
- VOC (volatile organic compounds) - 90%
- small particles: - 90%.

The study argues that these objectives can be met without limiting economic growth. In other words, technology can help decouple economic growth from the increase of environmental damage resulting from growing transport demand (Baum, 2000).

However, the introduction and uptake of new options is hindered at the level of several of the mechanisms of the innovation process. As pointed out by the High-Level Group set up by the Ministers of Transport of the European Union in April 1999, six categories of barriers to innovation in the transport field can be distinguished (HLG 1999):

- Lack of awareness of available information;
- Regulatory and legal barriers;
- Technical barriers;
- Financial and commercial barriers;
- Societal barriers;
- Decision-making barriers;

This diversity of barriers is compatible with a "co-evolutionary" understanding of the innovation process. It is argued that technological innovation nearly always consists of three components: *technology*, *institutions* in the environment in which the technology has to be introduced (e.g. legislation, distribution of competencies, ownership) and *culture* (e.g. attitudes, preferences, habits and values). In the innovation process all three components are strongly coupled and thus have to evolve simultaneously. Barriers can emerge from each of the three components and especially from the interaction between them. This implies that users and stakeholders have to be involved in the innovation process in order to avoid a discrepancy

in the evolution of culture, institutional issues and technology. Only an open, interactive innovation process has the potential to lead to sustainable innovation outputs.

Dealing with uncertainty: Information needs of innovation policy

These considerations show that public policy, and as part of this also European policy, is confronted with major difficulties when aiming to address these barriers and influence the future evolution of transport technology in line with the objectives set.¹

First of all, it is necessary to have a good understanding of the technological, economic and social implications of emerging technologies. There are different types of uncertainties and interdependencies to be understood, for example:

- Uncertainty with respect to the future performance characteristics of new technologies (What is their potential?);
- Uncertainty about the quality of their impact along different assessment dimensions reflecting the main policy objectives as pointed out above (Are they desirable?);
- Uncertainty about the size of their impact under different future scenarios of the transport system (Do they matter?);
- Uncertainty about the best technology to choose in order to realize certain policy goals, e.g. should we choose alternative fuels, electric propulsion or hybrid propulsion to reduce CO₂ emissions? (What priorities?)

Such uncertainties are not necessarily an obstacle for policy. On the contrary, often uncertainty means that it is still possible to make

A recent scenario study argues that transport objectives can be met without limiting economic growth, i.e., technology can help decouple economic growth from increasing environmental damage resulting from growing transport demand

Technological innovation involves the interplay of technology, institutions and culture. Barriers to uptake can exist at all three levels

A good understanding is necessary of the technological, economic and social implications of emerging technologies

Uncertainty is not necessarily an obstacle for technology, it can in fact mean that it is still possible to make choices and influence the future performance of technologies by policy measures

Policy itself can contribute to the uncertainties related to emerging transport technologies. Moreover, different levels and areas of policy do not always give complementary signals

choices and influence the future performance of technologies by policy measures taken today or tomorrow.

In addition, transport is a large-scale, multi-level system. Innovations in base technologies (e.g. new materials) need to be taken into account as well as new transport concepts (e.g. the all-purpose car or the high-speed train) in terms of their impact on the transport system.² Technological interdependencies in such a complex technical system favours incremental changes and hinders system innovations, as evidenced by the long lifetime of infrastructures and their high costs.

Finally, policy itself contributes to the uncertainties related to emerging transport technologies. The reliability of regulations, pricing frameworks and organizational structures (e.g. as a consequence of liberalization of transport markets) affects the perspectives for innovations, and different levels and areas of policy do not always give complementary signals.

Even with a fairly good understanding of these issues it is difficult to define the appropriate role of public policy supporting transport innovations. The second step for European transport innovation policy is thus to find an appropriate role within the range of policies where it can add value, as well as good timing to optimize its impacts.

During the innovation process, policy can in principle take different roles with respect to new technology, and these roles can change from phase to phase: Monitoring agent, R&D agent, regulator, innovation agent, implementer or even developer (van Zuylen et al. 2000). It is widely accepted nowadays that policy should not aim to pick "winning" technologies, but it is regarded necessary to influence and support innovations and their uptake in different phases in order to frame the corridors for technological trajectories in

the future. In addition, policies relevant to transport innovations are implemented in different policy areas and at different policy levels. As indicated by the interactive model of innovation, RTD policy, transport policy, competition policy and other policies affecting different elements of the interactive model, cannot be analysed in isolation. It is therefore necessary for European policy to find a role where it can really add value to the establishment of transport innovations, by giving well-timed impulses from research and by helping to coordinate different policy areas and levels.

However, this needs to be done on an informed basis. Identifying such "most promising" technologies becomes an important first step to inform and underpin policies to frame and support innovation in the transport field, in a way that is compatible with policy objectives. An important question in this respect is whether the identification of such most promising technologies should also be based on an interactive process (i.e. with involvement of stakeholders), or whether it should rely mainly on the judgement of independent experts. There is no unique best answer to this question, but recent experiences indicate that the involvement of industry and users is also recommended in this identification phase.

The contribution of forecasting and assessment: Identifying the most promising technologies

European transport innovation policy needs to be done on a well-informed basis, which is why it is important to identify likely impacts and performance potentials of emerging technologies. It is essential to have reliable assessment information and performance estimates for emerging technologies to underpin policy choices, and to anticipate potential challenges, risks and opportunities. Estimates of the future performance of a wide range of emerging transport technologies,

focusing in particular on new transport concepts, have been made for the time horizon 2020, based on the best currently available information, and assessed along four main dimensions for different scenarios and different application areas.³

The analysis led to the identification of a number of “most promising technologies”, i.e. of technologies which are expected to have a positive and significant impact on most of the assessment dimensions in the different scenarios and which are likely to be influenced in their uptake by policy measures (van Zuyley et al. 2000). In other words, these technologies are “robust”, i.e. they promise to have a positive impact under quite different scenario conditions, they are “relevant” because they are expected to have a considerable overall impact, and they are “policy-sensitive”, i.e. they can be influenced by innovation policy measures.

When looking at Table 1, it is striking that apart from the expected uni-modal technologies (air, rail, road, ship) information technology and multi-modal technologies stand out as particularly promising. Even within the individual modes, technologies such as traffic information and

management, telematics, and intelligent operation support system frequently arise and give additional weight to ICT for future transport technology. Multi-modal integration, as the second horizontal group of technologies, is also complemented by innovations in the individual modes, e.g. in terms of new mobility concepts (car-sharing, ride-sharing⁵, freight logistics). A third type of innovation that stands out across the different groups are new propulsion systems for all modes. This is the area where currently perhaps most attention is directed, mainly as a result of environmental concerns. Finally, in line with the reorientation of transport provision in a framework that is based on market principles, technologies to enable the tolling and pricing of road transport are regarded as highly promising future options.

Possible roles for the EU in transport technology policy

Most of the promising technologies identified would benefit from a combination of policy measures over the innovation cycle, but only some of them would best be initiated at European level. A balance needs to be struck of European against national, regional and local measures at different

Identifying “most promising” technologies is an important first step to inform and underpin policies to frame and support innovation in the transport field

Analysis of future performance of emerging transport technologies has revealed a number of technologies which are robust, relevant and policy sensitive

Among the emerging technologies, information technology and multi-modal technologies stand out as particularly promising

Table 1. The “most promising” transport innovations⁴

Category	Technology (Innovation phase)
Multi-modal technologies	<ul style="list-style-type: none"> • Multi-modal travel information (2,3) • Multi-modal trip planning information (2,3) • Intermodal transshipment terminals (3,4) • Intermodal passenger terminals (2,3) • Multimodal transport services (2,3) • Reservation system for transport modes (2) • Information system for the co-ordination of modes (2) • Information system to identify preferences and habits of travellers (1)
Information technology	<ul style="list-style-type: none"> • Smart payment systems (3,4) • Smart card (3,4) • Authentication systems (2,3) • Mobile access to internet (4) • Teleactivities (4)

Harmonization of structural conditions across Europe is conducive to transport innovations only if they do not imply heavy administrative and financial burdens which could new barriers to innovation

Continued

<p>Road</p>	<p>a) Generic</p> <ul style="list-style-type: none"> • Advanced propulsion systems (2,3,4) • Electric and hybrid traction (3,4) • Fuel cell (2,3) • Electric urban car (3) • Dynamic route planning (3) • In-vehicle traffic information (4) • Electronic tolling (4) • Navigation systems (4) • Traffic control systems (4) • Parking management systems (4) • Automated guided vehicles (2,3) • Driver support systems (2,3,4) • Drive by wire (2) <p>b) Passenger</p> <ul style="list-style-type: none"> • Human powered vehicles (4) • New systems for personal rapid transit (2,3) • Ride sharing (4) • Car sharing (4) <p>c) Freight</p> <ul style="list-style-type: none"> • Road trains (4) • Freight telematics (3,4) • Innovative systems to build underground freight infrastructure (2,3)
<p>Rail</p>	<ul style="list-style-type: none"> • Recycling and upgrading waste material (urban rail) (3) • Fuel cell and battery technology (on-demand rail systems) (2,3) • New rail infrastructure for new transport concepts, e.g. Maglev and Personal Rapid Transit (2,3) • Traffic management systems and integration of information technologies with GNSS (Global Navigation Satellite Systems). • Wireless Communication Systems and Computer Communications Networks (Internet, LAN, WAN) for long distance passenger and interurban rail) (3,4) • Weight and drag reduction (3,4) • Tilting high speed rail (3,4) • Technologies for coping with different voltages (3,4) • Light rail and people movers (3,4)
<p>Air</p>	<ul style="list-style-type: none"> • Megaliner (2) • Tiltrotor (2) • Improved propfan propulsion (3) • Supersonic commercial transport (2,3) • Airship (2,3) • Supersonic aeroplanes (3) • Defrosting/de-icing systems (3) • Air traffic management (3)
<p>Ship</p>	<ul style="list-style-type: none"> • All-electric ship (2,3) • Fast sea-going passenger ferries (3,4) • Fast inland passenger ferries (3,4) • Whale tail inland ship (2)

Source: van Zuylen et al. (2000), The meaning of the numbers in brackets refers to the innovation phase in which the technology currently is: 1 = technology in the invention phase, 2 = test phase, 3 = first practical application, 4 = market introduction, 5 =maturity and use, 6 = decline or take over by a new technology

times, addressing different key aspects of innovation, not least due to community principles such as subsidiarity and the need to justify the added value of community action. Similarly, technologies that are already targeted by industrial R&D do not necessarily require additional financial support from the EU, but could benefit for example from initiatives related to standardization. In general terms European policy is likely to contribute positively to innovation in transport by means of combinations of the following types of measures:

- *Structural measures:* Legal and regulatory framework conditions need to be conducive to innovation, and many organizational and taxation principles are actually defined at European level. The liberalization of transport markets is a good example of this, but also environmental regulations, or a future framework for fuel taxation. However, the harmonization of these structural conditions across Europe is conducive to transport innovations only if they do not imply heavy administrative and financial burdens, imposing new barriers to innovation.
- *Technology measures:* While large areas of innovation policy may be better implemented at national or regional level, there are nevertheless several technologies with a specific European dimension (think for example of aeronautics) where research actions at European level are appropriate. Similar arguments hold also for the generic types of propulsion systems, which would benefit greatly from a coordinated European research basis. Further downstream in the innovation process, experimentation and pilot projects financed by the European Union can be very useful for disseminating findings about the appropriate application conditions for new transport solutions. It should be clear, however, that the closer such measures come to the market, the more important it is to find a careful balance between the protection of

experimental technologies on the one hand and the need to prepare them for competitive pressure on the other. Support for niche technologies needs to be clearly limited.⁶

- *Compatibility measures:* A very important role has been assigned to early attempts to achieve a standardization of transport solutions. This is not only important to enable the compatibility of technologies across the borders of the European member states, and thus to exploit the size of the European market, but also to create the critical mass for introducing these technologies at global scale. However, there is a trade-off of early standardization because a definition of a standard too early can prevent superior options from becoming established.
- *Cultural measures:* European policy can play a framing role by promoting new visions related to transport, and thus changing the mobility culture in the member states. The Green and White Papers of recent years have paved the way for innovative behaviour by technology suppliers and transport operators, and have also affected citizens' awareness of the side-effects of transport.

As these conditions and policies are defined in different policy realms and at different policy levels, for coherent policy mixes to operate, a good coordination of measures would be desirable. For example, the fact that innovative behaviour in the transport sector is dependent on the degree to which competitive pressure exists means that transport technology policy is clearly linked to competition policy in this sector.

Conclusions: Possible packages for future European transport technology policy

Based on the identification of most promising technologies and the possible roles for European

Experimentation and pilot projects at European level can be very useful for disseminating findings about the appropriate application conditions for new transport solutions

Early standardization of transport solutions has an important role to play if the size of the European market is to be exploited to create critical mass

European policy can play a framing role by promoting new visions related to transport, and thus changing the mobility culture in the member states

From a European perspective, non-technical actions such as regulations and adjustments to the existing policy framework seem to be a promising way of speeding up the introduction of new propulsion systems

A crucial problem that needs to be addressed in the urban context is the interrelationship of transport with land-use planning and the improvement of public transport systems

There is no dominant driver of change fostering innovation in passenger and freight intermodality technology, but a multitude of factors. A set of interdependent actions would therefore be needed to stimulate intermodality

policy, seven different “policy packages” can be suggested to address the most important transport policy issues from the technology side. These packages are not organized around specific technological solutions, but rather reflect the main problem areas for future transportation in Europe.

- *Propulsion package:* With progress in propulsion technology mainly being driven from the regulatory side, there is only limited scope for direct research funding to complement ongoing national and industrial R&D. From a European perspective, non-technical actions seem to be more promising, for example through regulations and adjustments to the existing policy framework to enable and speed up the introduction of new propulsion systems. This would entail the setting up of a network of relevant actors (e.g. for infrastructures, fuels, etc.), but also pilots and demonstration projects in order to build up and disseminate the knowledge needed for a well-informed assessment of application conditions and prospects.
- *Urban package:* In addition to the propulsion package, a crucial problem that needs to be addressed with respect to the urban context concerns the interrelationship of transport with land-use planning and the improvement of public transport systems. The EU has a limited role only with respect to urban transport, because the implementation of most actions (e.g. in planning, investment, access restrictions, etc.) is clearly a local competence. However, the exchange of experiences, the raising of awareness, and the formulation of framing regulations (e.g. regarding safety and land-use planning) would be helpful to speed up the introduction of promising urban transport technologies. Although this can be underpinned by pilots and demonstration projects, the scope for direct R&D into transport technology for the urban context to be funded by the EU seems to be rather limited.
- *Intermodality package:* In contrast to propulsion systems where environmental concerns are the main drivers for innovation, there is no such dominant driver of change fostering innovation in passenger and freight intermodality technology, but a multitude of factors. A set of interdependent actions would be needed, composed of regulatory changes, standardization measures, pilot actions and demonstrations, R&D (especially in new rail systems), new terminals, and – perhaps most important – stimuli for the creation of intermodal service providers, i.e. of organizations that have an intrinsic interest in intermodal solutions. The uptake of intermodal technologies also implies major changes in user behaviour, as expressed more recently in the growing acceptance of intermodal mobility packages such as ride- or car-sharing.
- *Aeronautics package:* A significant part of the EU's current RTD actions is dedicated to aeronautics, being the first transport industry to become truly European. A large part of the activities in this area reflects industrial concerns. The main bottleneck to be addressed by the EU seems to be in ground-based systems and air traffic management, rather than in new aeroplane technology. In addition, R&D into safety matters should continue as a specific European research interest. The acceleration of certification and standardization procedures should also be integrated in the aeronautics package because it is an important determinant for the speed of uptake of new solutions.
- *Rail package:* Industrial development of new rail systems is under way for several of the most promising rail technologies. While high-speed and tilting trains have received a lot of policy attention over recent years, other options are still in an early development phase and would benefit from kick-off funding. This holds in particular for urban rail technologies and other

advanced people-mover-type technologies that are not yet supported by the main companies in the rail sector. A key element of an innovation-oriented strategy in the rail sector should also be seen in opening up to competition as an incentive for innovative behaviour. With safety concerns continuing to play an important role for rail systems, R&D and pilot projects are also justified at European level.

- *Navigation and travel information package:* Information and communication technologies play a growing role for all modes and for modal integration in particular. Much R&D is already being done in this area by industry. The focus for European policy should rather be seen in coming up with sophisticated solutions for dealing with standardization, interoperability and data protection issues to enable compatibility and competition throughout the Member States. Also the issue of property rights has to be considered in order to make travel information an economically exploitable service.
- *Traffic management, communication and payment package:* This package addresses "interactive" technologies that are likely to have an impact on transport demand, either in terms of absolute demand or in terms of the distribution of demand over time. The

application of technologies for traffic management will depend on the future pricing framework in the EU, clearly an issue to be addressed at EU-level. However, it will also require further R&D to foster technology innovation. With a lot of research going on in this area, the role of the EU could be to frame future developments in interactive technology, e.g. by promoting the establishment of common standards in traffic management.

These seven packages can only sketch out where future areas of action for European transport innovation policy could lie. Apart from these actions, which refer mainly to transport technologies, the EU will have to consider actions on technological innovations that may have a significant impact on transport demand. Teleactivities (such as teleworking, teleshopping, virtual entertainment, etc.) will change travel demand, at least in a qualitative way. Miniaturization, dematerialization, reuse of materials, renewable materials in industry will affect patterns of transport demand as well, while the use of ICTs in industry and services open up new ways to rationalize logistics, but also new kinds of transport streams (e.g. as a consequence of e-commerce) (Baum 2000). These innovations will have to be monitored carefully with respect to their future impact potential on transport.

In aeronautics, the main bottleneck to be addressed by the EU seems to be in ground-based systems and air traffic management, rather than in new aeroplane technology

Opening rail up to competition should be seen as an incentive for innovative behaviour and therefore a key element of an innovation-oriented strategy in the rail sector

The application of technologies for traffic management will depend on the future pricing framework in the EU. There is scope for promoting the establishment of common European standards in traffic management

Keywords

Transport, innovation, assessment, forecasting

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Notes

1. The main objectives of Europe's Common Transport Policy can be captured in the following rough categories as derived from the most recent Action Programme (CEC 1998): guarantee market access and functioning, establish integrated transport systems, guarantee fair and efficient pricing, contribute economic and social cohesion, make sure that the rules are applied, improve safety, reduce environmental impact, improve external effectiveness, ensure enforcement of existing rules, protect consumers and improve the quality of transport services.

2. In terms of levels, transport can be differentiated in six levels: base technologies, components, applications, vehicle concepts, transport concepts, and transport systems, with the latter level distinguishing mainly freight and passenger transport.

3. This work was done as part of the DG VII funded project FANTASIE (Forecasting and Assessment of New Transport Technologies and their Impact of the Environment). The scenarios were labelled as 'Unrestricted Growth', 'Sustainable Growth', 'Business as Usual', and 'Sustainable Balance' The application areas studied were freight and passenger transport for five different distance classes each, and for short trips a further distinction was made whether urban trips were included or not (Korver and Harrell 1999). The main assessment dimensions taken into account were environmental impact, safety impact, efficiency and quality impact, and socio-economic impact.

4. The technology categories used in this table distinguish mainly between different transport modes, complemented by two cross-cutting categories (multi-modal and information technology). Most of the individual technologies listed refer to the levels of transport concepts or vehicle concepts (see footnote 2).

5. The distinction between car-sharing and ride-sharing is that ride-sharing means that one individual still owns the car, but coordinates his trips with others by means of advanced ICT/telematics/ride information systems, e.g. for commuting. Car-sharing, on the other hand, is a professional service offered by a firm that also owns the cars and thus has the responsibility for maintaining and insuring them. This means also that a car-share car is only used within the car-sharing scheme, whereas a ride-sharing car is normally used for the individual needs of the owner.

6. This argument is in line with the findings of several EU-funded research projects that analysed the outcomes and processes of pilot projects and experiments with transport innovations, e.g. in the context of the projects SNM-T, Utopia and ENIGMATIC.

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The New Role of Intermediaries in Travel and Tourism Distribution Channels

Despina Kanellou, *SPRU*

Issue: The accepted wisdom in the Travel and Tourism (T&T) industry –with very few exceptions– has so far placed the emphasis on disintermediation or the disappearance of traditional intermediaries like travel agents, tour operators or even the Global Distribution Systems (GDSs).

Relevance: There is evidence on which to base an alternative scenario of development of the T&T channel which has far reaching implications for policies relating to electronic commerce.

The Travel and Tourism (T&T) industry is an important growth sector in the economy of Europe and elsewhere

Changes in telecommunications and the spread of the Internet are placing a number of traditional tasks of intermediaries under the direct control of consumers

Introduction

The travel and tourism sector (T&T) is among the leading growth sectors in Europe and worldwide. Its development is closely linked to broader socio-economic and technological changes, which, through their co-evolution, are continuously re-shaping the nature of supply of, and demand for, travel and tourism services.

Different participants in the T&T sector are very differently prepared to meet the technological challenges. Global Distribution Systems (GDSs), Computer Reservation Systems (CRSs) and especially small and medium sized enterprises (SMEs) have very different organizational structures and inherited competencies. The limits in terms of their interoperability or 'the end-to-end' provision of a given service in a consistent and predictable way is still 'the' big organizational and technical

problem in the sector. Furthermore, the demand side - the customer - is increasingly attracted to using information technologies, especially the Internet, in order to get direct access to information concerning their travel and tourism needs. As the costs of ICTs continue to fall and their capabilities increase, distribution and transaction management of T&T services could theoretically be within the users' control. It is a common view that the searching, evaluating, and coordinating functions, which represent the most knowledge intensive part of the transactions that people and companies must make when they exchange goods and services, will be transferred from the intermediary -the retailer- to the customer.

However, extensive empirical evidence and conceptual analysis on the travel and tourism distribution channel does not support this argument (see Kanellou, 1999). In a rapidly evolving electronic market, the spread of direct links

between suppliers and customers would lead neither to a 'squeezed intermediary' nor to its disappearance. On the contrary intermediaries not only continue to operate in the distribution channel, but are likely to do so as ever more powerful actors, actively shaping the structure of the T&T sector. The rationale for their continuing existence is in their unique functions of integrating -'packaging'- complementary travel services and products to provide a complete and satisfying service to the customer. This is the most important function of intermediation: the *intelligence* function.

Intermediaries in the travel and tourism distribution channel

In the absence of a physical distribution system in the T&T sector, a distribution channel based on intermediary functions has developed. The distribution channel is an orchestrated type of network that creates value for the producer/supplier or the consumer, and is built on the simultaneous existence of trust and power relationships (Stern and El-Ansary, 1992). The actors (intermediaries) in the distribution channel are creating value, and being paid for it on three basic levels: *the access to information, the ability to evaluate, process and manipulate the information* for each individual case and come up with the 'right information', and *the ability to sell directly*.

The analysis of the stages of intermediation in T&T (Kanellou, 1999) suggests that:

- the role of the intermediary has been an important element in all stages experienced by the tourism and travel sector so far;
- the role of the intermediary is inextricably linked to changes in technology ;
- since each major wave of new technology changes the arena and the distribution of

power between the actors, the role of each intermediary also changes; however, this change does not lead to disintermediation;

- in each stage a new intermediary controls the distribution channel; the nature of intermediation (source of power, product/service, and driving force) though is different.

The history of intermediation in travel and tourism also suggests that the accumulation of specialized knowledge or 'intelligence' about suppliers and customers is crucial for successful intermediation. Intelligence, in this respect is defined to be the *actionable knowledge* or the ability to filter and evaluate the available information about suppliers' products and services and match it to the needs of customers in a way that suppliers and/or customers are able to act upon it. The building of this capability, which is the key strategic resource of the T&T distribution channel, continues to be relevant today in the Internet-based distribution channel. How to transform the available information of global services into knowledge of the 'right' information about a trip, or a holiday that satisfies the needs and desires of any customer at any time, in any part of the world is a challenge for participants in T&T.

The novelty is that as the new technical solutions generate increasing information overload, this in turn increases the problem of how to transform the available information into 'tailored information' or 'actionable' knowledge. This problem is exacerbated as the integration of information becomes ever more important.

During the 1990s the tourism industry has utilized Computer Reservation Systems extensively. Virtually all larger airlines offered their range of services via one or more systems and the degree of penetration of on-line terminals among travel agents generally increased during

The history of intermediation in travel and tourism suggests that the accumulation of specialized knowledge or "intelligence" about suppliers and customers is crucial for successful intermediation

The advent of Global Distribution Systems in the 80s and 90s transformed the role of intermediaries in the travel and tourism sector from retailers of "package holidays" to distributors of information

The Internet has brought a new kind of intermediary into the field able to exploit the network to offer an increasingly comprehensive range of service and price options

The "virtual" nature of these new intermediaries means that gaining customers' trust, and building reputation and credibility become of the utmost importance

this period, so that 100% of American and 95% of European travel agencies are equipped with GDS terminals.

During the 1980s-90s, the GDSs emerged as the new intermediaries by interconnecting suppliers' databases and thus became the content originators for travel and tourism services. The result of this transformation was a major shift in the way travel is bought and sold around the globe, and it also changed the role of the travel distribution system from one of distributing "package holidays" to one of distributing information.

By the end of the 1990s the boom of the **Internet** had become obvious. Today, each GDS chooses its own strategy depending on its technological capabilities, its organizational structure and/or its market share in the distribution of travel sales. Each GDS realized quite early on the importance of the Internet as well as the threats posed by it and tried to respond to them.

The Internet as a new "medium" has the potential to evolve into an interconnected marketplace, facilitating the exchange of a wide variety of products and services. In the last few years, a new type of intermediary—the so-called "cybermediary"—has developed, alongside the existing intermediaries (travel agents, tour operators, CRS, and GDS). Their specialist service will be to tailor a diverse set of possible services and price options to individual customers' needs. By being able to monitor a large number of service suppliers, they can build intelligence tailored to individual needs or to specialized segments of demand. This strategy leads to the **integration of information**. From being distributors of information these new intermediaries face the challenge of becoming generators of customized travel and tourism information. The latest development in the sector, which took place in December 1999 when

Travelocity, Preview Travel and Price.com formed a marketing alliance whereby the users of any of these services will be able to access the services of the others, indicates the huge potential and opportunities for this new type of intermediary.

The main issue today is how customers will obtain information relevant to their interests and what can be done to increase the possibility that suitable suppliers' information reaches customers. *The challenge is to empower customers through intelligence based intermediaries*. The main business issues then are the shift from information processing capacity and organization towards:

- integration of information from all suppliers;
- building customer databases;
- ability to search and filter information for products and services that match customer needs that are not always clearly defined;
- ability to guarantee the quality of service;
- customization of information;
- personalization of service/product;
- cost and time savings.

The core business of distribution in today's travel and tourism sector is the transfer and manipulation of information. This has not been the case throughout the history of the travel and tourism distribution sector, but has become obvious with the widespread use of ICTs. ICTs give customers the opportunity to shift from being static spectators to dynamic "retailers", or at least allows them to perform some of the retailers' functions. On the other hand, the "virtual" nature of the intermediary means that gaining customers' trust, and building reputation and credibility become of the utmost importance for it to become "dynamic".

These developments change the importance and the role of intermediation very significantly and lead not to disintermediation but rather to a change in the origin of "dynamic governance

costs" i.e. the costs "of not having the capabilities you need when you need them" (Langlois, 1992). In other words the costs originate not from the supply side as was the case in previous stages, but from the demand side.

Dynamics and Strategies of Cybermediaries

The presence of intermediation is very evident already in Cyberspace. Travel is one of the most popular e-commerce categories, outpaced only by books (45% and 54% respectively). The on-line leisure travel business has been pioneered in the USA by the airlines and online agencies such as Preview Travel, Sabre Holdings' Travelocity, Price.com and MSN Expedia. On-line intermediaries –so-called cybermediaries– comprise 52% of the market and supplier-branded sites (air-car-hotel-destinations-tours) make up the remaining 48%. The value of on-line leisure and business travel was estimated at \$276m in 1997 and since then has increased to £3 billion in 1998 and £6 billion in 1999. Of that, £3.6 billion is from on-line travel agency sales (see www.phocuswright.com).

Nevertheless, it is important to keep in mind that only 3% of travel product/services are booked on-line and that airline tickets represent 73% of all on-line bookings. This is a very important indication of customer reactions to this new service. Customers are willing to buy travel services through the Net, but they make only simple transactions, which are presented in a simple way from a variety of sites -for example, purchase of airline tickets. The latest U.S *Travel Weekly* study (6-4-1999) confirms that nine out of ten leisure travellers value their Travel Agent (TA) much higher than the Internet sites, when it comes to problem solving and giving advice. In particular in the above survey consumers said they are loyal to their TA because of their agent's:

- ability to get the best price (34%)
- convenient location (31%)
- personal relationship with the customer (28%)
- general good service (24%).

It is also claimed that on a scale of one to ten, 57% of consumers scored their agencies at eight or better in complete understanding of customers' needs. Another on-line study by the

Although on-line sales of travel and tourism products are popular and growing, customers tend to make only simple transactionse presented in a simple way from a variety of sites such as the purchase of airline tickets

Table 1. Primary Reasons Why Internet Users Book Travel Reservations off Line

Primary Reasons for not booking on-line	Total Respondents	Newbies (less than 6 months on-line)	Intermediate (6-24 months on-line)	Net Vets. (more than 2 years on-line)
Lowest Price	31%	28%	28%	33%
Credit card security concerns	18%	33%	25%	13%
Human Contact	16%	8%	16%	16%
Accurate Reservations	14%	9%	13%	14%
Other	21%	22%	18%	24%

Source: NDP Online Research spring 1999 (www.ndp.com)

NDP Online Research for the Travel Industry found that a majority of Internet travellers (56%) continue to divert the confirmation of their travel reservations to traditional intermediaries. In a more recent study (January 2000) the Gartner Group projects that the worldwide on-line travel market will increase to \$30 billion by the end of 2001.

However, the study indicates that 75% of people with Internet access, researched schedules, flights, discounts and travel packages (400% increase from the fourth quarter of 1998) before booking personal travel through traditional channel, while only 16% of them booked flights and paid for tickets on-line (an 800% increase since the fourth quarter of 1998).

The two key reasons for not purchasing flights on the Internet were cited as:

- the need to ask further questions regarding special needs;
- the need for a more flexible ticket reservation and ordering process.

The reasons for booking off-line are not related travellers' level of experience with the Internet. In fact, as table 1 suggests, Net Vets value human contact and accuracy significantly higher when choosing off-line booking than do Internet beginners.

These results confirm the main argument concerning the importance of "intelligence" functions of intermediaries who are able to provide "actionable" knowledge for the consumer.

Table 2 presents different types and combinations of strategies that T&T cybermediaries currently follow. Strategies are described in terms of their supplier service focus (content/infrastructure), cost reduction focus (context), and customer service focus (combination of content-context-infrastructure strategy) ¹.

Strategy focused on development of infrastructure provided by so-called Portals/Vortals (i.e. "vertical portals" which aim their content at a particular audience) or is oriented mainly towards SMEs that cannot afford to create commerce friendly on-line sites. For example, Leisure Planet is a provider of tourist related information (content strategy) and travels bookings and customer services to on-line consumers but it also functions as an automatic forwarding system (infrastructure).

Another group of T&T cybermediaries is developing a *context only* focused strategy, i.e. IT is used as a tool for cost reduction which does not affect the service content. For example, **Priceline.com** does not have its own proprietary content or infrastructure. Instead, it creates a context in which consumers name the price they

Table 2. Strategic orientations of the main travel and tourism cybermediaries

Content/Infrastructure	Context	Content/Context/Infrastructure
Portals/Vortals	Auctions	Travel Web Sites
Leisure Planet	Priceline.com	Travelocity
WorldRes	Suppliers branded sites	Preview Travel
THISCO (Switch)	Airlines, Hotel chains, car-hire companies, destinations	ITN MS Expedia TravelWeb

are ready to pay for a wide range of goods and services through a Website (www.priceline.com), and then the site presents that price electronically to sellers, who decide whether or not to meet the buyers' conditions. Also, the airlines and the hotel chains that "own" the product or service that they sell directly in cyberspace, for the time being are utilizing this technology to cut their distribution costs, as well as to build a loyalty relationship with their customers.

The most innovative strategies in the T&T sector are those that are fully customer oriented and offer both content/context and infrastructure simultaneously. SABRE has been the pioneer in introducing a combined strategy of content, context and infrastructure via the Internet. This is important to bear in mind as it has been often argued that originally the top on-line intermediaries were not travel intermediaries pre-Internet. However, a closer look indicates that behind these cybermediaries there exists a very strong link with the GDSs. Travelocity, which functions as a travel agent on the Net, is the brainchild of GDS SABRE. Also, in 1985 SABRE introduced another on-line service for its business customers called Easy Sabre; thus, SABRE had had a lot of on-line experience before the emergence of the Internet. Galileo GDS, on the other hand has been always slower and more wary about adopting IT innovations, and so it chose the infrastructure based strategy, to serve 14 leading T.A companies such as Preview Travel, ITN, etc. In addition, behind EXPEDIA, the second most important travel cybermediary, are not only Microsoft's leading-edge technology and budget, but also WORLDSPAN GDS.

Intermediaries between passive and active use of information: Management and policy implications

The experience of on-line transactions in travel and tourism through the diffusion of CRSs in

1980s led to an increasing use of data processing technology. The accumulation of large databases has become a definite source of market power. As more sophisticated information was used to create market segmentation and product differentiation, the strategic profile of intermediaries became based on their data-processing capacity or their ability to store, process and transmit huge amounts of information accurately. This was coupled with exclusivity contracts, incentives to travel agents and geographical dominance (overriding commissions, more sophisticated information bias, etc.). Information-processing capacity may be used internally and/or marketed to other organizations, creating alliances, which are the source of much incremental revenue and market power. This is exactly what is happening at the moment on the Internet, and is not a specific feature only of the T&T industry.

However, as the number of intermediaries with data-processing capacities increases, the search for content as well as the pressure to generate customized or personalized information increases. The information is used as a **knowledge resource** with the aim of generating intelligence or actionable information for customers. As Kyriakou (1996, 1998) points out, continuing technological innovation and liberalization of markets have caused a reduction in the telecommunications distributors' expected profit margins, and increasingly are improving prospects for content providers and packagers. "The content provided is becoming ever more crucial to the consumer's decision to opt for one from among several rival distributors, i.e., intermediaries providing access to the carried content." (Kyriakou, 1998). This suggests that there is a shift in business strategies from the passive use of information (*information as syntactics*) towards the active use of information and development of a combination of content, context and infrastructure strategy (*information as semantics*).

A closer look at top on-line intermediaries in the travel and tourism business reveals that many have close links with existing GDS players and have built on their experience

Whereas in the 80s intermediaries could rely on using their data-processing capacity in conjunction with exclusivity agreements or geographical dominance, today they need to use their information resources to generate "intelligence" for customers

The Web gives access to almost unlimited information but does not integrate that information. This creates a niche in which intermediaries can provide consumers with a valuable service

The economic and management problem for intermediaries has become how to combine economies of scale and scope through mass customization of services. The crucial issue is how to design products in interaction with customers and yet achieve economies of scale.

The main objective in terms of business process organization is to achieve *information integration*. The Web was designed to facilitate access to information, not the integration of that information. The ill-defined nature of demand requires intermediation to assist in the articulation of consumer needs. Information dissemination (content) cannot meet this requirement unless the intermediary already has (or develops) the specific capabilities necessary to assist customers in the form of "intelligence" or "actionable knowledge". For successful intermediation, sector-specific competencies are essential. However, this does not mean that sector-specific competencies alone are sufficient. The challenge is to integrate the new technologies with sector-specific expertise, i.e. to combine IT knowledge with T&T specific competencies.

The novelty of contemporary intermediation is thus twofold. First, through its very close links with the customer the intermediary has the opportunity to learn much more about customer needs, requirements and behaviour. By doing so, the intermediary is able to control demand to a much greater extent than has been the case in the past. On the other hand, the "virtual" nature of intermediation means that gaining customer trust, and building reputation and credibility have become issues of the utmost importance for would-be market leaders. As with intermediaries in the past, cybermediaries today are not solely in the business of distributing products and services, nor are they even in the business of distributing information, but are mainly in the business of serving customer needs. Those players who are

able to recognize this trend and successfully adjust to it are likely to become market leaders in Internet-based T&T distribution.

The achievement of information integration in the T&T sector is an issue of importance not only for intermediaries in general but also for regions, national governments and the EU. The main problems in relation to the European T&T sector can be summarized as follows:

- The information and communications infrastructure is not developed equally across the European regions.
- Regions/destinations generate content for T&T products and for the services of intermediaries/cybermediaries. As content providers they become a crucial part of the distribution channel of T&T services. However, the relationships between destinations and intermediaries are not sufficiently developed to exploit the new opportunities that could emerge through such close relationships.
- Destinations are trying, most often in isolation, to build their own systems for direct selling. Due to information overload and limited marketing capacities there is a danger that their systems will become "lost in (cyber-)space".
- In addition, destinations face significant problems organizing themselves. They are dominated by family owned and run SMEs with informal organizational structures, which lack specialized personnel and receive inadequate training (Buhalis 1995). The limits in terms of their interoperability or the "end-to-end" provision of a given service in a consistent and predictable way is still "the" big organizational and technical problem in the sector. As a result their marketing and management performance is extremely poor. They are product focused, rather than customer focused, and as a consequence

depend heavily on intermediaries, like Tour Operators (Buhalis 1999,1995).

While the focus of this article is not on the policy aspects, certain policy implications do emerge clearly from the analysis.

First, policy should focus on regions/destinations in order to help them understand the need to redesign their business processes and to focus on information integration and customer-tailored services. Second, the shift towards IT-intensive services requires large-scale support for updating IT skills in regions through diffusion oriented programmes.

The EU has taken several actions to support SMEs as well as providing the Regional infrastructure for further T&T developments (EU 1993, 1998). However, the scale of coordination failures that must be overcome requires much larger *cooperative* action than has been the case so far. The opportunities that are emerging from ICT developments, and Internet based distribution in particular, need to be accompanied by structural policies at regional, government and EU level. These actions should include:

- Information and communications infrastructure development;
- Training for marketing and management of T&T information systems for SMEs. For

example, these policies could involve special training for regional travel agencies for the provision of tailor-made services by interactive communication with other agencies or suppliers in different regions. In addition, support could be given in the form of the information systems of SMEs, hotels, restaurants, etc. which would connect them to portals/vortals etc., or to other intermediaries in cyberspace through intelligent websites;

- Coordination activities at European level so as to disseminate best practice in the development of regional or national distribution systems that offer end-to end provision (interoperability) of T&T products and services;
- Development of a EU umbrella strategy focused **on content, context and infrastructure**. Instead of support being given to numerous regional systems it should be provided only to systems that can communicate with and support the systems and activities of other T&T providers which will help in the **coordination** of activities **and the cooperation between** different actors across the EU regions. It would also provide:
 - Valued information for the consumer and links with all relevant sites in countries and regions;
 - Specific information for the travel industry and the regions.

Exploiting the opportunities that are emerging from ICT developments, and Internet based distribution in particular, could be assisted through structural policies at regional, government and EU level

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Keywords

travel and tourism, distribution channel, e-commerce strategies

Note

1. The content, context, and Infrastructure strategies are explained well in Jeffrey F Rayport and John J Sviokla (1994): "Managing in the Marketspace", *Harvard Business Review*, November-December, pp 141-150.

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NGOs and the Internet: Use and Repercussions

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Issue: Information and communication technologies (ICTs) have played a major role in making non-governmental organizations' (NGOs) voices heard more loudly by citizens and governments around the world.

Relevance: Thanks partly to the use of ICTs, NGOs have gained an important place on the international scene. This not only poses new challenges for sovereign states, but at the same time, counter-technologies leading to more intrusive electronic policing are being developed and used, thus raising different and perhaps deeper concerns.

Perhaps one the most important reasons why over the last decade national governments and international organizations were gradually forced to share their powers with a multitude of citizens groups, known as non-governmental organizations (NGOs), lies in the evolution of information and communication technologies (ICTs). Advanced ICTs have increased NGO's ability to mobilize information strategically to help to create new issues, to persuade, apply pressure and gain leverage.

There have been two main effects triggered by widely available and affordable technologies, which have contributed to strengthen the influence of these non-traditional actors in the policy-making arena. Firstly, a large amount of information, including the technical and scientific data, can be easily collected. This has broken governments' monopoly over relevant information and thereby deprived them of the deference they

enjoyed because of it. Secondly, this information can be managed without any difficulty. It can be further processed, forwarded or stored. This provides a great opportunity for people and organizations around the world to gather and publish information and to share ideas and strategies.

New technologies and NGO cooperation

The spread of ICTs has made it possible not only to connect NGOs with citizens but also to establish efficient NGO networks. The impact of NGO networks is of paramount importance as they can allow NGOs to join forces to increase their influence. For instance, several NGOs cooperated to mobilize thousands of people against the WTO meeting in Seattle (mainly environmentalists and labour NGOs). Additionally, well experienced NGOs may provide advice to recently set up or less developed NGOs. For instance, women's and

Advanced ICTs have increased NGO's ability to mobilize information strategically to help to create new issues, to persuade, apply pressure and gain leverage

ICTs mean governments no longer have a monopoly on technical and scientific data, moreover this data can be processed, stored and distributed more easily and rapidly than ever before

ICTs have also allowed NGOs to form networks for cooperation and to mobilize the largest number of activists possible for particular events

human rights' groups in many developing countries have linked up with more experienced, better funded, and more powerful groups in Europe and in the United States. "The latter work the global media and lobby their own governments to pressure leaders in developing countries, creating a circle of influence that is accelerating change in many parts of the world" (Mathews, 1997). Other types of cooperation among NGOs can also be envisaged. For instance, armed with compromising evidence of local labour practices or environmental degradation from NGOs situated in developing countries, activists in developed countries can denounce corporations' practices more effectively.

Internet-based services are not only a key communication platform where, for instance, a large number of documents are posted or where international discussion forums take place, but they can be also used as a platform for organizing. For instance, in 1992 citizens' groups from around the world met for the first time online to prepare common strategies for the Earth Summit in Rio and to develop alternative policy approaches.

NGOs and advanced technologies

NGOs and non-profit organizations are well aware of the key role of ICTs in mobilizing public support. For instance, the non-profit Association for Progressive Communications¹ provides several services in order to help NGO staff to use ICTs effectively. These services have been specifically designed to respond to NGOs needs. They include training programmes (e.g. on how to use e-mail effectively and website construction) and technical resources (Internet Provider Services, IPS). In 1995 the Association for Progressive Communications provided 50,000 NGOs in 133 countries access to ten million Internet users for the price of a local call. The rationale was to empower civil society by making expensive technology cheap.

NGOs use e-mail extensively. For instance, NGOs often send identical information to a long list of people: calls for action, situation reports, etc. E-mail makes mailing a thousand people as easy as sending an e-mail to one.

Looking further into the future, distance training via the Internet may represent a cheap and effective way to help NGOs staff to learn the skills needed to use advanced ICTs.

NGOs, new technologies and the international scene

The result of the use of advanced ICTs has been to strengthen the influence exerted by NGOs in the international decision-making process, as is shown by the following examples:

- The conclusion of the International Treaties to ban antipersonnel land mines and to create the International Criminal Court (ICC) was the work of a coalition of civil society organizations such as NGOs, international agencies and the media. NGOs working together have played a major role in producing these treaties using ICTs.
- In 1998 some 600 NGOs working together defeated an attempt by 29 of the world's richest nations to harmonize rules on foreign investment under the aegis of the Organization for Economic Cooperation and Development (OECD). The NGOs claimed that the proposed global treaty (known as Multilateral Agreement on Investment, MAI) would override local and national law on the environment and the rights of women and minorities. A draft of the text of the MAI was leaked by the Canadian delegation that gave it to the Council of Canadians, the leading anti-MAI Canadian NGO, which, in turn, passed it to an organization known as Public Citizen (Longworth, 1999). The latter scanned the text and put it on the worldwide web (WWW) so that other non-profit

organizations such as, for instance, NGOs representing women, labour or the environment, could easily look at it. As a result, hundreds of watchdog groups decided to mobilize against it and the talks collapsed.

- Much of the pre-Seattle coalition building between environmental and citizens' groups was done by e-mail. About 1.500 NGOs signed anti-WTO protest declaration set up online by Public Citizens, a consumer-rights group. That, acknowledges Mike Dolan, a leading organizer of the protest, would have been impossible without e-mail (The Economist, 1999).

The Seattle Trade Summit was disrupted by dozens of websites, which alerted everyone to the planned protests.

In order to highlight the importance of tools such as the Internet and e-mail in making NGOs' voices heard easier and faster, one may compare the experience in Seattle with that of the Uruguay Round in 1992. At that time, as noted by Public Citizen leader Lori Wallach (2000), when a copy of the text of the agreement was leaked from the GATT headquarter in Geneva they had to make several copies of it and these were sent all by mail to different people around the world who, in turn, had to make other copies and sent them again to other people. This process was highly expensive (i.e. making copies of an 800-page text and mailing it cost around 50 US \$ per copy) and slow - it took a week and a half before anyone had it in their hands.

- Communicating via the Internet, about 450 groups sponsored the Washington demonstrations against the IMF and World Bank in April 2000. Among other events, the protest comprised a march for debt relief organized by Jubilee 2000 on April 9. This march had its own

website allowing online registration and where information about housing, transportation, parking etc. in Washington was available.

NGOs and technologies: the way ahead

NGOs are not resting on their laurels, but are looking towards the future and adapting to rapid technological changes. As the exponential growth of the Internet is making it increasingly difficult to navigate the flood of information², many NGOs are launching communications models not only intended to get their message out but also to make sure their message is heard. This includes the creation of "portals" containing a focused collection of the best online content and opinion on a particular topic (see Box 1). The rationale is to aggregate and to bring together information in order to attract more attention and audiences rather than competing with sites having a similar focus. For instance, the Canadian Council for International Cooperation has instituted an anti-poverty portal in which a number of labour unions, social service organizations and international development NGOs participate. Information from all the members is aggregated on a central common site where information of general interest (e.g. recent conferences) is also posted. By sharing the same database behind the scene NGOs get more exposure and can enhance their joint impact.

The availability and use of Internet related tools on the part of activists and NGOs more generally is not without its counterpart. Both private firms as well as public authorities are using surveillance-type tools which at the very least raise questions regarding invasion of privacy.

For instance, there is at least one company (e.g. eWatch) that "specializes in tracking the comments of, and gathering personal information" (Business Week, 2000) on people who criticize a company.

The new strength of NGOs has been shown recently in a number of high-profile cases, such as the anti-personnel landmine ban, or the "swarming" of the Seattle WTO talks

NGOs are increasingly using portals to aggregate information so as to counter the effects of the exponential growth in Internet content

Business and government have reacted to the perceived threat posed by NGOs by developing electronic snooping systems

The blanket interception approach taken by some systems raises serious privacy concerns

At another level, the US Federal Bureau of Investigation (FBI) has been using an exceptionally intrusive email surveillance system called Carnivore, as surfaced on the Wall Street Journal, July 11, 2000. Carnivore gives unprecedented email interception capabilities to the FBI, or any other policing group using it, after being attached directly to an Internet Service Provider's (ISP) network, on the basis of a court order permitting real time interception of the contents of electronic communications of a specific individual, or so-called "trap-and-trace or pen-register" orders, which allow the identification information corresponding to communications originating or terminating at a specific target to be obtained.

What makes Carnivore exceptionally intrusive is that unlike other interception methods, it allows access to the email of all customers of the ISP in question (those explicitly under investigation as well as everyone else), as well as the email of all those who communicate with them. The policing authority in this case acts as a fisherman who has explicit license to catch one type of fish, uses a type of net that catches everything that moves in the sea, under the implicit promise that he will throw back immediately all other types of fish and just hold on to the ones he was licensed to catch.

Law enforcement is often required to minimize interception of non-incriminating communications of a target of communication-surveillance orders; it is hard to see how Carnivore abides by this minimization. Carnivore not only provides information on who contacts whom, regarding traffic that passes through the ISP to which Carnivore is attached; it also provides Internet protocol addresses, dial-up numbers, email logs and information on the content of the communication (e.g. the message header).

It is easy to see how such a super-trap can be used to intercept vast numbers of communications across activist groups or individuals preparing for

an event, including many for which the police would have no grounds for obtaining, or even seeking, a court order allowing surveillance.

Box 1. Portals of NGOs: Some Examples

IndianNGOs.com is a portal for all Indian NGOs. It was established in January 1999 as a partnership, but in April 2000 it became a Private Limited Company. IndianNGOs.com provides current information about a large number of NGOs located in India and their activities. One of the main goals of IndianNGOs.com is to set up a database and open directory of various individuals and institutions associated with the Social, Developmental and Health sector in India. Among the various initiatives of IndianNGOs.com it is worth mentioning the creation in March 2000 of a web site (<http://www.internationalngos.com/>) containing information about different NGOs around the world.

Ngonet (<http://www.ngonet.be>) provides a large amount of information about Belgian NGOs to the Flemish community. It delivers a wide range of services, from a focus on technical issues to content.

PhilNGO Network (<http://www.philngo.com>) is a portal of environmental NGOs in the Philippines. It contains information about environmental NGOs and their main initiatives as well as about recent developments in the field of environment in the Philippines.

Conclusions

In conclusion, there is evidence that ICTs, and especially the Internet and e-mail, have made NGOs more effective at contacting people, in organising events, in establishing networks and in disseminating information about their activity. Thanks to advanced ICTs NGOs have experienced rapid growth in their power in the policy-making arena. The protests organised by NGOs against the WTO meeting in Seattle, against the IMF and World Bank in Washington and against the Multilateral Agreement on Investment and the important contribution of NGOs to the setting up of the

International Criminal Court are only some examples of their influence in the decision-making process at international level. One should also recall the importance of ICTs in establishing NGO networks. ICTs are key to NGOs and will continue playing a vital role also in the future. In the present circumstances many NGOs are adapting to fast technological change through the creation of portals to sustain the promotion of their voices in the Internet.

On the other hand, some may suggest that electronic surveillance technologies already deployed by police authorities will, among other things, limit the effectiveness of such tools for activists. The profound concern raised in this context is whether such policing measures are too intrusive and sacrifice too much, in terms of privacy, freedom of expression, etc., on the altar of tighter policing.

Keywords

NGOs, ICTs, Internet, e-mail interception

Notes

1. For more information see the website <http://www.apc.org>
2. With information contained in WWW doubling every three months (Fallows, 2000), people looking for information might drown in it.

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Electronic Business and Taxation: Exploiting the Opportunities

Ine Lejeune, *Pricewaterhouse Coopers*

Issue: Amid fears that global communications, and in particular the Internet, will erode the tax revenues governments rely upon to provide the services their citizens have come to expect, and while businesses maintain that complex and unclear taxation of the internet may place a brake on its otherwise explosive growth, the tax status of e-business is being challenged.

Relevance: Many tax administrations believe that e-business creates problems for taxation field and appear to see it as a threat. There are, however, opportunities for tax payers and tax administration alike.

Using technology to automate the administration and collection of taxes could cut the cost of collecting taxes by as much as 50 to 90 percent

Introduction¹

Through its overall stimulation of the economy, electronic business has the potential to boost tax revenues in the form of taxes on business income, personal income (as a result of job creation) and consumption. At the same time, e-business could make the administration and the collection of taxes more efficient. By automating the whole process using technology, the cost of collecting taxes could even be reduced by 50 to 90 percent.² Consequently, e-business has the potential to allow tax administrations to refocus resources on control, cooperation and taxpayer service.

E-business, in all its facets, creates an opportunity to integrate nations in a global, consistent and sustained flow of trade and thus to increase global wealth. Furthermore, electronic business alleviates a great deal of the administrative burden

on traders. It often costs as much as \$100 to produce and process an invoice regardless of whether the value of the invoiced item is ten dollars or several million dollars. Electronic invoicing cuts these costs so businesses can refocus their resources. It would mean that the invoice, the most important document in commercial trade, could be sent and processed by electronic means and no longer manually.

In this respect it is interesting to look at new business models, which are moving away from the "integrated" traditional supply chain toward a networked economy. Today's models look at outsourcing non-core business and changing value chains as market opportunity requires: for the duration of a contract, for all services to a particular customer, or only for the instant required to conduct an e-business transaction. Other important trends are disintermediation and re-intermediation. These implications are also

significant from a tax perspective. However, taxation should not stop business from changing!

Business's move to the Internet presents opportunities rather than problems. Care should be taken to ensure, however, that policy-makers do not fail to respond in time to the challenges and cause opportunities both for business and the public interest to be missed.

Matching national taxation to international business

In order to create a level playing field both for business and governments, tax policy has to be reviewed. Tax policy touches upon sovereignty and is still basically national in scope (direct taxes and most of the transaction taxes go directly to national budgets) whilst e-business is simply not. If not global, e-business almost always crosses borders. Cross-border cooperation is a critical success factor for trade and policy, but it is slow relative to the pace of change in business.

Taxes still bear the stamp of the pre-global era. Direct taxes are still very much based not on global business flows, but on physical presence, tangible assets, paper reporting etc. Business today, spurred particularly by developments in telecommunications, finds it increasingly easy to transcend the sorts of boundaries existing tax systems rely upon. These new ways of doing business, however, simply mean that taxation needs to be rethought or reinvented.

The tax classification system needs to be updated

The classification of both direct taxes and transaction taxes needs to be rethought to adapt them to today's realities. In the field of direct taxes, for instance, the question arises as to whether the payment for an on line delivery constitutes

"business income" or a "royalty" payment. The outcome of this decision will determine whether taxes should be withheld or not.

In the field of transaction taxes it should be agreed that anything supplied on-line constitutes a service. This is clear cut in the case of downloading information or a software programme in a business-to-business environment, but less so in that of on-line interactive training or the "webcast" of a "speech" or a "concert". The simplest approach could be to introduce a single classification for all goods or services supplied on-line.

New approaches to communication with administrations are needed

Business needs to be allowed to communicate with the tax administrations in new, and particularly electronic, ways. Where governments want to attract e-business and stimulate the transformation of "old" economies into the "new" economy, they need to move away from "paper tax reporting and compliance" to "on line" reporting. Filing tax returns on line would save costs both for the taxpayers and for the government.

Innovation is needed in the invoicing process

The PricewaterhouseCoopers Global VAT Network has recently carried out a study for the European Commission on the requirements imposed by the Member States, for the purpose of charging taxes, for invoices produced by electronic or other means³. In the first part of the study the existing rules for paper and electronic invoicing were analysed. The expected lack of harmonization was confirmed. Some Member States do not allow electronic invoicing. Apart from Finland, Sweden and Denmark, all other Member States impose strict rules and the use of specific technologies for electronic invoicing.

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The classification of both direct taxes and transaction taxes needs to be rethought to adapt them to today's realities. The simplest approach could be to introduce a single classification for all goods or services supplied on-line

Electronic invoicing is not allowed in all Member States. What is perhaps required is an EU directive on electronic invoicing, so as to allow business to take advantage of the "new economy" both to do business and reduce the related administrative costs

VAT regulations vary across Europe, and the reporting and collection mechanisms can impose high compliance costs on businesses doing cross-border trade

The study proposed a set of requirements for introducing electronic invoicing in the whole of the European Union. The study also found a number of obstacles to the implementation of this system to exist in the VAT system, although these are not insuperable from a technical point of view. What is perhaps required is an EU directive on electronic invoicing, so as to allow business to take advantage of the "new economy" both to do business and reduce the related administrative costs⁴.

New forms of tax collection are needed

Innovative ways of collecting taxes need to be developed. Today, transaction taxes, such as VAT, are collected on the basis of a reporting system. The taxpayer has to report periodically in a VAT return its output (turnover) and input (purchases) to the tax authorities of the authorities of the state or states in which it operates. If this return has on balance an amount of VAT to be paid (difference between output and input VAT), the taxpayer will make the necessary transfer of money to the government. If the business, the taxpayer, is not established in the country where he has to VAT, it will, in many cases, be obliged to obtain VAT registration. This implies that companies end up having multiple VAT registrations, filing and payment obligations outside of their country of establishment (See also the draft Directive on the person liable to pay VAT⁵).

At the time of drafting these rules the taxpayers' business was still very "domestic" and limited to the country of establishment. Consequently, VAT returns had to be filed and collected by the government in just the "home" state. Consequently, governments were able to enforce collection easily as their taxpayers had a physical presence in their jurisdiction.

Today however, the taxpayer can both be established in- or outside the State due to collect

the VAT or other taxes. The previously existing reporting and collection mechanisms need to be updated in order to reduce the cost of compliance for business.

An OECD Technical Advisory Group (TAG) is currently investigating this⁶, as is the private sector. The option put forward by the European e-business Tax Group (EeTG) should be mentioned in this respect. The EeTG includes a number of European-based businesses that have joined forces to develop proposals regarding the taxation of electronic business, focussing on proposals that are achievable and realistic in practice. This may be indicative of a changing relationship between the private sector and the regulators.

In its response to the Working Paper of the European Commission of 8 June 1999 on VAT and electronic commerce, the EeTG has suggested that several equally valid options be offered to businesses to comply with their VAT obligations. One of these options is that "the supplier being liable to pay the VAT opts for outsourcing the compliance to a Third Party VAT Collector"⁷. The EeTG is currently actively studying these options in depth. It should be borne in mind that the rapidity with which technology changes tends to make any prescription of a specific technical solution obsolete by the time the regulation is implemented. This then would create a new barrier to the development of e-business instead of removing one, which is, fortunately, the intention of most rules in the field of e-business. The model should ideally therefore be technology-neutral.

New approaches are needed to enforcement

In recent years an increasing number of tax treaties have been ratified and, within this conventional framework, clauses such as exchange of information and administrative

cooperation have become more common. This is part of a recognition that in the world of e-business the level playing field will only be created if the tax law can be enforced. Together with innovation in collection, for instance by using technological solutions, such technology could also be used to make enforcement easier. These are difficult issues where views differ and reaching agreement will no doubt take time.

Two examples of tax issues raised by electronic commerce

Commentators on the Internet seem to be divided between those who see it as allowing too much control (such as loss of privacy) and those who fear it will cause control to be lost. In the case of business transactions it allows a great deal of control, but even when a transaction has been identified as being liable to tax the law still needs to be enforced. As this enforcement increasingly frequently requires national boundaries to be crossed, cooperative enforcement is more of an issue than control per se, i.e. there is a need for dialogue and information exchange between governments.

Another important issue raised by electronic commerce is definition of the place of taxation for consumption taxes. Some advocate a shift to the place of origin, where the supplier is established, as for instance in the draft e-commerce Directive⁸, others to the place of destination, place of business, place of the final consumer. Lengthy studies have been published on "consumption" and "place of consumption". It may indeed be simpler to assume consumption takes place in the country where the consumer is resident as already happens in the case of telecommunications services. Consumption within the EU means taxes for all players, consumption outside EU means no taxes —again for all players. There is a need to simplify the

situation both for business and governments and the technology is available to do so. This opportunity should be seized as it enables governments to collect 80% of the taxes with 20% of the effort.

In fact, no new taxes are necessary and no radical shifts from traditional principles are required. But there is a critical need for information and a dialogue to adapt smoothly to the new era and so ensure the benefits of the new opportunities are shared. Two points, however, need to be made very clear:

- Firstly, we need to agree on the definitions, the monitoring methodologies, possible use of technology (without imposing the choice of one specific technology) and the modes of measurement for taxation. Here again, the work of the OECD and of research institutes is extremely important. For example, the estimates found in different studies of the current total volume of e-business may still vary by a factor of more than 100 (for instance ranging from 70 to US\$8,000 million depending on the analyst for the years 1995-97⁹). And there has as yet been no empirical study that has sufficient breadth and scope to assess the relationship between tax and e-business and to establish a solid basis for an objective discussion (cf. the recent announcement of a US Department of Commerce Study on business-to-business transactions¹⁰).
- Secondly, business, tax advisers and governments need to understand and listen to each other in an active and constructive way in order to come to a win-win solution for all stakeholders within the shortest possible timeframe. There is still a lot to be done, but if the intention and commitment are there, then the different stakeholders will come to a workable solution which is acceptable to all.

An important issue raised by electronic commerce is definition of the place of taxation for consumption taxes. Some advocate a shift to the place of origin, where the supplier is established, which is the approach taken by the draft e-commerce Directive

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Conclusion

The technology that is re-fashioning the way we do business, and building global markets, can be harnessed to cut the costs of tax administration both for business and governments, thereby making it possible for governments to fund public expenditure more effectively without adding to the burden of taxation. The way to do this is through engaging the necessary political will to make these technologies interface in a responsive way and creating a level

playing field in a timely fashion. By doing so, they can serve the needs of markets and governments - and satisfy the public interest in taxation that is fair, efficient and effective. Business can help to create this interface. But there has to be the necessary political will and for the future this means closer intergovernmental and business cooperation and ultimately the willingness to take the necessary decisions in the interest of all global stakeholders and stimulating the new economy.

Keywords

e-business, e-commerce, tax, policy

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Notes

1. The article reflects the views of Ine Lejeune (a Pricewaterhouse Coopers Tax Partner and EMEA Leader for e-business tax and legal services), and is based on a presentation given at the joint IPTS/CSIS Workshop on Electronic Commerce, Aspects of Regulation and Taxation, which took place on 24 January 2000 in Seville, Spain. The article aims to point out the main problems, but does not claim to be exhaustive.

2. Source: OECD Report: Economic and social impacts of e-commerce, September 1998 (book published in February 1999), Table 4.4.

3. Study on the requirements imposed by the Member States, for the purpose of charging taxes, for invoices produced by electronic or other means, prepared by PricewaterhouseCoopers for the European Commission; Tender XXI/98/CB-5010, 23 August 1999; WWW:

http://europa.eu.int/comm/taxation_customs/publications/reports_studies/taxation/final_report_pwc.pdf

4. For the business point of view on the need to introduce electronic invoicing see the "EeTG Position Paper on Invoice Requirements".

5. COM (1998) 660 final, Proposal for a Council directive amending Directive 77/388/EEC as regards the determination of the person liable for payment of value added tax.

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6. For more information on OECD's TAGs, please visit http://www.oecd.org/daf/fa/e_com/tag.htm

7. A copy of the EeTG Response can be obtained by contacting PricewaterhouseCoopers, which supports and manages the EeTG activities as secretariat, e-mail: ine.lejeune@be.pwcglobal.com

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Social Impacts of Robotics and Advanced Automation towards the Year 2010

Antonio López Peláez, *UNED-GETS*, and Miguel Krux, *VDI-TZ*

Issue: Robot technology is advancing rapidly and larger numbers than ever before are being installed by businesses in Europe. In the future, our homes and workplaces will be characterized by automated and robotic systems forming a part of everyday work and living, and robots will perform many tasks in the services sector as well as in manufacturing.

Relevance: Using the results of Delphi studies it has been possible to develop scenarios towards which experts think European societies are likely to evolve, depending on the different policies adopted. A number of issues are likely to play an important role in European debates on science and technology policies touching on the impact of automation and robotization.

The stock of industrial robots in the European Union has increased significantly over the last five years, and growth rates are now higher than in Japan, traditionally the largest market for industrial robots in the world

Social Impacts of Robotics and Advanced Automation towards the Year 2010

One of the most important technologies in the new post-industrial and technological society, or the so-called network-society, is Robotics (Castells, 1996). The vision of a world in which the labour of human beings could be replaced by that of robots which has been proclaimed by experts in robotics for some time (Moravec, 1999) has not yet been realized. However, industrial robots are today a common and a very competitive part of the equipment of industry. In particular, in the European Union, the stock of industrial robots has increased significantly over the last five years, and growth rates are now higher than in Japan, traditionally the largest market for industrial robots in the world (International Federation of Robotics, 1999).

Industrial robots are now being joined by services robots, of which there are more than 5,000 units in operation world-wide. Despite the fact that there are still important technological problems to be solved for the development of intelligent and autonomous robots, such as navigation in open environments, it is already clear that the spread of service robotics will have an impact on employment, working conditions and the structure and organization of companies. The simultaneous expansion over the coming years of industrial and services robotics in the European Union may have very significant effects on both the job market and other aspects of daily life.

The industrial-robot market in Europe

The European robot market grew by some 22,000 units in 1998, which represents a 10%

increase with respect to 1997. During the first half of 1999, orders placed for the purchase of robots increased by 32% compared with the first half of 1998. The increase in the number of robots, even though it varies from country to country within the European Union has reached figures that justify its characterization as rapid growth. For instance, in Spain, Denmark and Finland the robot market has increased at rates of between 50% and 70%. In 1998, growth in Germany was 10% and in Italy 19%. Despite the fact that the crisis in the Japanese and South Korean markets has diminished the growth of the world robot market as a whole, in both the European Union and the United States a growing trend towards the automation of many industrial activities is apparent. And, although worldwide robot sales fell in 1998 (as compared with 1997), the stock of robots in operation in 1998 increased by 3% over the period, reaching an estimated figure of 720,000 units.

The forecast of the International Federation of Robotics for the coming years suggests that growth in the robot market will be concentrated in the United States and in Europe. Between 1998 and 2002, the growth in sales of industrial robots in Europe will be more than 10% a year and by the year 2002 it will reach a 45% increase on the number of robots installed in 1998. The stock of operational robots will continue to grow in the near future, and robot density (measured as the number of robots in operation per ten thousand workers) will increase in all European countries. At the same time, the cost of robots will continue to fall, while their versatility and capabilities will continue to expand.

Expected growth: service robotics

Service robots are currently at an initial stage both in terms of their development and their commercial expansion. To differentiate service robots from manufacturing robots, a service robot is

“a robot which operates semi or fully autonomously to perform services useful to the well being of humans and equipment, excluding manufacturing operations” (International Federation of Robotics, 1999). The tasks typically performed by robots of this kind include cleaning (e.g. domestic robots), inspection, medical tasks (e.g. surgical robots), security, helping the disabled, etc. Clearly they are particularly well suited to environments that are difficult, unpleasant or dangerous for humans to access (such as climbing walls, going down drains, inspecting nuclear reactors, etc.). The total world stock of service robots in operation in 1998 was more than 5,000 units. It is anticipated that by the year 2002 the figure will be over 23,600 units, excluding the so-called “domestic vacuum cleaning robots” (of which, according to the International Federation of Robotics, there could be as many as 450,000 units in operation in the year 2002).

The impact of automatic and robotic systems in manufacturing and services: towards a new work pattern

The effects of automatic and robot-based systems in the industrial and services sectors fall into four categories: firstly, they are likely to affect employment rates in those fields of activity in which tasks become automated; secondly, working patterns and job characteristics may change, making new skills and training necessary; thirdly, changes may occur in business organization, as firms adapt to take advantage of the full potential of robot systems; and fourthly, robotics could have a more general impact on society, in terms of new patterns of leisure, changes in the home (resulting from the coexistence with service robots), and a transformation of the meaning and value of work itself.

In 1997, a Study Group on Social Trends (SGST) carried out a survey comparing the main innovations in robotics provided by previous Delphi Studies conducted in Germany, England, France, Spain and

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Service robots typically carry out cleaning, inspection, medical tasks, helping the disabled, security, etc. They are particularly well suited to environments that are difficult, unpleasant or dangerous for humans to access

The widespread use of robots is likely to affect working patterns and business organization, as firms adapt to take advantage of the potential of robot systems

Japan. (Tezanos, et al., 1997). Drawing on the results of this research a new Delphi Study took place in 1998 (Lopez Peláez, 2000). This is the first Delphi Study to have systematically addressed a wide variety of issues related to the change in working patterns and company organization as a result of the impact of advanced Robotics. The forecasts made by the experts involved are summarized in Table 1.

- Within the 2001-2010 horizon robotics will have the following features: a) gradual

increase in technical capabilities and versatility of robots, which will allow them to interact with their environment and develop self-learning, repair and self-diagnosis processes; b) gradual development of anthropomorphic features to meet the needs of the services sector; c) reduction in price, programming and maintenance costs, making them cost-effective for any kind of company; d) gradual development of robots that will require little or no programming.

Table 1. Main effect of robotics and advanced automation (year 2010)

Technological development	Changes in work	Working day	Company Organization
The cost of purchase, programming and maintenance of robots will come within reach of small and medium sized companies.	80% of industrial jobs will require a medium-high level of qualification. In the services sector, 50% of jobs will require a medium-high level of qualification.	In most companies in the industrial sector with a high level of automation, work will be in shifts and working hours will be flexible.	Reduction in middle managers and less possibilities for making a career in the company.
50% of tasks in many industrial sectors will be undertaken by robots.	The rate of temporary jobs will reach 40% in the manufacturing sector and 50% in services.	In most companies in the services sector with a high level of automation, work will be in shifts and working hours will be flexible. This will take place more slowly than in the manufacturing sector, but will depend on the specific activity carried out.	Labour relationships in working groups will become more individualized.
Expansion of robotics in services sector.	Manufacturing employment will fall over the next ten years. Employment in the services sector will increase.	Working hours will be shortened, though not significantly before year 2010.	Reduction in occupational accidents.
Strong investment in robotics in OECD countries.	Salaries will be kept at the present level. There will be an increase in functional mobility, saturation levels, number of tasks and duties to be undertaken, greater intensity and job enhancement.		Reduction in labour disputes.
	Greater employment instability in both industry and services.		Strengthening of the core management of the company and growing precariousness for the rest of the employees.

Source: Antonio López Peláez, Impactos de la Robótica y la Automatización Avanzada en el trabajo. Estudio Delphi, Sistema, Madrid 2000.

Industrial robots will increase their presence in all economic sectors, bringing levels of automation in many areas of business up to 50% by the year 2010. According to experts' forecasts, in the longer term (year 2042) the number of activities undertaken by robots will reach nearly 80% in all sectors of the economy. In the longer term, technological progress could allow the expansion of robotics to home and leisure, following a similar pattern to the diffusion of personal computers.

- According to the experts' forecasts, robotics will have a similar impact in both manufacturing and services, except with regard to employment and career development. Experts foresee a parallel evolution in both sectors in terms of the other events, trends and impacts analysed in this Delphi study. Therefore changes and impacts arising from the use of robots in industry (as the experts have stated in their personal comments), can reasonably be extrapolated to the services sector, to the extent that robotics in services will also expand over the coming years.
- The changes in working patterns that experts the experts envisage occurring reflect a labour market in which workers' training, qualifications, performance and flexibility all increase while job security generally will decline. The labour market will be characterized by a fall in manufacturing employment; higher requirements in terms of training and qualifications; growing intensification of work with higher saturation levels; enhanced jobs; adaptation of working hours to automated systems (longer working time through the introduction of shifts and flexible working time, depending on the occupation). As to working conditions, difficult and hazardous working conditions will tend to disappear, and responsibility will increase at all levels. In the services sector, the number of jobs will increase, though in their personal comments, experts

question the possibility that such increases will compensate for the cuts in jobs in the manufacturing and service sectors brought about by the increased use of robot systems.

- In terms of the effects on company organization, experts foresee a reduction in the number of levels in the hierarchy, greater importance of senior management, research and development, etc. At the same time a flatter structure would make it harder for most workers to forge a career within a given company. Demand for more highly qualified workers will increase, and consequently they will tend to be able to demand better conditions. At same time there could be a considerable reduction in middle management, and therefore workers will find it hard to advance professionally without switching to another company. This is a process that goes together with the polarization of the labour market. In their personal comments, most of the experts maintained that most payroll costs would remain stable overall at present levels whilst there would be a rise in salaries for senior managers and a possible reduction in pay for medium and lower categories. Together with these changes in the organizational structure, health and safety in the workplace will improve through a reduction in occupational accidents. However, the reduction in certain labour hazards through the incorporation of robots will bring with it new hazards, mainly related to psychological illnesses such as tiredness, greater stress, and depression resulting from the pressure of keeping up with automated systems, etc.
- One of the effects that robotization will have on society, according to the experts, is a transformation of the role of work and leisure. The overall productivity of the economic system will increase, and quality of goods and services will also improve relative to price. And, as a result of the growing level of automation a

Industrial robots will increase their presence in all economic sectors, bringing levels of automation in many areas of business up to 50% by the year 2010

Workers are likely to need more training and better qualifications as greater emphasis will be placed on their flexibility and performance, while job security for less-skilled workers will generally decline

Companies are likely to have flatter hierarchies with fewer intermediate managers and a broad divide between ordinary workers and those in key areas such as senior management, research and development, etc.

Using robots for the most dangerous work will make the workplace safer, but the greater sense of insecurity may increase rates of psychological and stress-related ailments

The fact that both the service and manufacturing sectors will be automating simultaneously could create added pressures, making it harder to retrain workers for new activities

The experts involved in the Delphi study identified two scenarios, one in which the economy and society becomes more polarized, and another in which policy intervention ensures automation brought benefits for all

significant part of the working population will change activity. Therefore, within the time period covered by the survey, leisure time is likely to increase, perhaps even to the extent that one could start to talk of a "leisure society".

One of the main impacts of robotics on society in general will be the transformation of the productive and services structures. This will eventually make political decisions necessary so as to reduce the impact of robotization (e.g. adequate welfare provision for the unemployed, retraining, job creation, etc.). The answers given by experts reveal this clearly and systematically. It will be necessary to reach a social consensus to take advantage of the wealth generated by the new advanced technological economy. An economy with higher levels of competitiveness, productivity and quality can be compatible with the generalized unemployment of large sectors of the population. The coincidence in time of automation in the industrial and services sectors and the difficulty of retraining many workers replaced by automatic systems will create pressures which most of the experts envisaged increasing over the period (in particular, in terms of increasing structural unemployment). It is for this reason that they highlighted the need to adapt the education system to the new demands of the emerging economy, and at the same time permanent training and retraining will become the main factors in achieving better adaptation and integration levels in a continuously changing technological context.

The European challenge: social demands and public policies in the new emerging society

There are three main variables comprising the basic dimensions of future scenarios regarding the impact of the use of robotics in the EU over the time frame to the year 2010. The first variable is the

evolution of a robot workforce in both the manufacturing and services sectors, which according to the experts' forecasts is likely to sustain high growth rates. The second variable is the new work pattern, and the changes in working hours and company organization foreseen by the experts. The third variable is the institutional and political reaction to the changes in the economy as it becomes more fully automated. Below we present two alternative scenarios for the year 2010 arising from the different combinations of the first two variables and the third, the characteristics of which will depend on the different socio-political options taken.

In terms of the institutional reactions to the impacts arising from the growing incorporation of automated and robot systems we can progress towards a more polarized economy and society (scenario number 1) or towards a more integrated economy and society (scenario number 2). Bearing in mind the evolution foreseen by experts in advanced robotics and automation, the characteristics of both scenarios will become more marked in the coming decades, taking as a reference an estimated automation of 80 per cent of all activities in all current economic sectors by year 2042.

Scenario number 1: A Polarized Society

The view of the experts was that there would be a significant series of changes taking place over a relatively short period of time, which will increase the adaptation problem for a broad swath of workers. For instance, experts' reasoning questioned the capacity of the new high-tech sectors, with growing demand for workers, to take on the unemployed who have been displaced by automated systems. It will be difficult for workers with low levels of qualification or with inappropriate training to take up jobs requiring the skills and flexibility to adapt to changing technological contexts within a period of time as short as that foreseen for the automation of 50% of all activities in numerous industrial fields.

The drop in employment as a consequence of the new robot based production and servicing systems could lead to a society in which many people may be unable to find a job.

The lack of measures to redistribute wealth and allow adequate purchasing power for all becomes the main characteristic of this scenario. The emerging society will not be a leisure society. Although there may be enforced inactivity for many, income will depend primarily on paid work, placing meaningful leisure out of the reach of the unemployed. This would result in a dual society in which not only would a large number of people will be unable to find a job but many workers will also have to cope with reduced job security in more demanding jobs. In this scenario, the divide between a secure and well-paid minority and an insecure majority is likely to provoke social tensions.

In this context the duality will not only be between the employed and unemployed but, even among the employed, jobs will be more sharply polarized. The lack of institutional measures will reinforce the trend towards a dual labour market where on the one hand we would have a group of workers with high levels of education and training able to compete in expanding sectors, and on the other, the remainder of the workforce struggling to cope with temporary work, insecurity and who have to compete with automated and robot systems. The workers in this second group, who have been displaced by automation, will be those who have the greatest difficulties in readapting to take on jobs requiring higher qualification/skills. According to the experts' forecasts this difficulty will become more of an obstacle as the average training of workers required in industry and services also increases within a short-term horizon. By the year 2010 it is estimated that 80% of the jobs in industry and 50% of the jobs in the services sector will require medium-to-high level qualifications.

Scenario number 2: An Integrated Society

In this scenario the impacts foreseen by experts are the same. However, decisions are made by institutions in response to these events and trends in order to bolster mechanisms for social integration and wealth redistribution to meet the new challenges posed by the spread of robots in manufacturing and the services. In particular, the displacement of human labour by robots is responded to with specific measures to provide training to help re-employment of those groups of workers affected by automation and robotization. Furthermore, it will be essential to provide some kind of income for the people affected until they can rejoin the labour market.

One of the features of prospective methodologies is to attempt to foresee impacts and to construct scenarios providing society, citizens and companies with an efficient tool for the adoption of measures, whether public or private, to enable optimal management and construction of the future. In this scenario, we can project some of the demands of the emerging society and the likely reply from institutions, such as the demand for new regulations defining the rights of workers, providing protection and security for them, and labour regulations to allow the shortening of working days, without reducing their purchasing power. Advanced robotics and automation will change our idea of work as we see it today, as a number of activities will be undertaken by robots and they will bring significant changes to what we understand by leisure time and home management. The higher productivity and higher education/training level on average provide a different horizon with changes in working life, time spent at work and time off. In this context it becomes indispensable to strengthen the initiatives for lifelong learning, training and retraining.

The fact that robots will be able to release us from many activities should open up the possibility

In the "polarized" scenario the division would not just be between those with and without work but also between those with secure, well-paid jobs and an insecure majority

In the second, "integrated", scenario the displacement of human labour by robots is responded to with specific measures to provide training to help re-employment of those groups of workers affected by automation and robotization

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for a society in which access to the job market allows more freedom in the programming of our working life. However, measures will have to be taken to mitigate the effects of automation on certain sectors and ensure adequate levels of income for those displaced from productive work. This would lead to a genuine leisure society, with new jobs based on services and knowledge.

Conclusion

The above scenarios indicate the importance of developing European-wide coordinated policies in three main areas:

- Worker training, both initially and ongoing;

- Consensus on the development of labour and legal reforms making it possible to make the most of the potential of automated and robot systems, to improve working conditions and contractual guarantees, minimize the negative effects for the most affected groups and to allow the development of a leisure society;

- Finally, the setting up of mechanisms to allow the redistribution of wealth generated through the use of new technologies to the extent that the purchasing power of European citizens is not adversely affected by the expansion (and the impact on unemployment and salary polarization) of industrial and robotics in the coming years.

Keywords

robotics, foresight, work, working day, business organization, future scenarios, Delphi method

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